

Older Yet Fairer: How Extended Reproductive Time Horizons Reshaped Marriage Patterns in Israel

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Abstract

Israel's 1994 adoption of free *in vitro* fertilization provides a natural experiment for how fertility time horizons impact women's marriage timing and other outcomes. We find a substantial increase in average age at first marriage following the policy change, using both men and Arab-Israeli women as comparison groups. This shift appears to be driven by both increased marriages by older women and younger women delaying marriage. Age at first birth also increased. Placebo and robustness checks help pinpoint IVF as the source of the change. Our findings suggest age-limited fertility materially impacts women's life timing and outcomes relative to men.

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1 Introduction

The ability to control fertility at young ages revolutionized women's marriage patterns and career choices. More recent technological innovations have promised greater control over fertility at *older* ages, specifically to avoid age-related infertility.¹ If declining later-life fertility is a materially important constraint, this increased control could potentially alter women's marriage decisions and outcomes.² Unlike the pill and abortion, whose channel of impact is through usage (e.g., Goldin and Katz (2002), Myers (2017)), assisted reproductive technology may affect women who anticipate its availability, even before the realization of their actual later-life fertility. Thus, testing its impact requires a sharp and large increase in availability, in order to facilitate a rapid update of women's expectations. In light of this, Israel's unprecedented decision to make *in vitro* fertilization (IVF) completely free to all citizens in 1994 provides an ideal natural experiment.

The unique advantage of Israel's policy decision is that it overcomes the tendency for technology changes to diffuse slowly. It came at a time when IVF was relatively new and unknown, and therefore the change in fertility expectations was likely to be large. It affected the entire population, and was widely covered in the Israeli press so this information could disseminate. Thus, it caused a large and discontinuous increase in usage: in the three years following the policy change, live deliveries using IVF more than tripled. By 2002, 8 years after the policy change, 1,657 IVF treatment cycles per million people were performed in Israel, compared to 126 in the United States (Collins, 2002). Even without direct knowledge of the policy change, the large amount of media attention to older women having children, and first-hand experience of observing motherhood at older ages, could have facilitated a general shift in beliefs regarding the time horizon of fertility. Although the new IVF funding was granted as part of a broader health reform, we find no change to other health expenditures, nor any change to media coverage for other conditions that received additional funding.

An additional advantage of the Israeli setting is that marriage and fertility rates are high and that the two are closely related. This enables us to use marriage timing to learn about how IVF availability affects *planned* fertility timing, rather than realized fertility, which is also directly impacted by the new option to use IVF.

The challenge inherent in this setting, however, is that since all Israelis were exposed to the

¹Women lose 97% of eggs by 40 (Kelsey and Wallace, 2010), while remaining egg quality declines (Toner, 2003). Pregnancies are rarer (Menken, Trussell and Larsen, 1986), more likely to end in miscarriage (Andersen et al., 2000), and more likely to result in fetal abnormalities (Hook, Cross and Schreinemachers, 1983) later in life, before the complete cessation of fecundity in menopause. While it is difficult to separate fecundity from fertility choices, even prospective studies of women trying to conceive show an accelerating decline in fecundity by age 40 for women, whereas men's fertility is relatively stable. For example, Rothman et al. (2013) finds that women 35-40 years old will become pregnant 77% as frequently as women age 20-24, whereas for men this ratio is 95%.

²In this way, our work is related to literature on how life expectancy impacts financial planning (Skinner, 1985; Jayachandran and Lleras-Muney, 2009) and how health assets affect other decisions and investments (Delavande and Kohler, 2015; Hugonnier, Pelgrin and St-Amour, 2012). It also relates to literature showing policies can have behavioral impacts far before they actually bind, for example Persson (Forthcoming).

policy change at the same time, there is no spatial or other statutory variation induced by the policy. Therefore, to understand the causal impact of the policy change on women’s marriage decisions, we compare their outcomes to those of men. Prior to this change, men’s and women’s age at marriage moved in lockstep, experiencing a common trend over time, and seemingly responding in tandem to shocks. This makes sense, as Jewish men and women have a largely “closed” marriage market in Israel. Access to IVF, however, is a shock that specifically affects women, and does not have a direct impact on men’s later life fecundity.³ Thus, the fact that we find a disruption of the tight co-movement between men’s and women’s outcomes precisely in 1994 represents strong evidence of a causal impact of the IVF expansion. Our results depict an immediate, discontinuous increase in women’s age at first marriage relative to men’s, continuing in an upward trend over the next 15 years.

Using the same strategy, we also find that age at first birth increased for women relative to men following the introduction of the new IVF funding. This demonstrates that the marital delays were linked to fertility delays, and thus that women’s life-timing more broadly was reshaped by access to fertility extending technology. Note, that for couples whose marriages were not impacted by the policy, changes in fertility due to IVF would be equally reflected in men’s and women’s age at birth, and thus a differential change for women would not appear.

Obviously, even when men are not impacted directly, they could be affected in equilibrium by women’s decisions. Nonetheless, we choose to compare women’s outcomes to men’s because it is precisely the extent to which time-limited fertility constrains women’s decisions *relative* to men’s, despite equilibrium effects, that is of interest economically. If men’s decisions fully adjust to the extension of female fecundity via IVF, then perhaps time-limited fecundity did not inordinately constrain women’s decisions in the first place. If, on the other hand, we can show that the expansion of access to IVF differentially changes women’s decisions, it is evidence that their time-limited fecundity asymmetrically affected them, and may therefore be linked to other persistent gender asymmetries, such as the gender wage gap.

To shed additional light on these equilibrium impacts, as well as to confirm that the effects we find are not driven by other policies that specifically affected women in Israel during this time, we also use Arab-Israeli women as an alternate comparison group. Arab-Israeli women were much less likely to use IVF at the time of the policy change due to religious and cultural restrictions, but *were* impacted by policies and shocks affecting specifically female Israelis. For example, both groups would be the health reform (and thus any gender-specific effects it could possibly have), as well as the broader trend, both global and local, towards increased female education. This control strategy may suffer from its own shortcomings, as there are significant differences between the Arab and Jewish populations in Israel, but they are unlikely to be correlated with any issues

³Although the policy also provided treatment of male infertility via access to sperm donation, this is “primary” rather than “secondary,” meaning age-related, infertility, and thus does not affect time horizons.

with the male control strategy, and thus obtaining similar results using the two comparison groups would provide compelling corroboration of a causal impact. When using the Arab control group, we obtain slightly larger overall effect sizes, consistent with the idea that men's marriage age may have also been pushed up in equilibrium by women delaying.

The mechanism we propose for this effect is an increase in the expected utility from marrying at an older age (causing some women to delay) and from marrying an older wife (causing men to be more willing to partner with older women). Delaying marriage has the benefit of being able to make greater career investments⁴ as well as being able to search longer for a more suitable mate. However, this comes at the cost of an increased risk of infertility, which affects women's own utility in addition to making them less attractive to a potential spouse.⁵ Extended fertility horizons may both encourage young women to delay marriage to reap these gains, now at a lower cost, and might make older women who already waited to marry more appealing on the marriage market. When we explore the impact on the entire distribution of age at first marriage, we find evidence for both channels.

To rule out potential alternative explanations for our findings, we employ a number of robustness checks and placebo tests. We first use a Quandt-Likelihood Ratio breakpoint test and event-study analysis to pin down the precise timing of the change, showing that any alternative event would need to have an impact precisely at 1994. We also use the United States and an earlier round of Israeli census data to show placebo tests, and use a permutation analysis to demonstrate that our effects are uniquely empirically large. Finally, we show a striking echo of our effect among the Israeli population living in the United States, with increasing marriage ages only for those who married in Israel after the policy change.

A heterogenous treatment effect analysis also helps to pinpoint IVF as the likely source of the change. We find that Ashkenazi, non-Orthodox, and middle-class women were most impacted by the policy change. The latter finding aligns with the idea that very rich women would be aware of and able to access IVF in the absence of the new law, and additionally rules out that other health programs designed to reach the very poor could be responsible for the effects.

Our research builds on previous work that exploits variation in mandated insurance coverage of IVF across US states and over time, showing that IVF materially impacts the fertility of women who use it (Velez et al., 2014; Hamilton and McManus, 2012; Bitler and Schmidt, 2012, 2006; Bundorf, Henne and Baker, 2007; Buckles, 2013; Schmidt, 2007, 2005; Machado and Sanz-de Galdeano, 2015). This line of literature provides evidence that when coverage goes up, more women use IVF, fertility

⁴The literature indicates a substantial family-career tradeoff (Loughran and Zissimopoulos, 2009; Buckles, 2008; Blackburn, Bloom and Neumark, 1993; Taniguchi, 1999; Gustafsson, 2003; Miller, 2011; Avellar and Smock, 2003; Wilde, Batchelder and Ellwood, 2010; ?; Kleven, Landais and Søgaard, 2019; Angelov, Johansson and Lindahl, 2016; Lundborg, Plug and Rasmussen, 2017).

⁵Low (2019) presents experimental evidence on the impact of fertility on marriage markets, showing that when age is randomly assigned to dating profiles, men, but not women, prefer younger partners.

rates for older mothers go up, and multiple births rise. A much more limited literature uses the same state-year variation to explore the impact on the timing of marriage and childbearing, supporting the hypothesis that access to infertility treatments may influence the decisions of younger women. Abramowitz (2017, 2014) and Ohinata (2011) show that increased IVF access is associated with marriage and childbearing delays for white women. Buckles (2007) and Kroeger and La Mattina (2017) find some evidence for associated labor supply and career effects.

The approach of using state-year variation in IVF coverage mandates has limitations, especially when discussing general equilibrium shifts in perceptions of both men and women. Since these are small and localized policy changes, awareness may not be widespread, particularly with young women who may not even be managing their own insurance yet.⁶ Nonetheless, the fact that these papers find effects even with this more limited variation suggests an important potential contribution in testing the hypothesis using a more discrete policy event.

The Israeli policy change provides a unique opportunity to study a large-scale event that could have affected not only the actual chance of older motherhood but also the *beliefs* of both women planning their life timing and their potential partners. Our findings are important since they demonstrate that the beneficiary population of assisted reproduction technologies extends far beyond the women who actually encounter infertility. We show that slowing down the biological clock for women has a transformative impact on the marriage market. In related work, we also show that the women impacted by the policy change pursued greater education and ended up in higher-earning careers (Gershoni and Low, 2019). Thus, policies that alleviate the career-family tradeoff for women can have far-reaching impacts.

The remainder of the paper proceeds as follows: Section 2 describes the setting and policy change, Section 3 describes the empirical strategy, Section 4 presents results and tests their robustness, and Section 5 concludes.

2 Setting and Policy Change

2.1 IVF Policy Change

In 1994, following a widely covered, public debate, the Knesset enacted the National Health Insurance Law (NHI), which included IVF tests and treatments in a “basket” of health services that all health plans must provide. The law provides all Israeli citizens with guaranteed access to:

“IVF treatments for the purpose of the birth of two children for couples who do not have children from their present marriage, as well as for childless women who wish to establish a single-parent family.”

⁶More generally, because mandates may increase insurance premiums for the most affected workers, in equilibrium they could negatively affect their wages and employment (Lahey, 2012).

The law, as originally written, did not place any restrictions on the age of women, or the number of attempts that could be made, and provided coverage for up to two “take-home babies.”⁷ This is in stark contrast to IVF coverage policies worldwide, which usually place strict age-limits on usage and entitle beneficiaries to a certain number of *treatments*, rather than a certain outcome. In addition, the Israeli provision was unique (at the time) in that it provided equal access to single women.⁸

The NHI law proposal was originally introduced in 1993, but the version that specifically included IVF coverage was first presented on February 14, 1994, and was approved one week later. The final version of the law was adopted in June that year (after various adjustments that were not related to IVF coverage). Thus, the first moment people could anticipate IVF would be included in all health coverage was the beginning of 1994.⁹

Changes induced by the NHI law Because the IVF coverage was adopted as part of a broader reform to Israel’s health system, it is important to understand these other changes. The health system in Israel was practically entirely public even before the NHI law, and health care was provided by four government-subsidized, non-profit health plans or “HMOs”. The main aims of the NHI law were to improve the efficiency of the government health system and streamline the collection of fee payments.¹⁰

Prior to the law’s enactment, payments were collected directly by the HMOs, which also provided healthcare. Fees were determined relative to income, and in other ways the system had all the hallmarks of national insurance. Under the new law, collection was placed in the hands of the National Insurance Institute, a governmental agency that manages all social-security payments and transfers in Israel. This change in collection enabled the larger “behind the scenes” changes the law created, reforming the way money flowed between the government, the HMOs, and hospitals and service providers.

Overall, despite its complexity and substantial consequences for the operation of the health system, for the average Israeli the reform was, as stated by the health minister at the time, “a change to accounting, not to the health coverage you will receive.”¹¹ Appendix figure A5 shows

⁷Eventually, a relatively “soft” recommendation to restrict usage above age 45 and to limit the number of treatment cycles depending on outcomes for women over 42 was approved by the Ministry of Health in 2014 (see notice 6/2014 from the Ministry of Health, January 20, 2014).

⁸In comparison, in Denmark, which is also known for relatively generous coverage of IVF, the 1997 Act on Artificial Fertilization (which practically made the existing practices official) banned single women (and lesbian couples) from using IVF, even in private clinics. In addition, state-funding was only granted to women below the age of 40, and private-clinics were only allowed to treat women below the age of 45 (Mohr and Koch, 2016; Larsen, 2015).

⁹The history of the law is documented on the Knesset website at <https://main.knesset.gov.il/Activity/Legislation/Laws/Pages/LawBill.aspx?t=LawReshumot&lawitemid=157723>

¹⁰The aims of the law were described both in the law proposal and in the Annual report of the National Insurance Institute of Israel for 1994-1995.

¹¹See *Yedioth Ahronoth*, December 15, 1994. For more on the history of the reform and on its consequences, see the reports issued by the Ministry of Health: “20 Years to the NHI Law” (May 2015) and “Light and Shadow in the evolution of the NHI Law” (February 2010).

that overall the law did not discontinuously change national level health expenditures, nor the private versus public share of expenditures. What changed was that HMO fees were supplanted by the health tax, in the same overall amount.^[12]

A secondary goal was to standardize coverage between the four health plans as well as to extend coverage to the small percentage of people who were previously uncovered (approximately 5%).^[13] This piece of the reform is our primary challenge to identification, but the largest effect was for the poorest individuals, and thus we partly rule this out as a source of the impacts we see through a wealth heterogeneity analysis in Section 4.6. In addition, a substantial share of the uncovered population were Arab, and hence the fact that we find impacts on Jewish women when we use Arab women as a control group indicates that the general expansion of health insurance did not drive those effects.

Additional changes in coverage were first, that the new system made it easier for individuals to choose and switch between HMOs, compared to the previous system under which HMO membership was mostly based on parents' membership (which had been historically based on political affiliation and union memberships). Second, fee structures were adjusted slightly to make them more progressive, as well as adjust discounts and exemptions for certain groups, for example decreasing fees for single-earner households. Overall, for most middle-income households changes were negligible and because insurance contributions were generally very low relative to income (capped at 5%), even extremely high or extremely low earning households did not experience a dramatic change.^[14] Finally, coverage levels were standardized between HMOs, but aside from notable exceptions such as IVF, these changes were minor.

Change in IVF Coverage In the case of newer technology, some attention had to be paid to whether these items should be included in the national health basket. This was the case for IVF,^[15] which was a relatively new technology at the time of the law, for which the extent of coverage in addition to other related legal and ethical questions were still debated, regardless of the NHI law.^[16] Although Israel was an early leader in IVF technology,^[17] usage of the technology in the early 1990s was still relatively low, and technological advances were slow in coming. IVF treatments were covered at least to some extent, with substantial variation among HMOs. In practice, couples often

^[12]These fees together with the “out of pocket” expenses represent households’ total health expenditures. As for the public share of expenditures, it changes smoothly except for the phasing out of an employer tax in 1997, that was replaced by government budget financing.

^[13]See, e.g., a report issued in May 2015 by the Knesset Research and Information Center “Central Health Matters”, written by F. Davidovitch.

^[14]For a detailed comparison see the 1994-1995 Annual review published by the Israeli National Insurance Institute, pp. 229-231 (in Hebrew).

^[15]Other items that fell in this category were coverage for learning disabilities treatment and psychotherapy, as well as for newer tests for early detection of cancer.

^[16]As, for example, can be seen in the discussions of the Aloni committee that was appointed by the government in the early nineties in order to thoroughly inspect the legal aspects of IVF and related practices (e.g., surrogacy).

^[17]The first Israeli “test tube baby,” born in 1982, was only the fifth IVF birth worldwide.

had to pay substantial fees to access services.^[18] and even if eventually funding was granted, terms of eligibility and its extent were initially vague or undetermined, specifically with regards to older women.^[19]

The decision to include practically free-IVF for up to two children per-couple within the basket of standard health services was driven by a pro-natalist agenda, rooted in the Jewish tradition of familism.^[20] This is exhibited in the Israeli supreme court's ruling that the provision of IVF by the state is justified because becoming a parent is a fundamental human right.^[21] For our proposed analysis, it is important that the law was not driven by pro-women or "feminist" impulses which may have carried other effects on our outcomes of interest.

Impact on Usage and Awareness The new and unique Israeli funding policy facilitated fast adoption and increased usage of fertility-enhancing technologies. Figure 1 shows that the number of IVF treatment cycles (both total and relative to the population of fertile women) more than doubled in the 6 years following the approval of the new policy.^[22] Although the benefits of the law came into effect in 1995, the increase in the number of IVF treatment cycles began already in 1994, with the large amount of press coverage and increased knowledge of IVF availability.^[23] The figure on the right hand side shows that in the year after usage increased, there was a sharp increase in live deliveries using IVF.

At the time of the policy change, the media was flooded with IVF success stories, such as extreme cases of women having children at advanced ages, further raising awareness of the new technology.^[24] Local success stories were celebrated as "national accomplishments and symbols of local scientific excellence" (Birenbaum-Carmeli, 2004). The IVF law itself was also heavily covered in the press, and continued to be covered as debates ensued on whether to limit coverage.^[25] Advocates of the health reform, including the minister of health, publicly touted the benefits of IVF funding in

^[18]See, for example "We will have to forgo having a child since we cannot afford fertility treatments," *Yedioth Ahronoth*, June 14, 1992.

^[19]The most generous coverage that was offered by the largest health plan ("Clalit") placed almost no limitations on usage, but it was due to a technical difficulty in tracking treatments, rather than an official policy (Birenbaum-Carmeli, 2004). The other health plans offered a limited number of treatment cycles and placed age restrictions on use, as well as requiring long qualification periods.

^[20]For a thorough discussion of pro-natalist policies in Israel and their evolution over time, see Birenbaum-Carmeli (2003).

^[21]See, e.g., High Court 7052/03 Adalla vs. Ministry of Interior.

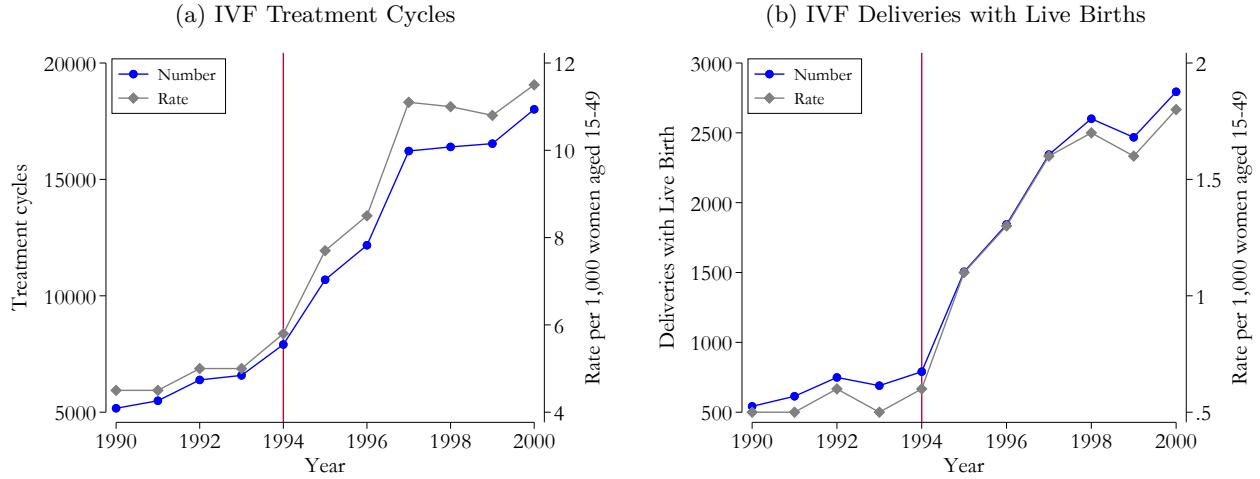
^[22]The common measure of usage is the number of IVF treatment cycles relative to the size of fertile women population. Since there is no documentation of the number of women treated each year, it is impossible to assess whether the sharp increase in usage stems from an increase in the number of women undergoing IVF treatments, or from an increase in the number of attempts each IVF patient makes. However, it is reasonable to assume that it is a result of a combination of these two.

^[23]The Israeli parliament issued a report in 2012 that attributes this dramatic change to the regularization and expansion of IVF funding under the NHI law.

^[24]For example, "World record: woman aged 60 gave birth to girl," *Yedioth Ahronoth*, February 22, 1994.

^[25]The Ministry of Health expressed its intent to limit coverage to seven treatment cycles and provoked public protest. The press covered this conflict using personal stories of women over 40 that had children only following dozens of IVF treatment cycles and others who are still trying after a number of failures (Birenbaum-Carmeli, 2004).

Figure 1: Direct Impacts of IVF Access



Notes: Administrative data from Israeli Ministry of Health, covering all women in Israel.

interviews as a reason to support the policy change.²⁶

This change in news coverage can be seen quantitatively. Figure 2 shows that 1994 saw a spike in newspaper coverage of IVF and funding issues surrounding it, using Israel's leading daily newspaper, *Yedioth Ahronoth*.²⁷ The graph also shows that the level of coverage in 1994 is much higher than the news coverage in the early 1980s when IVF was originally introduced in Israel. In fact, the 1994 spike is so large that it is equivalent to the large spike in news coverage surrounding the adoption of organ transplantation in Israel, in 1986.²⁸ Other health treatments and conditions do not see a similar spike, including those that received some change to their funding as part of the NHI law (we include in the figure learning disabilities, psychotherapy, and cancer treatments, in addition to transplants, all of which had at least minor changes in coverage resulting from the law).

In the years following the policy change, there was expanding access to IVF services, and a standardization of practices surrounding IVF and its funding.²⁹ Nowadays, there are 26 IVF clinics spread throughout Israel, making treatment very easily accessible for most residents of Israel. Israel has become the world leader in the rate of IVF treatment cycles and in the percentage of babies born following IVF treatments: approximately 4% of all babies born in Israel are conceived using IVF

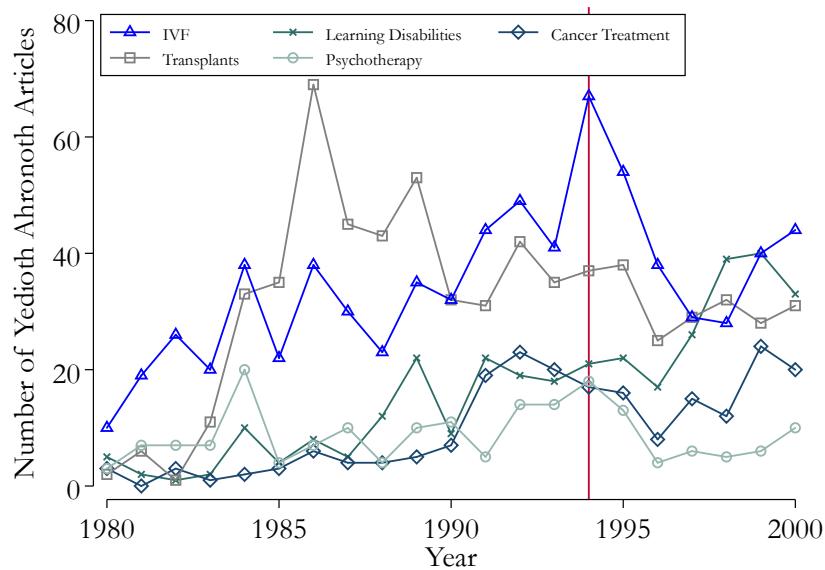
²⁶See for example an interview with the minister of health Dr. Ephraim Sneh, *Yedioth Ahronoth*, December 15, 1994.

²⁷There are no news databases available that can search every Israeli newspaper historically.

²⁸This was the time the first liver transplant was conducted in Israel. There was a large amount of controversy over whether transplanting from a donor who was braindead, but still breathing, was allowable under Rabbinic law. The controversy made international news.

²⁹The most distinct example is the 1996 Embryonic Carrying Agreement Law, officially legalizing and regulating surrogacy for the first time in the world (Simonstein, 2010).

Figure 2: Number of Newspaper Articles in *Yedioth Ahronoth*, by Year



Notes: The figure presents the number of articles found in a search of IVF related terms (e.g., IVF, infertility, ART, sperm and egg donation and surrogacy) and other health conditions and treatments that appeared in the headline section of Israel's leading daily newspaper at the time (*Yedioth Ahronoth*) in each year between 1980-2000.

(Hashiloni-Dolev, 2013).³⁰ Three forces: improved access, technological innovation, and publicity reinforced each other, driving a rapid and ongoing change in Israelis' attitudes and perceptions regarding IVF success rates, and thus the fertility time horizons for women.

Hashiloni-Dolev, Kaplan and Shkedi-Rafid (2011) surveyed undergraduates in Israel in 2009, and found that there was wide awareness of age-related fertility decline and of IVF. Appendix Table A1 presents an estimated comparison between perceived natural fertility versus IVF-enabled fertility for women of different ages, constructed based on this survey. It shows that students believed that the addition of IVF technology made 36-39 year-old women as fertile as those age 20-35, demonstrating the belief that this technology allowed a substantial delay in commencing childbearing without a decrease in expected fertility. The survey respondents also tended to over-estimate IVF success rates, especially at an older age.³¹ Although these beliefs cannot be compared to the pre-change perceptions (this was the first and only survey conducted in Israel on this subject), they provide important evidence that even college-aged women and men took IVF into account when thinking about future fertility horizons, and that there was wide awareness in the post-reform period.

2.2 Marriage and Fertility in Israel

If the introduction of IVF funding had an impact on perceived fecundity limitations which in turn could alter decisions on marriage and fertility, its implications would depend on pre-change patterns of marriage and child-bearing. Israel is characterized by remarkably high total fertility rates, which also remain stable over time, especially for the Jewish population.³² On average, Israelis have 1.4 more children than an average OECD family. This in turn would mean that women have to start families relatively early to avoid age-related fecundity constraints, which can be seen in a relatively low average age at marriage, despite the delay in family formation which is expected due to obligatory military service for all (Jewish) Israeli men and women.³³ Hence, we expect IVF availability in Israel to have an impact even on individuals who would otherwise marry well below the age when natural fecundity for women substantially deteriorates.

Israel is also characterized by high marriage rates, which remained practically constant over time, and very low rates of cohabitation, especially for couples with children.³⁴ This creates a

³⁰Compared to approximately 1-2% of the children born in other countries where IVF use is prevalent. The annual number of IVF cycles per million persons in Israel is the highest in the world and amounts to almost 3,500, compared to 2,000 in Denmark, which is second (Birenbaum-Carmeli, 2010).

³¹For example, students believed that IVF would be 32% effective for women 40-43, whereas the true rate is around 20%.

³²Based on OECD statistics, the average TFR is 3.11 for Israel and 1.7 for all OECD countries <https://data.oecd.org/pop/fertility-rates.htm>. Also see Hleihl (2011)

³³The military requirement, for example, postpones college graduation by an average of 2.5 years relative to other OECD countries (based on OECD data the average age at college graduation in Israel was approximately 29 compared to 26.5 in OECD countries, see OECD (2013), Table A3.1a.).

³⁴Marriage rates - according to OECD report https://www.oecd.org/els/family/SF_3_1_Marriage_and_divorce_rates.pdf. Based on the Israeli Census Bureau of Statistics 2001-2002 report on households and their characteristics, between 1998 and 2002, 2.7% of the couples in Israel were cohabiting, compared to approximately

tight relationship between decisions on marriage and fertility, which is also apparent from the short gap between marriage and first birth, the median for which in the pre-change period was one year (based on the 2008 census data that will be used in our main analysis). Moreover, in a survey on women's fertility attitudes that was administered in 1989 (5 years prior to the IVF policy change), more than 50% of women said that the proper number of months between marriage and first birth was twelve (97% answered 24 months or less).

Based on the answers to this survey, we can also estimate that the typical Israeli woman (at the time) would have required 10-14 fertile years since marriage to achieve the family size she desired, if everything goes according to plan.³⁵ Therefore, it is not surprising that the modal ideal age at marriage was 20 (88% thought it should be 24 or below), and that the modal ideal age at birth was 21 (97% answered 26 or below). With regards to our previous discussion of beliefs regarding age-related fecundity, an interesting finding based on this survey is that 30% thought that the ideal age at last birth was 30 and 85% thought it was 35 or less (of course fecundity is not the only consideration for this answer, but it is reasonable to assume that it is a substantial determinant).

3 Empirical Approach and Data

We now lay out our strategy to examine the impact of this discontinuous change in IVF access. As previously mentioned, the 1994 Israeli IVF policy applied to all Israeli citizens. This provides the advantage of potentially shifting widespread beliefs about reproductive time horizons, but the disadvantage of not providing statutory variation for identification. We thus employ a difference-in-differences strategy, comparing groups which are expected to be more versus less affected by the policy, within the country. We use two different control groups and a number of robustness and placebo checks to present a collage of evidence that the policy indeed causally impacted the outcomes we examine. We consider 1994 to be the first year of the treatment period, as our treatment is knowledge of IVF availability in the future and the resulting change of expectations, rather than the actual funding change.

Our data comes from the 2008 Israeli population census, covering approximately 20% of Israeli households.³⁶ This data is merged with administrative birth records for each individual in our sample.

Our analysis is restricted to native born Israelis, to avoid potential bias from substantial immi-

7% in the US at the time and even higher rates in Europe (e.g., 15% in the Netherlands, 14% in the UK and 23% in Sweden). For couples with children, only 1.2% were unmarried and mostly these are older couples that may have been previously married.

³⁵This is based on 75% of women reporting that their ideal number of kids is between three and five, more than 50% saying four and only less than 5% saying two or below, and on approximately 80% of respondents the ideal age gap between siblings is two to three years.

³⁶The survey began at the end of 2008 and was concluded in July 2009 (see https://old.cbs.gov.il/census/census/pnimi_page.html?id_topic=2).

grant inflows over time, including the mass migration from the former USSR during the late 80s and early 90s. Our “treated” group is Jewish-Israeli women, who are most likely to be responsive to a change in IVF access.³⁷

3.1 Marriage Timing

We begin our analysis by comparing marriage timing for Jewish women compared to Jewish men. Marriage ages—both the average and the distribution of ages—for these two groups have moved in parallel for a substantial period of time prior to the policy change. This makes intuitive sense, as Jewish men and women in Israel largely marry one another, and thus are similarly affected by shocks that change marriage patterns. In addition, both face similar economic conditions and experience the same demographic and labor market shifts. The challenge in this tight co-movement is of course that any change to women’s marriage behavior may also impact men’s decisions. However, IVF clearly has a differential impact on women, since it directly extends their later life fertility, an impact that men would only experience indirectly through their future partners. Women would not only experience a differential change to their own planning horizons, but also an update to their marriage market possibilities, since their appeal to partners who value fertility would change. Thus, if we can show a disruption of the co-movement between men’s and women’s outcomes exactly in 1994, it would present strong evidence of a causal impact of IVF on women’s decisions about marriage, despite the numeric estimates perhaps being distorted by equilibrium impacts of the policy change on men.

More importantly, part of our hypothesis is that time-limited fertility affects women differently than men. For this to be the case, it has to constrain women’s choices and options (e.g., in terms of available marriage partners at different ages) more than it constrains men through equilibrium effects. We therefore expect IVF to affect women differently than men, even taking into account equilibrium effects. And, it is precisely this net impact that may be most interesting to measure from an economic perspective, since it sheds light on how much limited reproductive time horizons act as a differential barrier to women.

To then ensure that the source of the changes we measure is truly IVF, and not another systematic change affecting specifically women in Israel around this time,³⁸ we turn to the Arab control group. Arab-Israeli women are much less likely to use IVF due to stronger religious restrictions on its use (Birenbaum-Carmeli, 2003), making them a suitable control group for our purposes.³⁹

³⁷ Judaism permits all forms of Assisted Reproduction Technology (ART), whereas Islam places restrictions on certain practices and the Roman Catholic church bans it entirely (Birenbaum-Carmeli, 2003).

³⁸ One example is an ongoing reform in Israel that increased access to higher education, especially for disadvantaged populations in peripheral areas, which could in turn affect marriage timing. This reform could have a gender specific impact if, for example, the cost of moving away from home to acquire education is higher for women relative to men. However, both Arab and Jewish women in such areas would be affected by this change.

³⁹ Most Arab-Israelis are Muslim, and Islam places stringent restrictions on usage of ART, due to a particular requirement that the parental lineage can be traced to the married mother and father. This means IVF was viewed

Moreover, Arab women got married almost 3 years younger on average before the change, and therefore were much less likely to be on the margin for delaying marriage into a zone where fertility would be a concern.⁴⁰ One reason for this gap in initial age at first marriage is that, as opposed to most of the Jewish population of Israel, they are exempted from obligatory military service. Also, Arab women in Israel come from more conservative backgrounds, with more traditional gender norms (Danziger and Neuman, 1999), and at the time had much lower education levels and labor market participation rates.⁴¹

This group has the added advantage of being unaffected in equilibrium by Jewish women's marriage decisions, since generally Arab and Jewish Israelis are not in the same marriage market. However, that also means this group may not as effectively control for common shocks that affect the Jewish-Israeli marriage market, and may be affected by different events and trends (especially in light of the significant differences between the two populations, as we describe above). However, while this strategy may have its own potential confounding factors, they should be orthogonal to any issues presented by the male control group, and thus if we estimate similar effects using the two strategies, it is unlikely that they are caused by a single omitted factor.

To assess the plausibility of the assumption that the treatment and comparison groups' age at first marriage would move in parallel in the absence of the policy change, we plot the pre-period trends for each group separately, over the 15 years prior to the policy change, 1979 to 1993. Figure 3 shows that men and women had strikingly parallel trends in age at first marriage during the pre-period, moving in lock-step and responding to common shocks. This is even more clear when, in panel (b), we artificially super-impose the two series by de-meaning each.⁴² This may be partially attributable to the largely segregated marriage market of Israeli-born Jews—immigrants and other ethnic groups tend to marry within their own groups.

For the Arab women control group, the pre-trends are not as parallel. This is not surprising, due to the fact that the two groups of women are not in the same marriage market, and may face different cultural forces. Moreover, the Arab population is smaller, and therefore shows more random variation. For these reasons, Arab women are not our preferred control group. However, we can see in panels (c) and (d) of Figure 3 that the trends for these two groups become approximately

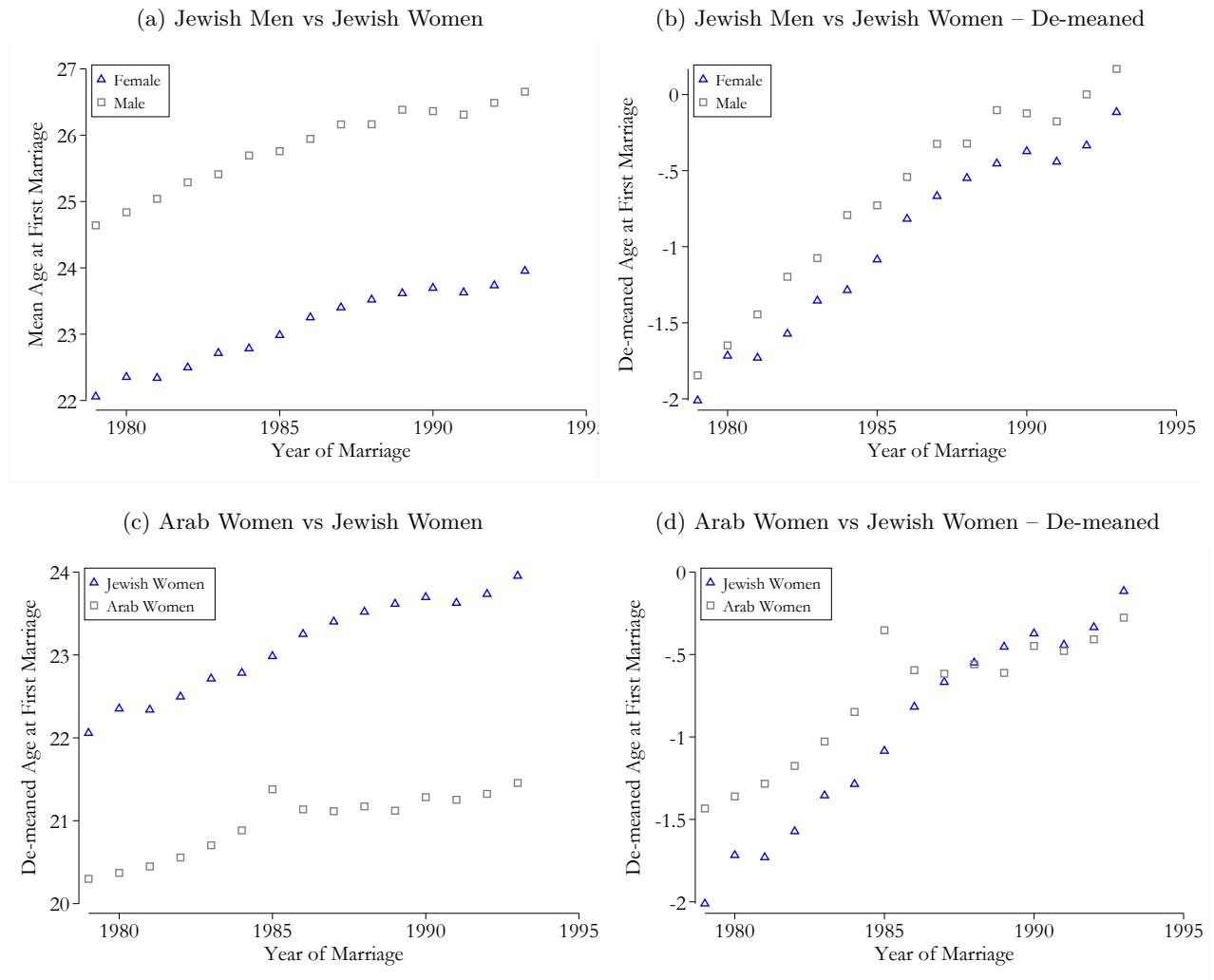
skeptically upon its introduction, and not immediately accepted by Muslim religious leaders, whereas Jewish religious leadership quickly approved of IVF and all accompanying technology. Even today, Muslim practices require IVF to be performed under stringent guidelines, and ban the use of donor eggs or sperm (Al-Bar and Chamsi-Pasha, 2015). As a result, IVF is seen as a last resort by the Arab-Israeli population (Remennick, 2010).

⁴⁰ According to annual data published by the Israeli central bureau of statistics, in 1993 (just before the policy change) the median age at first marriage for Arab-Muslim Israeli women was 20 compared to 23.3 for Jewish Israeli women (average age was 21.1 compared to 24). In the census data we also see a similar gap.

⁴¹ At the baseline year 1993, there was a 25 percentage point difference in the rate of women's college attainment between Jews and Arabs, and a 10 percentage point difference in the same figures for graduate education. Labor force participation rates in the early-mid 90s were approximately 13% for Arab-Israeli Muslim women compared to around 55% for Jewish-Israeli women (based on data from the Labor Force Surveys as reported by the Bank of Israel).

⁴² We use the mean age at first marriage in the year of the change, 1994, for each group, so for this year all de-meaned values equal zero

Figure 3: Control Groups – Pre-trends



Notes: Figure shows average age at first marriage for the treatment group – Jewish women and for two potential control groups: Jewish men and Arab women, by year of marriage, for the years prior to the policy change. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

Table 1: Summary Statistics

Marrying pre-1994:	Jewish women		Jewish men		Arab women	
	N=38,370		N=33,949		N=14,901	
	Mean	SD	Mean	SD	Mean	SD
Ultra-Orthodox	0.08	0.27	0.09	0.28	N/A	N/A
European-born mother	0.24	0.43	0.28	0.45	N/A	N/A
Asian/African-born mother	0.54	0.50	0.52	0.50	N/A	N/A
Income in Shekels	95,629	92,393	186,757	173,543	53,299	49,999
Age	44.81	5.39	47.46	5.34	42.24	5.66
Age at first marriage	23.15	3.91	25.86	3.86	21.03	4.11
AFM pre-trend (SE)	0.13	(0.00)	0.14	(0.00)	0.08	(0.01)

Notes: 2008 Israeli population census (20% sample). Restricted to Israeli-born. Sample “marrying pre-1994” is those married 1979 - 1993, inclusive.

parallel by the end of the 1980s. Thus, we shorten the pre period when using the Arab female control, and use only the years from 1988 onward (the estimated effects are not sensitive to our exact choice of pre period).

Table 1 shows summary statistics for our sample, comparing Jewish women to Jewish men (our main comparison) as well as Arab women, in the pre-change period. In addition to showing means for our key outcomes and controls, Table 1 compares pre-trends in outcomes for the different groups.⁴³

For both control groups, we first estimate a basic difference-in-differences specification, that measures the average change in Jewish-women’s age at first marriage (AFM) relative to the comparison group, between the “pre” and “post” periods, according to the following equation:

$$AFM_i = \beta_0 + \beta_1 T_i + \beta_2 post_i + \beta_3 T_i \times post_i + \beta_4 time_i + X'_i \gamma + u_i,$$

where T is a dummy for Jewish-female, $post$ is a dummy for marriage years 1994 and onwards (up to 2008), X is a vector of individual level controls, which includes indicators for religiosity (ultra-Orthodox or not) and parents’ origin (Europe and America, Asia and Africa, or Israeli born), to account for demographic shifts over time, and $time$ is a linear time trend.

We then use a specification that allows for a change in both levels and the time-trend following

⁴³Because our analysis addresses differential changes in slopes, we also tested for differences in trends between groups using a regression that includes a quadratic time variable. The differences between Jewish men and women are not significant both for the linear and the quadratic time trend. For Arab and Jewish women, there is a significant difference in the linear trend.

the change, allowing us to examine the evolution of the effect over time:

$$AFM_i = \beta_0 + \beta_1 T_i + \beta_2 post_i + \beta_3 T_i \times post_i + \beta_4 time_i \\ + \beta_5 post_i \times time_i + \beta_6 T_i \times time_i + \beta_7 T_i \times post_i \times time_i + X'_i \gamma + u_i$$

We repeat the estimation of both equations adding year of marriage fixed-effects, to more flexibly control for time trends and account for transitory shocks that may affect the marriage market.

We use two alternative methods to calculate standard errors. The first method has the advantage of accounting for cross-sectional correlation in outcomes as we cluster at the year \times group level—this captures the most important source of correlated shocks, those that affect a certain group as a whole (Jewish women, Jewish men, Arab women) marrying in a certain year. Our second set of standard errors aims to deal with potential serial correlation in the outcome variables, which could lead to over-rejection of the null hypothesis in a DID framework (Bertrand, Duflo and Mullainathan, 2004). We divide our sample into sub-groups, based on the standard classification of Israel into 51 “natural regions” and cluster at the geography \times group level, assuming that both changes in access to health or education and structural shifts in labor and marriage markets are likely to have significant regional components (examples of similar sub-group clustering can be found in Agarwal et al. (2014), and in Hanlon (2015)). To further address the concern for serial correlation, we then collapse the data into year-group cells and use Generalized Least Squares (GLS) estimation with an explicit AR(1) error structure that allows for correlation both *across* and *within* panels (as in Chandra, Gruber and McKnight (2010)).⁴⁴ Finally, in the appendix, we show permutation tests for each of our main results, demonstrating that our effects are “large” relative to the actual variation present in the data.

We complement these results with an analysis of women’s propensity to marry at different ages over time, which can demonstrate the two channels of impact — young women delaying and older women entering marriages. In addition, we present a number of robustness checks and placebo tests to verify that the results stem from the 1994 policy change, and a heterogeneity analysis that helps to further identify the channel of impact.

3.2 Fertility

If the effects we see for Age at First Marriage are driven by an increase in older age fecundity, we would naturally expect an increase in Age at Birth stemming from the policy change as well. This increase in age at birth would have more channels than an increase in age at first marriage. Specifically a) women who would previously have married and given birth young may delay, b) women who are older and unmarried might marry and give birth, c) women who are already married

⁴⁴The within-panel correlation factor accounts for serial correlation, assuming an AR(1) process with a unique autocorrelation parameter for each panel (either gender or ethnic group).

might delay birth, and d) women who are married and have been trying to conceive unsuccessfully might successfully conceive.⁴⁵ The first two mechanisms, (a) and (b), are shared with the age at first marriage results, and would be expected to impact women differentially from men. However, the latter two, (c) and (d), are unique to age at birth and are couple-level effects that equally impact men and women, given that they impact already-formed couples.

For this reason, identifying the impact of the policy change on age at first birth is more challenging than identifying the impact on age at marriage. Men are directly affected through the post-marriage couple-level effects, rather than only being affected indirectly through women's decisions. Thus, while men can serve as some kind of comparison group for mechanisms (a) and (b), they cannot truly serve as a control group. Additionally, the trends for Arab women in age at first birth are not sufficiently parallel to make them a strong candidate for a control group, either.

As described above, marriage and childbearing in Israel are closely related and therefore, our analysis focuses on age at marriage rather than age at birth. Nevertheless, we take two approaches to analyze whether women's aggregate birth timing was indeed affected by the policy change, as an additional support to our proposed mechanisms.

First, we zoom in on the group most likely to have IVF births be a high percentage of overall births: those women over 40. By focusing on this group where the potential impact would likely be large relative to baseline births, we can expect a discontinuity that is large enough to recognize even in the absence of an adequate control group (these women would be impacted by mechanisms (b) and (d), thus men would be affected as well). In addition to portraying an impact on actual fertility, showing that births to women over 40 go up will demonstrate that the policy would indeed rationally change the older age fertility expectations for younger women as well as men considering older spouses, supporting our hypothesized mechanism of impact on young women's decisions.

Second, we show the time series of age at first birth for Jewish men and women in comparison to one another. This allows first the observation of any changes in the series together, relative to their pre-trends. Additionally, we can examine women's trends relative to men, which would reflect the effect stemming from mechanisms (a) and (b). If the change in marriage age is related to the new option for women to delay fertility, we should expect their age at first birth to change relative to men, even while other mechanisms may be moving both genders together. We then show the same time series also for Arab women, and focusing on a shorter time span, for which pre-trends are indeed parallel.

⁴⁵There also may be a small number of women who become older-age single mothers.

4 Results

4.1 Age at First Marriage

4.1.1 Average Effects for Women Compared to Men

The primary outcome we consider is age at first marriage. If indeed the marriage market improved for older women, due to higher expected fertility, we would expect more older women marrying, pulling up the average age at marriage. Similarly, if young women chose to delay marriage both in response to the improvement in later-life fertility prospects and the aforementioned improvement in marriage market possibilities, this would also increase marriage age in the long run. Note that women delaying marriage could either increase or decrease the immediate effect, depending on where they (and their partners) come from in the marriage age distribution.

We first plot the raw averages for age at marriage over a 30 year period, before and after the change, in order to visually inspect the trends and differences between the groups. Figure 4 shows that in 1994, women's marriage age departed from the parallel trend with men's, and experienced a discontinuous increase relative to men, continuing in a differential time trend.⁴⁶

When we graph the difference between men and women on the right-hand side, we clearly see a sharp increase in level immediately at 1994, followed by a substantial positive change in trend. This striking discontinuity in age at first marriage is unprecedented in Israel, is unique amongst other countries over the same time period, and has no clear explanation other than the introduction of free IVF.⁴⁷

Table 2 analyses this change using a regression, in both a simple DID framework (columns 1 and 2), and an analysis demonstrating the change both in level and trend (using both OLS in columns 3 and 4 and GLS to correct for serial correlation in columns 5 and 6). Using the latter specification, we find that women's age at marriage jumps by approximately three months, relative to men, immediately following the policy change, and continues to increase steadily thereafter. The estimated discontinuity as well as the estimated slope change are significant in all specifications and with all types of standard errors.⁴⁸

As for the magnitude of these effects, their interpretation should take into account that men's behavior may be changed due to the shift in women's choices. The immediate impact is relatively large, around a quarter of a year (slightly smaller in column 6), and one explanation of its magnitude

⁴⁶In 1994 itself, men's age at first marriage appears to decline, but women do not respond in tandem, despite responding in parallel to shocks previously. The apparent change in men's outcomes could either be a random shock, or could be a result of an equilibrium shift due to certain women choosing to delay marriage.

⁴⁷Note that the immediate increase of women's age at first marriage relative to men's suggests that either the women delaying marriage were of average age or younger, or there was a sufficient increase in marriages by older women to balance out any delays by women older than average. We show the distribution of impact in more detail in Section 4.3.

⁴⁸When we use the geographical clustering, standard errors generally increase, however the p-values remain around 0.06.

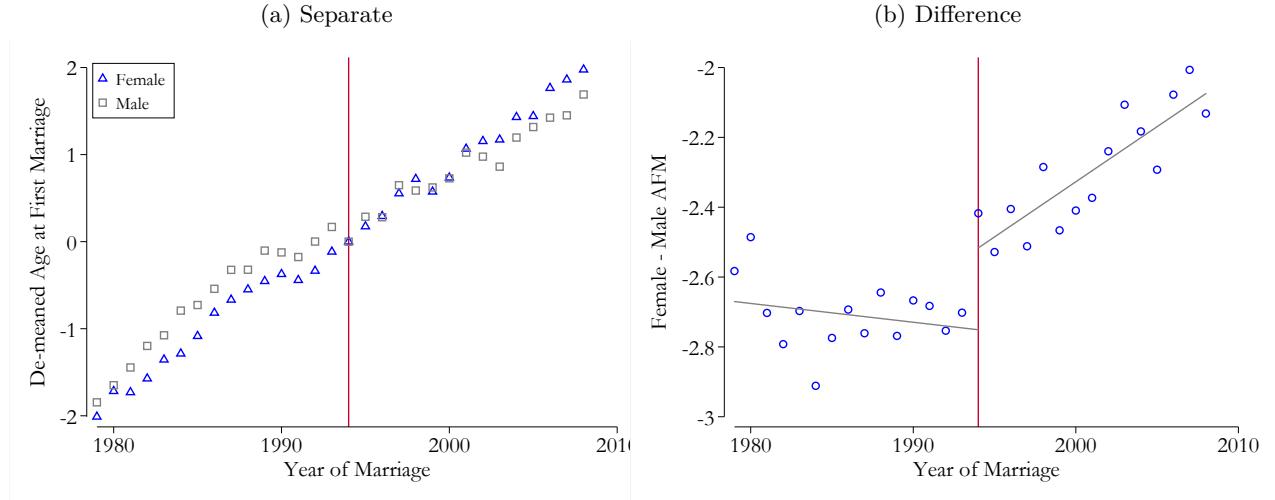
Table 2: Age at First Marriage

	Dependent variable: Age at First Marriage					
	DiD		Slope-Change DiD		GLS Slope-Change DiD	
	(1)	(2)	(3)	(4)	(5)	(6)
fem × post	0.399 (0.071)*** [0.223]*	0.402 (0.037)*** [0.223]*	0.233 (0.122)* [0.131]*	0.239 (0.042)*** [0.128]*	0.247 (0.082)***	0.195 (0.058)***
fem × post × time			0.041 (0.013)*** [0.020]**	0.042 (0.005)*** [0.021]**	0.035 (0.010)***	0.036 (0.007)***
fem × time			-0.009 (0.012) [0.015]	-0.010 (0.003)*** [0.014]	-0.009 (0.008)	-0.007 (0.005)
post × time			-0.003 (0.010) [0.014]		-0.002 (0.013)	
post	-0.439 (0.082)*** [0.139]***		-0.328 (0.092)*** [0.077]***		-0.395 (0.108)***	
female	-2.667 (0.056)*** [0.234]***	-2.669 (0.017)*** [0.233]***	-2.740 (0.111)*** [0.251]***	-2.745 (0.030)*** [0.248]***	-2.783 (0.067)***	-2.757 (0.045)***
time	0.175 (0.004)*** [0.011]***		0.169 (0.009)*** [0.010]***		0.138 (0.010)***	
Constant	26.288 (0.070)*** [0.194]***	23.533 (0.080)*** [0.177]***	26.241 (0.099)*** [0.183]***	23.495 (0.065)*** [0.186]***	26.856 (0.088)***	24.628 (0.022)***
YOM FEs		YES		YES		YES
Observation	173750	173750	173750	173750	60	60
R-Squared	0.241	0.242	0.241	0.242		

Notes: Columns 1–4: Ordinary least-squares difference-in-differences regression using micro data, including controls for religiosity and parents' origin. Robust standard errors clustered at the gender × year level in parentheses; robust standard errors clustered at the gender × geography level in square brackets. Columns 5–6: Generalized least squares regression with data collapsed to the gender-year-of-marriage level. Robust standard errors that allow for cross-sectional correlation and for panel-specific serial correlation (i.e. estimate a unique autocorrelation parameter for each group), in parentheses. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

*** p<0.01, ** p<0.05, * p<0.1

Figure 4: Female vs. Male Age at First Marriage



Notes: Figure (a) shows average age at first marriage for women and men, by year of marriage, de-meaned so that the relative changes can be seen more clearly. Figure (b) presents the difference in average age at first marriage between women and men, as well as fitted lines for the pre (1979-1993) and post (1994-2008) periods. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

could be that in addition to the positive change in women's age, there is some decrease to men's age. For example, imagine that a 23 year old woman that would otherwise get married in 1994 decides to postpone, and therefore her male spouse also does not get married that year (either because he chooses to wait and marry her later or because he is now searching for another spouse). Both of them are pulled out of the sample of marriages for 1994. Because the woman is younger than average, the average declines for women. The men, according to our data, will on average be older than the average man that gets married that year (because the age gap for spouses with younger-than-average wives is larger than average). Therefore, pulling him out reduces the average age for men, making the overall difference between men and women larger than the initial increase for women.

However, even if we ignore this and consider the 0.24 effect at face value, the size of the effect still seems plausible if the young women who may have pulled out of the marriage market were “replaced” by the older (previously considered infertile) women who entered. A back of the envelope calculation that replaces some number of 24-year-olds in the marriage market with an equal number of 34-year-olds shows that only 2.5% of all marriages would need to be affected in order to get such a large initial effect (this is the same magnitude as thinking of the effect as the displaced men marrying one year older, displacing men who also marry one year older, and so on, until reaching the older women who would not have found spouses). More generally, the key driver is that the women who might enter the marriage market are far above the previous average age at first marriage (24). We present more evidence to support these interpretations of the impact in section 4.3 and

in Appendix Section 1, and Appendix Figure A1.

Consistent with the idea that for men’s and women’s age at marriage to diverge from the common trend, the age gap between spouses must adjust, the raw data shows the age gap between spouses changed by about 3.5 months (from 3 to 2.7 years) over the first three years of the policy change, and by 0.6 years over the 15 years following the policy change (compared to 0.007 since 15 years prior to the benchmark year 1993).⁴⁹

4.1.2 Confirming a Trend Break in 1994

Quandt Likelihood Ratio breakpoint test To confirm that what we are picking up is truly a discontinuous shift in age at first marriage—a break in the time series—rather than more gradual time trends, we perform a Quandt Likelihood Test to “search” for the most likely break year in the data, over our entire sample period except for the standard 15% “trimming” on either end, to account for limited data at the beginning and end of the sample period. To implement the test, we run a loop of regressions identical in specification to our columns 3 and 4 regressions, except the “break” year changes in each regression. We then perform an F-test for whether the two “break” parameters—slope and intercept—are different from zero, and search for the maximal F-statistic among all years.

As shown in Table 3, the test returns the highest F-statistic for 1994, which stands out as other years are more similar to each other and have distinguishably lower values. This indicates that the year of the policy change and hence our treatment year is the most probable break year. Moreover, this break is significant even when accounting for the multiple tests used to identify it. The procedure for the QLR specifies comparing this “sup(F-stat)” to a table of critical values adjusted for the number of tests: the critical value for two restrictions and 15% trimming is 5.86, whereas the QLR statistic for age at first marriage for the “break” year is 11.46 or 11.89, depending on whether fixed effects are used or not.⁵⁰ This shows strong evidence of a break specifically at 1994.

Event Study analysis To further verify that long term time trends are not responsible for the effect we see, we perform an event study analysis (also known as dynamic lag analysis), to pinpoint the timing of the changes we observe.

The event study graph depicted in Figure 5 is created by regressing our key outcome variable on a series of dummies for each year, interacted with gender and including the same controls as our regression specifications. Because *each* year of the entire sample period is allowed to have a group-

⁴⁹Numbers from the 2008 Israeli population census, with matches between spouses, and thus are for couples that “survive” into 2008 only.

⁵⁰Note, some of the other F-stats are still large, as is common in QLR tests where there is indeed a break in the data, so moving additional data points to either side of the “break” does not completely eliminate its statistical impact on the test.

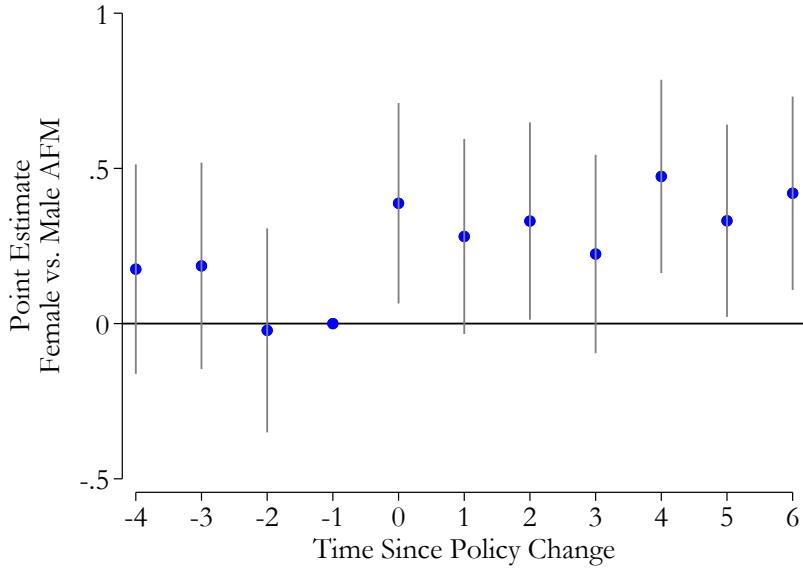
Table 3: Quandt Likelihood Ratio test for break point

Year of Marriage	F-Statistic	
	No FEs	With YoM FEs
1983	8.64	9.05
1984	9.05	9.51
1985	9.07	9.53
1986	9.03	9.55
1987	9.52	10.02
1988	9.75	10.10
1989	9.83	10.09
1990	9.77	9.97
1991	9.51	9.67
1992	9.17	9.48
1993	9.79	10.15
1994	11.46	11.89
1995	8.38	8.71
1996	7.53	7.84
1997	6.50	6.79
1998	7.16	7.37
1999	5.10	5.16
2000	5.27	5.46
2001	4.87	5.04
2002	4.32	4.42
2003	3.09	3.15
2004	1.19	1.21

Notes: Table reports F stats from a regression according to the specification in columns 3 and 4 of Table 2, where the hypothesis is that the coefficients on $post \times fem$ and $post \times fem \times time$ equal 0, and “post” is defined as being greater than or equal to the indicated year. Standard errors are not clustered in this case, as clustering is not conventional in QLR models, but similar results are obtained with clustering.

specific effect, this is a demanding test. The coefficients graphed represent the differential effect on women (compared to men) for each time period relative to the last year of the pre-change period. This analysis shows no significant differences for the years prior to the policy change, whereas in the year of the policy change, there is a large and permanent change to subsequent outcomes. This confirms that the increase in women's average age at first marriage is not driven by pre existing trends.

Figure 5: Event Study Analysis



Notes: The figure presents dynamic lag event study analysis for the impact of the policy change on age at first marriage for women relative to men. Point estimates and confidence intervals are for the coefficients on yearly dummy variables interacted with an indicator for women (treatment group). Time is year of marriage, with 1994 as time “zero.” The regression equation includes all year-group interactions for the entire sample period, as well as a linear time trend and demographic controls. All regressions restricted to Israeli-born Jews.

4.2 Alternative control: Arab-Israeli women

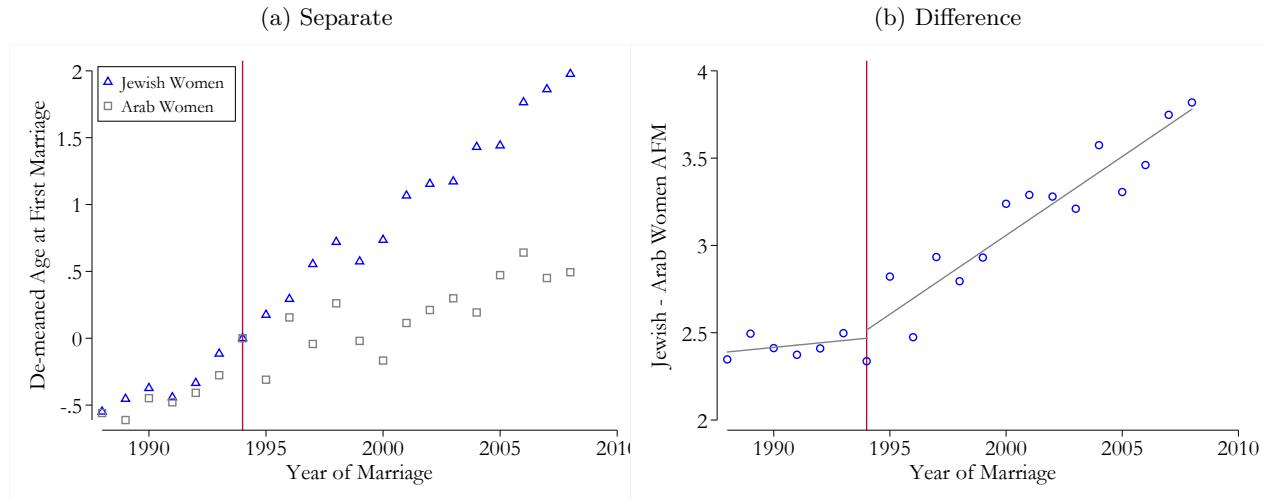
Our identification strategy relies on the post-1994 time-path of men's outcomes being similar to women's in the absence of the IVF policy change. A threat to this identification would be a policy, or any other exogenous shock, that affected Israeli women, but not men, commencing at or around the time of the 1994 IVF policy change. Additionally, because men co-exist in the same marriage market with women, it may be difficult to use men to pin down the exact magnitude of the policy's impact, as women delaying marriage may influence men's marriage timing.

The advantage of using Arab-Israeli women as a control group is that they would have the same exposure to other forces that might influence women's age at marriage. For example, if we

worry that other elements of the health reform changed women's propensity to marry across the age distribution, or if there were other policies promoting women's welfare.⁵¹ As we describe in detail in section 3, Arab-Israelis were less likely (if at all) to respond to the change in IVF funding for two main reasons. First and foremost, most Arab-Israelis are Muslim and Islam places more stringent restrictions on the use of IVF than does Judaism. Second, the initially younger average age at marriage for Arab-Israeli women, as well as their extremely low labor market participation, makes fertility horizons a less material constraint in the first place. Also related to this point, is the small number of single "older" women who could potentially enjoy the benefits of IVF and improve their marriage market status. However, it should also be noted that some of these differences account for Arab women not being our preferred control group. The lower rates of educational attainment and labor force participation mean that there are important differences in the social forces influencing the two groups.

Figure 6 compares Jewish and Arab women's average age at marriage before and after the policy change, as we did in figure 4 for Jewish men and women. It is restricted to the pre-period during which the trends for Arab and Jewish women were found to be parallel. The figure shows a strong divergence in trends starting in 1994, with an increase of about 1.5 years for Jewish women's age at first marriage relative to Arab women's by 2008.

Figure 6: Jewish vs. Arab Women's Age at First Marriage



Notes: Figure (a) shows average age at first marriage for women and men, by year of marriage, de-meaned so that the relative changes can be seen more clearly. Figure (b) presents the difference in average age at first marriage between women and men, as well as fitted lines for the pre (1979-1993) and post (1994-2008) periods. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

⁵¹One example is a push to expand higher education to outlying areas in the 1990s. In fact, Arab-Israelis were much more likely than Jewish-Israelis to be affected by this reform, which gradually enabled colleges (rather than universities) to grant academic degrees, due to lower high-school achievements (on average) and higher concentration in peripheral areas. This effect is described in Volanski (2005) and also in various reports issued by the Israeli council for higher education (e.g. Higher education in Israel 2014, pp. 29-31).

Table 4 confirms that Jewish-Israeli women experience a differential increase in age at first marriage, beginning in 1994, compared to Arab-Israeli women. Note, that the estimated effect is somewhat larger than the one reported in Table 2, which may be because Arab women are not affected in equilibrium by Jewish women postponing marriages, while Jewish men, the marriage partners of Jewish women, are likely to be. Thus, the Arab female control group may be useful in understanding the true effect size.

Note that in both the figure and regression results, we do not observe a discontinuity precisely in 1994 as we do for men. In general, the Arab women sample is much smaller and their trend over time is not as smooth as for the Jewish population (both men and women), so the series is more noisy, and there may be a random positive error term for Arab women in 1994. A second option, though, is that the immediate effect is inflated when we compare to men, because men's average age at marriage as an impact of women delaying (see section 4.1 above), before "jilted" men re-enter the marriage market. This equilibrium effect obviously is not present for the Arab women comparison group.

The impact on the trend, however, is larger when we use the Arab control group, which may be a result of a positive long-run equilibrium effect on men as they adjust their marriage behavior in response to women's altered timing.

Table 4: Age at First Marriage (Arab Control)

	Dependent variable: Age First Marriage					
	DiD		Slope-Change DiD		GLS Slope-Change DiD	
	(1)	(2)	(3)	(4)	(5)	(6)
jewish × post	0.772 (0.127)*** [0.179]***	0.767 (0.099)*** [0.178]***	0.076 (0.140) [0.184]	0.083 (0.091) [0.182]	0.054 (0.188)	0.096 (0.160)
jewish × post × time			0.117 (0.024)*** [0.047]**	0.116 (0.018)*** [0.047]**	0.113 (0.046)**	0.118 (0.038)***
Constant	21.815 (0.059)*** [0.277]***	21.167 (0.242)*** [0.327]***	21.648 (0.025)*** [0.313]***	21.666 (0.039)*** [0.315]***	21.635 (0.191)***	21.151 (0.080)***
YOM FEs	YES		YES		YES	
Observation	95540	95540	95540	95540	42	42
R-Squared	0.109	0.110	0.110	0.111		

Notes: Columns 1–4: Ordinary least-squares difference-in-differences regression using micro data (no controls included since religiosity and parents' origin controls used only apply to Jewish population). Robust standard errors clustered at the group × year level in parentheses; robust standard errors clustered at the group × geography level in square brackets. Columns 5–6: Generalized least squares regression with data collapsed to the group-year level. Robust standard errors that allow for cross-sectional correlation and for panel-specific serial correlation (i.e. estimate a unique autocorrelation parameter for each group), in parentheses. All specifications include coefficients for group, post, time, post × time, and group × time. Data from the 2008 Israeli population census, restricted to Israeli-born.

*** p<0.01, ** p<0.05, * p<0.1

These results are further confirmed by a triple-difference estimation presented in Appendix

Table A2, which compares the male-female difference-in-differences to the same exercise for the Arab population. The triple-difference shows a strongly significant slope change with magnitudes in line with Table 4. Note, however, that these results should be interpreted with caution as the pre-trend for Arab men does not appear to be parallel to that of either Arab women or Jewish men.

Overall, these findings corroborate our main results, in that they show a substantial change for Jewish women compared to Arab women. The magnitude of the change in the longer run is larger than the one observed with the male control group, indicating that the echo effect on men may have caused an underestimation of the true effect.

4.3 Distribution of Age at First Marriage

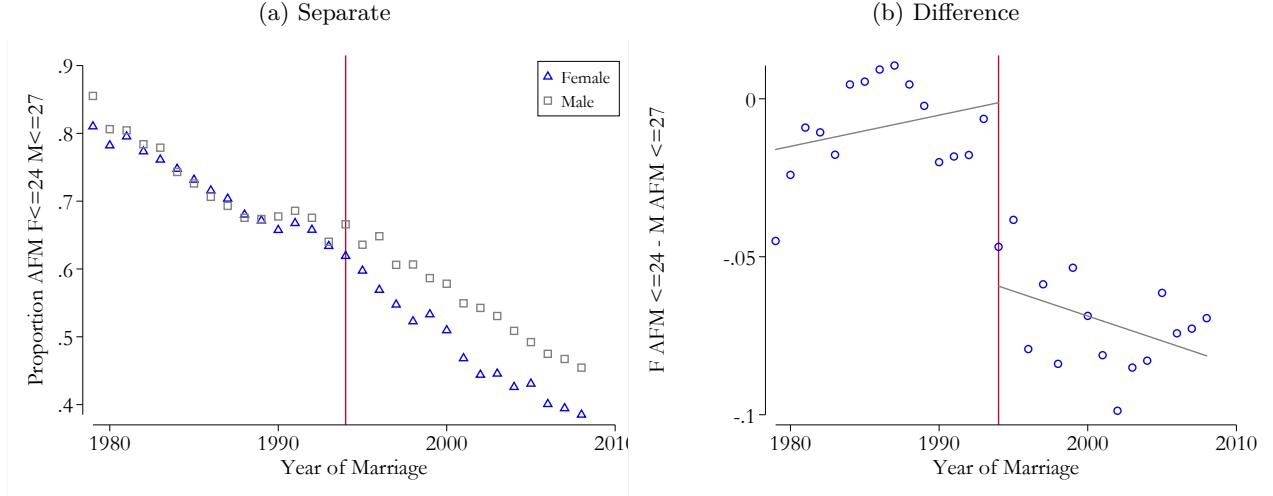
After establishing that women's average age at first marriage significantly increased following the policy change, we now explore what happened to the distribution of age at first marriage. This allows us to understand if the change to the average is driven by a decrease in marriage rates of younger women who choose to delay marriage, or by an increase in marriage rates for older women, or both. This in turn will facilitate a more comprehensive understanding of how we should interpret the main results, recognizing that men are affected in equilibrium by the change in women's marriage timing.

First, we show in Figure 7 that the same discontinuity we observe for average marriage age is present if we compare the proportion of men and women marrying at or below the (approximate) average age at marriage for each in 1993. As discussed above in section 2.2, women in Israel marry relatively young, partially due to very high fertility rates. This means that women in their late twenties are already on the “older” side of the Israeli marriage market. In panel (a), in the pre period, we see strongly parallel trends—though fewer men and women marry at a young age over time, the rates decline at an equal pace. Starting in 1994, there is a sharp divergence of the two series. In 1994, more men married below the 1993 average age than did women. The differences in this series, shown in panel (b), confirm a large trend break in 1994, demonstrating that men's and women's age at marriage departed in opposite ways from what had been the average age for marriage prior to the policy change.⁵²

The fact that we capture a break in this measurement implies two key effects: It suggests that either some women who were marrying at younger-than-average ages delay to older-than-average ages or new women entered the marriage market at older ages, or both. That is, it suggests that the policy did not *only* shift women who already married older than average to marry at even older ages, as that would not have shifted the proportion marrying at the average. This helps further

⁵²This picture does not show as strong of a differential trend as does average age at marriage, because what is being measured is the proportion marrying younger than the 1993 average. If women who already marry above the 1993 average continue to marry at older ages, this would increase average age overall, but not the proportion above average.

Figure 7: Female vs. Male Proportion Married at or below 1993 Average Age at First Marriage



Notes: Figure (a) shows the proportion of women and men married at or below the average age at first marriage, by year of marriage. Figure (b) presents the difference in this proportion between women and men, as well as fitted lines for the pre (1979-1993) and post (1994-2008) periods. The average age at first marriage is 24 for women and 27 for men. It is calculated for 1993, just before the policy change, and rounded to full years in order to fit the way age is calculated in the data. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

explain why we see an immediate increase in age at first marriage, when potentially the effect of women delaying could be ambiguous initially, depending on their age. The policy indeed shifted the distribution of marriages *across* the previous average age at marriage.

To further examine whether the shift in proportion was caused by both an increase in older women marrying and a decrease in younger women marrying, we look at changes in the number of marriages occurring in different age groups. Appendix figure ?? presents *counts* of marriages at a “young” age and an “older” age. Starting in 1994, there is an apparent decrease in the number of women who get married younger than 24 relative to trend (and relative to men at a comparable age) while the number of women marrying over 27 increased relative to trend (and relative to men at a comparable age). This supports the conclusion that both channels lead to the overall increasing age at first marriage shown in Figure 4.

This is also important because if we thought some other policy, such as the other insurance changes stemming from the NHI law, shifted propensity to marry, we would expect an increased or decreased propensity throughout the distribution of ages. Instead, we see an increased propensity to marry by one group, older women, and decreased propensity by another group, younger women. In fact, we observe little change to marriage rates overall in this year.

We then turn to examining how the policy change shifted marital behavior over the lifecycle. We do this using a series of regressions that look at whether women in our sample were married by a certain age before and after the policy change, compared to men. For each year we include

in the analysis *all* individuals who were at this certain age or above it at this year (as opposed to previous results that only included individuals who actually got married that year). Thus, the pre and post periods are defined according to the year in which the individual reached the specified age, since, for example, individuals who were already 22 before the time of the policy change, could not change their outcome (married by age 22) due to the policy. Hence, this analysis also captures the possibility of remaining unwed. As before, we use a DID specification, that allows for shifts both in levels and trends, with men as the control group. We add controls and flexibly control for group specific time trends similar to the column (4) specification in table 2.

Figure 8 shows the point estimates and confidence intervals for the impact of being in the treated groups after the policy change on both the level and trend of being married by a certain age. The estimates reflect the change in the percentage of women married by the age specified on the x axis. Figure 8(a) presents estimates for the immediate (and permanent) change in level and figure 8(b) shows the estimated change in trend. The two graphs show no substantive decrease in marrying by age 22, which provides a useful falsification test, since we would not expect women inclined to marry and begin childbearing by age 22 to be concerned about fertility in their late thirties, and hence to be affected by access to IVF. In time trends, we see the largest reduction in marriage by age 26, and from there a steadily decreasing impact, until the total effect reaches zero or slightly positive, which suggests that women are delaying marriage, but not forgoing it entirely. Overall, this analysis suggests that the women who delay marriage do so from their mid- and late-twenties into their thirties. In addition, it shows an immediate positive impact on older women's propensity to marry, confirming that lower fecundity may have previously reduced the marriageability of these women.⁵³

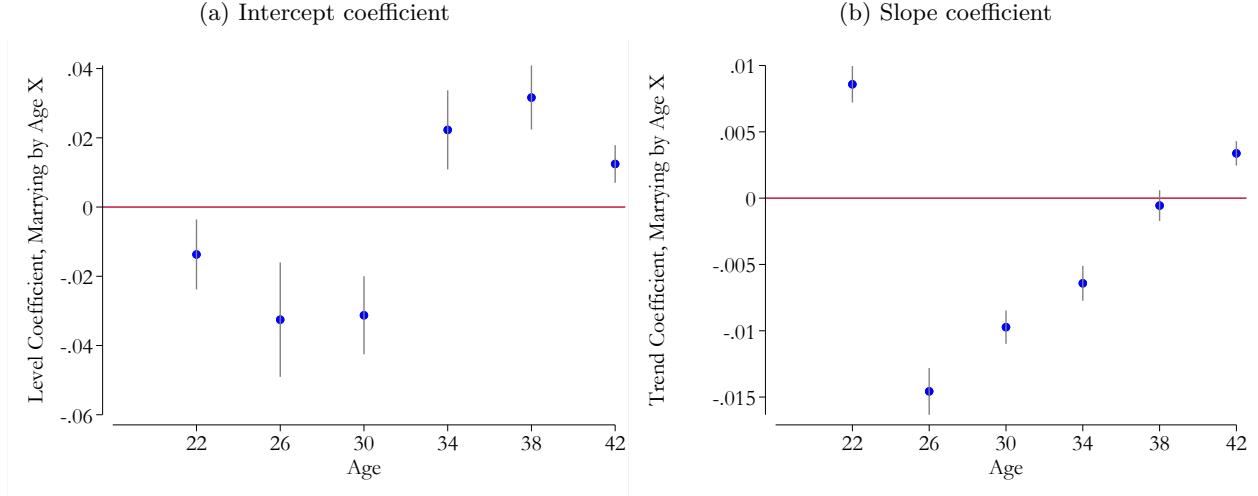
4.4 Age at Birth

As discussed in section 3, our ability to identify changes in fertility patterns is limited because some of the impacts are at the post-marriage couple-level. Hence, contrary to marriage decisions, men are directly affected (in addition to being affected in equilibrium by women) and cannot be thought of as a true control group. Moreover, the Arab control group does not exhibit a trend that matches the Jewish population, at least in the earlier section of the pre-period. We thus only present evidence on fertility that are suggestive, to support our main hypothesis that IVF availability drove changes in marriage patterns, both through increasing marriages for older women and decreasing them for relatively young women.

First, in Figure 9, we examine how fertility outcomes changed for women over 40, who we expect to be the most obvious immediate beneficiaries from increased IVF availability (in terms of fertility). For this purpose, we use data from the Israeli Labor Force Survey, a repeated cross-section sample,

⁵³To test the robustness of this result, we present the same analysis in appendix figure A2 with men's age shifted by three years, to reflect the average age-gap between spouses. The main conclusions hold.

Figure 8: Regression Coefficients for Effect of IVF Law on Marrying by a Given Age



Notes: The figures present the point estimates and confidence intervals of the coefficients on (a) the interaction term $\text{fem} \times \text{post}$ and (b) the interaction term $\text{fem} \times \text{post} \times \text{time}$, for regressions where the outcome is a binary variable indicating whether or not the individual got married at or before a certain age, and the specification is as in column (4) in table 2. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

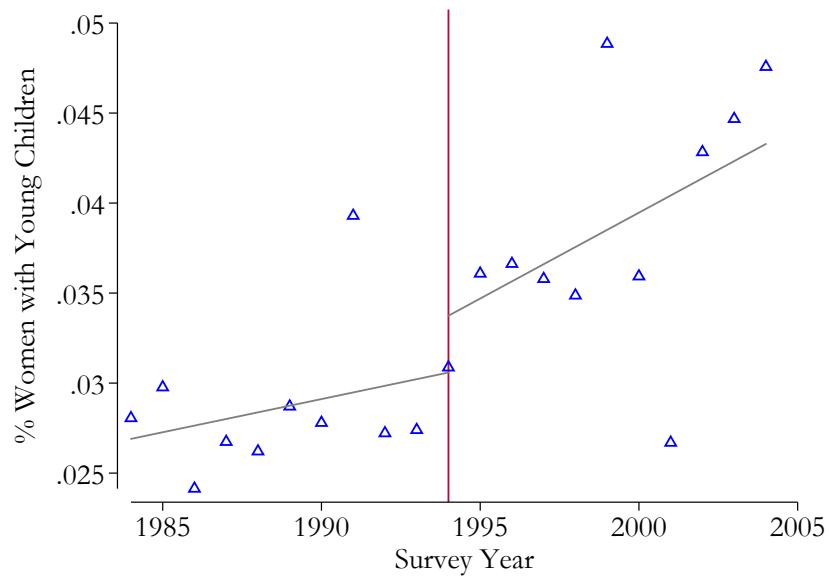
which allows us to see a new sample of women in each year. We graph the percentage of women over 40 with an infant (child younger than one) in the house. The figure shows a discontinuous increase in the percentage of women over 40 who gave birth during the last year immediately after the 1994 IVF reform. This instantaneous change, amounting to more than 30% of the initial level of older motherhood, persisted and kept expanding rapidly in the years that followed. This adds to the evidence on the sharp increase in IVF assisted live births that was shown in Figure 1 above by demonstrating that these births have a detectable effect on older women's fertility.

Figure 10 turns to more generally examining Age at First Birth, plotting the series for men and women from 1986 to 2006 (earlier and later years are subject to censoring). Looking at the two series de-meaned, in panel (a) shows that prior to 1994, women and men's age at first birth followed approximately parallel trends. In the post-1994 period, the two series begin to diverge. Naturally, we expect age-at-birth effects to appear with some lag, even if decisions on birth timing change immediately.⁵⁴ There also appears to be a joint uptick in both series in the years following the policy change, although this is difficult to separate from shifting trends over time.

Note that because of the couple-level effects (mechanisms (c) and (d) as described in section 3), we do not expect a difference-in-differences approach to identify the true total impact on birth age. However, looking at differences in panel (b) still shows a strong differential shift for women relative to men, demonstrating that the same female-specific mechanisms that operate on marriage

⁵⁴With regards to its relation to age at first marriage, note that the average lag between first marriage and first birth is approximately two years.

Figure 9: Percentage of Women over 40 with Children ≤ 1 year, Labor Force Survey

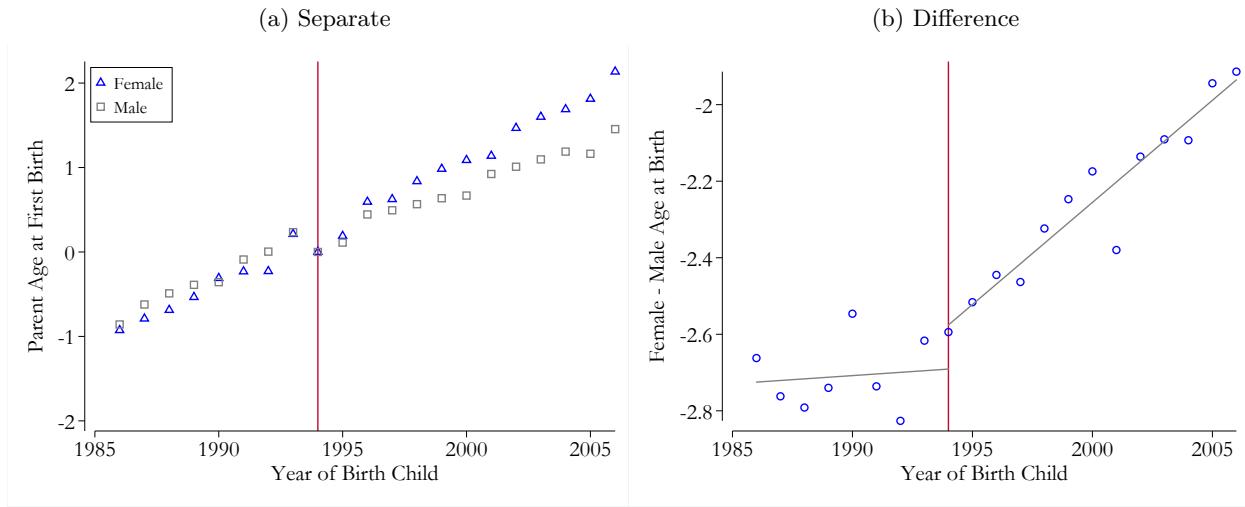


Notes: The figure presents the percentage of women above age 40 (>40 and ≤ 47 , since in practice very few women above 47 have young children) with children of age 1 or below. Data from the Israeli Annual Labor Force Survey 1984-2004, restricted to Israeli-born Jews.

timing (mechanisms (a) and (b) as described in section 3) appear to act on first birth. By 10 years after the policy change, women's age at first birth has increased by half a year relative to men's, similarly to age at first marriage.

Appendix Figure A4 adds the time series for Arab women to this graph, providing another contrast with the sharp increase for Jewish women. Although Arab women are clearly not on a similar trend pre-reform, zooming in on the years around 1994 in Figure A4 panel (b), it is clear that the post-1994 trend for Jewish women changes relative to both of the other groups, and starts to increase faster. In addition, the change relative to Arab women is larger than relative to men, which should be expected if men (but not Arab women) are partially affected by the policy change via channels (c) and (d).

Figure 10: Average Age at First Birth, by Child's Year of Birth



Notes: The figure presents the average age at first birth by the child's year of birth, for the years 1986-2006, demeaned so that the relative changes can be seen more clearly. Figure (b) presents the difference in average age at first marriage between women and men, as well as fitted lines for the pre (1986-1993) and post (1994-2008) periods. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

These results demonstrate that the change in marriage age we document is directly linked to fertility behavior, and thus provide additional evidence that it is driven by the extension of later-life fertility induced by IVF availability.

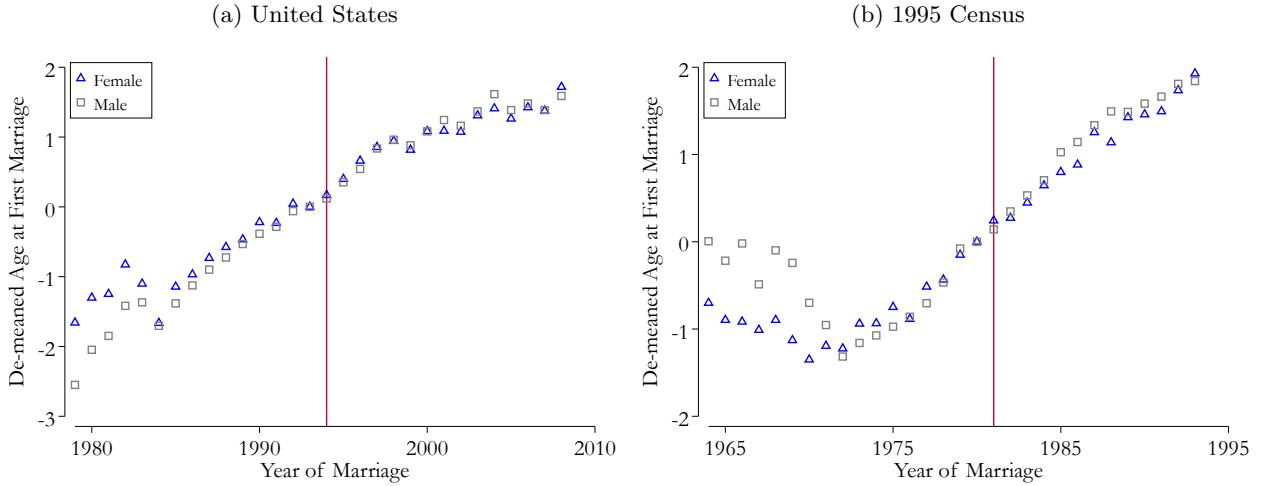
4.5 Placebo and Robustness Checks

Placebo tests In this section, we perform placebo tests to demonstrate that our effects are substantial relative to shocks in other domains. First, we look at average age at first marriage in the US. Figure 11, panel (a), shows the average age at marriage of men and women over time in the US American Community Survey. Unlike in the Israeli data, the US data shows a consistent trend. Both men's and women's age at first marriage has been rising, with women's rising slightly less

over time, and therefore falling relative to men's. This trend has been constant, though, exhibiting no apparent breaks, and certainly not one around the 1994 break in the Israeli data.

Second, we look at Israel in the past using the 1995 census, to show that there has not been a similar disruption of women's versus men's age at marriage in historical data. Figure 11, panel (b), shows that men and women's age at marriage has moved roughly in parallel since 1973. Prior to that, there were some differences, but this group is also heavily selected, as few Israelis marrying at that time had parents who were born in Israel (our sample restriction). Fourteen years prior to this earlier census, in 1981, there is no evidence of a trend break. This demonstrates that our effect is not the result of a data artifact due to retrospective analysis.

Figure 11: Placebo Tests



Notes: Panel (a): Placebo test for 1994 shift outside Israel, using the 2008 American Community Survey (restricted to individuals with a single marriage). Panel (b): Placebo test for spurious results due to retrospective analysis, using 1995 census and fictitious 1981 "policy change."

Permutation approach to significance levels We can also confirm that our effects are large relative to variation within the same data being used for the analysis. To do this, we use two types of permutation analyses on the coefficient in the standard DID (since these have only a single coefficient of interest, unlike the regressions that allow for a slope change). The results are presented in Figure A3. We first perform a permutation test that respects the potential serial correlation in the data, by implementing a standard DID specification (like in column (1) in Table 2) for only ten years of data, five years pre and five years post, with 1994 as the treatment year. We then compare this coefficient to the coefficient obtained from taking each possible sequential interval of ten years within our study period, and each corresponding false "treatment" year in the middle

of the interval.⁵⁵ In addition, we perform a more standard permutation test, where we run the baseline regression with a “post treatment” period that is randomly drawn from the entire study period (for an example of this approach, see Agarwal et al. (2014)). This approach does not respect the underlying serial correlation in the data, since the years are drawn randomly, but does account for intra-group correlation or other non-standard error structures. We perform 1,000 such random draws, and compare our true treatment coefficient to the resulting normal distributions. Both tests show that the true effect is far to the right of the counterfactual tests.

Israeli women in the US As a final robustness check, we try to find a way to compare treated women to other women who are also Jewish-Israeli. To do this, we examine women of Israeli origin living in the US. Although we see no aggregate break in US women’s age at marriage around 1994, one would expect women who were married in Israel to demonstrate the same shift in age at marriage as our main sample. For these women, we have a natural control group—those women who moved to the US before marriage, and thus were not exposed to the IVF policy change when making their decision about when to marry. If the effects we see in Israel are driven by some broader demographic shift among Israelis, rather than IVF availability, one might expect Israeli migrants to be similarly affected.

Using the 2006-2016 American Community Survey (multiple years are required, due to the restrictiveness of the sample), we examine married women who were born in Israel but now reside in the US. We divide the sample based on whether the women were married in Israel or were married once they came to the US. This contrast is shown in Figure 12. The figure shows a break in the age at marriage for the women married in Israel that mirrors the trend in our main sample. At the same time, the age at marriage for women who married in the US stays approximately constant. This pattern is somewhat remarkable: it is possible to detect the impacts of the Israeli policy change on American women, differentiated based on their place of marriage, and thus which policies they were impacted by at the time of marriage.

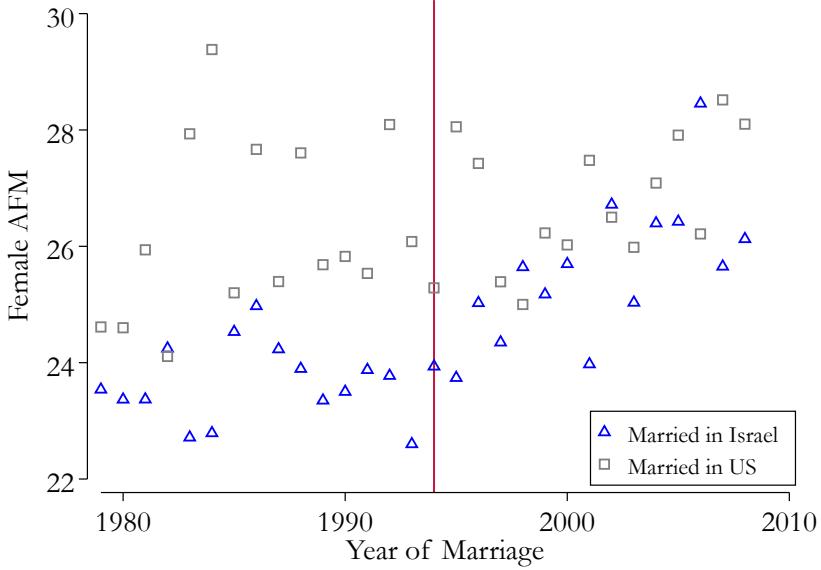
Together, these placebo and robustness checks provide further evidence that we have shown a real and statistically large impact of the 1994 policy change on Jewish-Israeli women.

4.6 Heterogeneous Effects

As discussed above, the availability of later life fertility-enhancing technology is expected to improve fertility and marriage market results for “older” women. This is expected to encourage women to postpone marriage and childbearing, allowing them to potentially invest in more demanding careers with longer investment periods or just search longer and increase the quality of their matches on the marriage market. This change may therefore impact differently women with different baseline levels

⁵⁵This test does not yield a normal distribution of coefficients, as there are a limited number of ten-year intervals in the study period.

Figure 12: Comparison of Israelis in the US: Married in Israel vs. Married in US



Notes: Data from the 2006-2016 American Community Survey, restricted to Israeli-born women who have been married.

of wealth, education, and propensity to marry and have children. We thus conduct an analysis of heterogenous effects by population group, looking at religious and cultural backgrounds that are correlated with gender norms, desired fertility rates, higher education rates, parental income and women's labor force participation, all of which could have an impact on the shift in marriage timing due to the policy change.

We also look at heterogeneity in impact by socioeconomic background, which should affect the financial implications of the government funding change for IVF. Moreover, those in the lowest socioeconomic group would be the ones that were uncovered by insurance prior to the NHI policy change, which is important to rule out as a channel of impact.

In table 5 we run the main specification (column (4) in table 2) for different groups of Jewish Israelis. In columns (1) and (2) we present a comparison of the impact for Ashkenazi and Sephardic Jews.⁵⁶ The point estimates for the Ashkenazi group are larger, both in level and in trend. The difference in trends is significant (with a P-value of 0.014), and although the difference in levels is not significant, its magnitude is substantial. On average, Ashkenazi Jews were characterized at the

⁵⁶We define a person as "Ashkenazi" if at least one of their parents is from European or American origin and none of their parents are from African or Asian origin, and the opposite for "Sephardic". Jews from Asian origin would mostly come from the middle-eastern countries and the Asian part of the former Soviet Union. Jews from African origin mainly come from Northern Africa. We exclude from this analysis people whose parents are both Israeli-born since they could potentially belong to either group of origin, and we do not have data on grandparents' origin.

time by higher age at marriage and education rates. In addition, Ashkenazi Jewish women tended to have lower fertility rates and a longer average (and median) time gap between first marriage and first birth. This may imply that a larger impact appears where traditional social norms are less restrictive for women's choices.

When we divide our sample by level of religiosity, in columns (3) and (4), we observe again that less religious, and hence less traditional, women have a stronger response to the increased availability of IVF. This aligns with our expectations regarding propensity to delay marriage in response to the policy change. Note, however, that our identification of religiosity is imprecise, as it is based on their neighborhood of residence, and thus measurement may be imperfect.⁵⁷ Perhaps because of this, the point estimates say that even in ultra-Orthodox neighborhoods there was a gradual increase in average age at marriage for women relative to men. In addition, although initially we do not expect women in this group to delay marriage, it is possible that IVF availability improved the fortunes for women who were before considered too old to be fertile enough for a large family, and this created an upward trend for women's marriage age over time.

The last two columns split the population by socioeconomic status (SES), based on the rank of the neighborhood of residence.⁵⁸ In column (5) we estimate the impact of IVF funding on the population which is neither at the top nor at the bottom of the SES rank, and show that the main impacts remain similar (and even slightly increase) for this sub-sample.

This analysis helps rule out other possible explanations for the changes we see, thus further pinpointing IVF availability as the key driver of delayed marriage and fertility. First, excluding the bottom SES individuals, who were most likely to be among the 5% of the population that were not insured prior to the health reform, helps confirm that our results are not driven by previously uninsured women accessing additional health services (other than IVF).⁵⁹ If IVF funding is not the main mechanism that drives the shifts in marriage age, but rather the more general institutional change in the provision of health insurance, these individuals should be the ones that were most affected and hence their exclusion should have decreased the magnitude of the estimated effect.

Second, excluding the top-SES individuals from the sample demonstrates that the effect is not driven by women who were likely to have been able to afford IVF (and more likely to be aware of it) before the policy change. Indeed, we find that excluding these groups does not diminish our effect, and thus neither the bottom nor top SES groups drive our results.

⁵⁷We use the Israeli Central Bureau of Statistics classification of neighborhoods as (mainly) ultra-Orthodox which is based on patterns of voting in the national elections (for ultra-Orthodox parties).

⁵⁸We use the smallest geographic unit available, "statistical area" which usually has 3-5 thousand residents. The SES rank is based on the calculations of the Israeli Central Beaurue of Statistics. The scale goes from 1 to 20.

⁵⁹The previously uninsured population consisted mostly of very poor households, immigrants, elderly individuals, and Arab-Israelis living in remote areas (See for example: the Netanyahu Commission report, "State Commission for Investigation of Functioning and Efficiency of the Health Care System in Israel," 1990; NHI law proposal, June 1993; "NHI Law: Equality, Efficiency, and Cost," report issued by Adva center, 1996.) Since the three latter groups are already excluded from our main sample, SES is the main trait that proxies pre-reform insurance status for non-Immigrant Jewish individuals.

In column (6) we present the results for the SES ranks that were excluded from the column (5) sample. Relative to the middle-SES group, both for the top and for the bottom SES,⁶⁰ the magnitude of the estimates is smaller (though still positive) and only some of the estimates are significant at conventional levels. The differences between the estimates for the middle SES group compared to high and low are not statistically significant, possibly because our identification is only by geographic area, and thus imperfect.

Table 5: Heterogeneous Treatment Effects

By:	Parent's Origin		Religiosity		Socio-Economic Status	
	Ashkenazi (1)	Sephardic (2)	Non- Ultraorthodox (3)	Ultraorthodox (4)	Mid-SES (5)	Top & Bottom SES (6)
fem × post	0.396 (0.123)*** [0.197]**	0.262 (0.065)*** [0.113]**	0.247 (0.052)*** [0.123]**	0.110 (0.087) [0.239]	0.216 (0.067)*** [0.134]	0.105 (0.087) [0.244]
fem × post × time	0.073 (0.013)*** [0.030]**	0.025 (0.008)*** [0.024]	0.046 (0.006)*** [0.020]**	0.038 (0.009)*** [0.030]	0.057 (0.007)*** [0.019]***	0.038 (0.009)*** [0.026]
YOM FEs	YES	YES	YES	YES	YES	YES
Observation	46317	81811	154625	19125	83591	42594
R-Squared	0.216	0.254	0.199	0.166	0.213	0.329

Notes: Ordinary least-squares difference-in-differences regression using micro data, including controls for religiosity and parents' origin (where the sample is not split on these characteristics). Robust standard errors clustered at the age group × year level in parentheses; robust standard errors clustered at the age group × geography level in square brackets. Columns 1 and 2 present results by parents' origin. Columns 3–4 present results by level of religiosity. Columns 5–6 report results by socioeconomic status. Column 5 is for SES rank 7–14; column 6 is for the 6 lowest and 6 highest SES ranks. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

*** p<0.01, ** p<0.05, * p<0.1

These results help support our conclusion that IVF access is responsible for the discontinuous increase in women's age at first marriage post-1994. They also help rule out other components of the NHI law as possible drivers of the effect.

5 Conclusion

Increased access to IVF offers women the security of a second-line option in case they do not naturally achieve their desired level of fertility. This extension of the reproductive time horizon for women should both increase the value of “older” brides on the marriage market as well as make women more willing to delay marriage, whether to invest in their careers or search longer for a mate.

We show a stark increase in age at first marriage for women relative to men immediately

⁶⁰We present the effects for top and bottom SES combined for conciseness, and to avoid small samples. However, running the regressions for each group separately yields very similar results.

following the policy change, and rule out that it is caused by gradual trends, using trend-break and event study analyses. Identifying this change is especially interesting given that men may also be impacted in equilibrium by women's decisions. The fact that we are able to identify a shift in women's outcomes relative to men's resulting from IVF lends credence to the idea that women's time-limited fertility represents a differential constraint on women's marriage timing compared to men's.

We analyze the composition of marriages by age to confirm that the differential increase in marriage age for women is driven both by young women delaying marriage and by older women actually getting married. These effects together lead to a decrease in the spousal age gap, which is what allows women's age at marriage to change relative to men.

We also show that women's birth timing was impacted by the policy change, demonstrating that the marriage delays were closely tied to fertility decisions.

We present a number of analyses to rule out potential alternative explanations for our findings, such as other societal shifts that may have affected women differentially around this time, or the other elements of the NHI law. We use an alternative control group of Arab women to difference out any societal shifts or policy changes that may have affected specifically women in Israel beginning in 1994. We also present placebo analyses for the United States and a fictitious historic policy change. Lastly, we use a heterogeneity analysis to show that the most impacted groups are who we expect under the theory that IVF increased the value of marrying at an older age for both women considering delaying marriage and men contemplating an older bride.

If women who marry later use the additional time to pursue additional education and potentially other career opportunities, IVF availability can have significant consequences relating to women's labor market outcomes and the gender wage gap. Indeed, in [Gershoni and Low \(2019\)](#) we show that the cohorts of women exposed to the IVF policy change went on to get more education and have higher paying and more prestigious careers.

This is of critical importance because the cost per user of free IVF with Israel's generous coverage is high, and Israel is currently considering measures to limit the policy, having already placed age limits on use, and restricted the number of cycles for certain women. When taking into account the "insurance effect" of the policy, the potential benefits to be weighed against those costs expand considerably.

One slight caution in regards to this cost-benefit calculation is that the type of benefits we describe may not be what the Israeli government had in mind when they enacted the policy. The objectives of the policy were not to increase women's ability to choose when to marry or to impact any other life choices, but were rather explicitly pro-natalist, aimed at increasing the birth rate of Israeli citizens by providing aid for infertile couples (or single women).⁶¹ Thus, policymakers should

⁶¹The policy was defended in courts and described as a part of the fundamental human right to give birth and build a biological family.

note that the behavioral response to IVF access may cause fertility effects to be attenuated, or even go in the opposite direction. If women do delay starting families, assured against the outcome of having zero children, they may nonetheless end up with a smaller overall family size, due to the late start. Moreover, since some evidence suggests individuals are *overly* optimistic about IVF's success rates, some women may delay and go on to use the technology, only to be unsuccessful conceiving.

More broadly, the substantial impact on marriage markets reported in this paper should be considered as the availability of ARTs increases worldwide. While IVF technology may allow women to extend their chances of conceiving a biological child as long as they still have viable eggs, cryopreservation technology may potentially extend this option indefinitely. Realizing this, private firms have already begun to subsidize egg-freezing for their female employees, with the clear intent to enable them to delay family formation and thus avoid (or postpone) the female-specific trade-off between labor market productivity and home production. While this can potentially benefit women, usage of fertility technologies may also have health and welfare costs. Some women who are already planning to delay childbearing may be relieved by the benefit, while others could see a constantly moving finish line for how long they are expected to delay, and feel pressured to submit themselves to intrusive medical procedures and late parenthood. Thus, it is unclear if expanded access to IVF is the *best* policy to alleviate the one-sided burden of depreciating reproductive capital. What is clear, however, is that this burden plays a crucial role in women's decisions and outcomes.

By testing what happens when the threat of later life infertility is attenuated, this research suggests time-limited fecundity as a key source of asymmetry between men and women. The constraint women face in needing to plan marriage and family timing around their fertility time horizons could be an important "wedge" between men's and women's abilities to invest in careers, helping to explain the gender wage gap and dearth of women in high-powered careers. Policies that relieve the career-family tradeoff, such as access to assisted reproduction, can blunt this effect, and thus promote equality. However, policymakers may also want to consider other options to relieve the stark career-childbearing tradeoff, such as by promoting family leave, work return, and flexible hours. All of these things may help relieve the differential constraint of women's shorter reproductive time horizon.

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Online Appendix

Older Yet Fairer: How Extended Reproductive Time Horizons Reshaped Marriage Patterns in Israel

Naomi Gershoni and Corinne Low

1 Counts of Marriages

In this section, we examine counts of marriages in different age groups over time, to provide suggestive evidence that both young women delaying marriage and older women being more eligible on the marriage market drove the aggregate changes in average age at marriage that we see. It should be noted that looking at counts retrospectively may be more problematic than looking at proportions, since the population is changing over time, and only sampled in a representative way once, in 2008. Thus, we can only glean insight by looking at different series relative to one another, and looking for non-smooth changes around the 1994 policy change. We therefore show as a reference the series of counts for men three years older than the ages for women, as this is the average age gap between spouses pre-change. If there is a common trend towards older marriages, or sampling error that evolves over time, the men's series should be affected as well. Indeed, although these series are somewhat noisy, since variation in cohort size affects the number of marriages each year, the figures show that pre trends were roughly parallel.

We first look at women on the young side of the marriage market, zeroing in on those marrying at or below the 1993 average age of 24. These are women who might have married before completing college, or not attended at all, as women start college relatively late in Israel.⁶² Given the average gap in marriage age, comparable men are those who marry at 27 and younger.⁶³ We see evidence, in Figure A1 panel (a), that the number of marriages in this group decreased relative to the pre-trend, indicating women in this group may have delayed marriage, and thus were removed from the “count.” Post 1994, men’s marriage numbers in this age group remained relatively stable, while women’s precipitously dropped.

If these women forego marriage, their partners might be affected as well, and thus we expect some “missing” men, too. However, we do not expect *all* of them to come from the less than 27 group, and hence the decrease for women should not necessarily be matched by men in this age group. This is even more pronounced because the average age gap for spouses decreases with age,

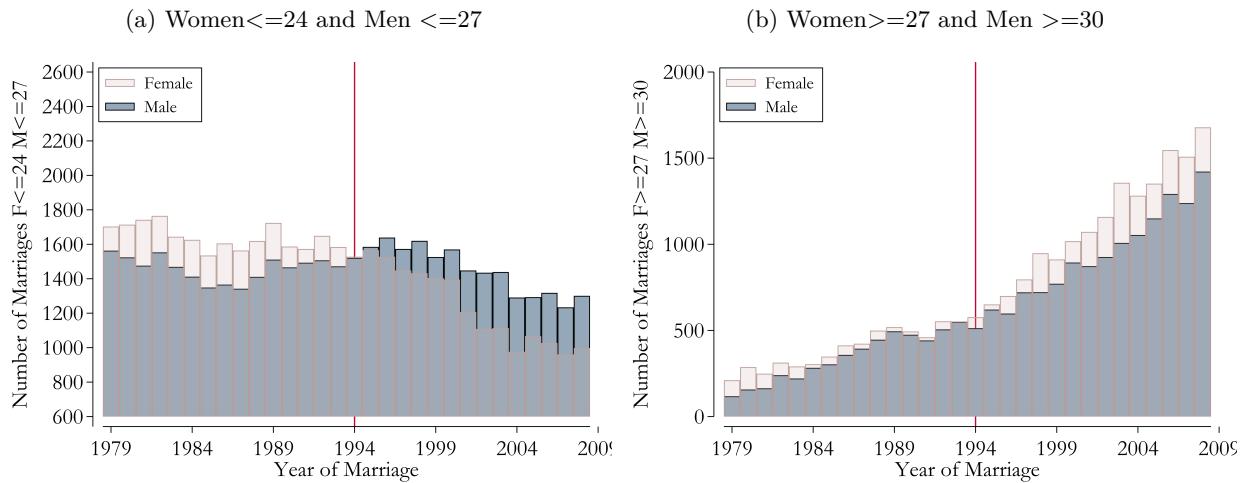
⁶²The median age for college entrants at the relevant period was 22.5 for women.

⁶³Although 24 is the average age at marriage for women and 27 is the average age at marriage for men, because there is a long tail in men’s age at first marriage that is absent for women, there are fewer men marrying below 27 than there are women marrying below 24).

so the actual age gap for women younger than 24 is more than 3 years.⁶⁴ This fact could help explain the slight decrease in men's average age at marriage exactly in 1994, shown in Figure 4. If the women who delayed had slightly *older* than average partners, and their partners had to either wait with them or re-match, this would lead to a decrease in men's average age at marriage in the initial year.

Next, in panel (b) we examine women that are older than the bulk of the marriage market, and have potentially completed college before looking for a partner, those marrying at or above age 27, and men marrying at or above age 30. For this group, the pre-trends track one another extremely closely, and almost the same number of men and women are marrying in these age groups in the ten years preceding the policy change. Post 1994, however, marriage counts appear to go up for women at a much faster rate than they do for men. This shift appears as a gradual trend, rather than an immediate increase, consistent with the idea that these older women must first search for a mate, and then marry, which cannot occur immediately at a large scale.⁶⁵

Figure A1: Number of Marriages in Different Age Groups



Notes: Figure (a) shows the number of women married at or below age 24 and men married at or below age 27, by year of marriage. We exclude the ultra-Orthodox population, most of which marry in this age group, since the large population growth they experience during this period adds irrelevant noise to these counts. Figure (b) shows the number of women married at or above age 27 and men married at or above age 30, by year of marriage. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

2 Appendix Figures and Tables

⁶⁴From Census data.

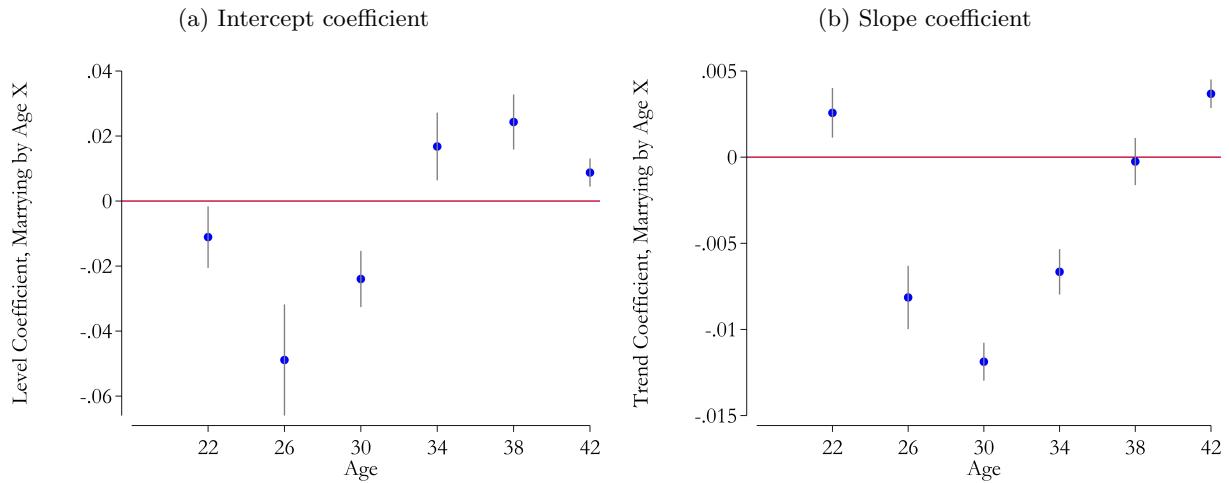
⁶⁵Men's marriages in this group are slightly lower than the overall series (although it could be noise) exactly in 1994, indicating some of these men may have been partners of younger women who chose to delay, as mentioned above.

Table A1: Beliefs of Israeli Students about IVF Success Rates, 2009

Age	Natural fertility	Success rate	Improvement
	success rate %	with IVF %	from IVF %
20-35	74.6	90.8	21.7
36-39	58.1	75.9	30.5
40-43	46.9	63.9	36.3
44-47	36.8	52.8	43.2
48-52	28.4	41.5	45.8
53-58	17.6	29.5	67.4

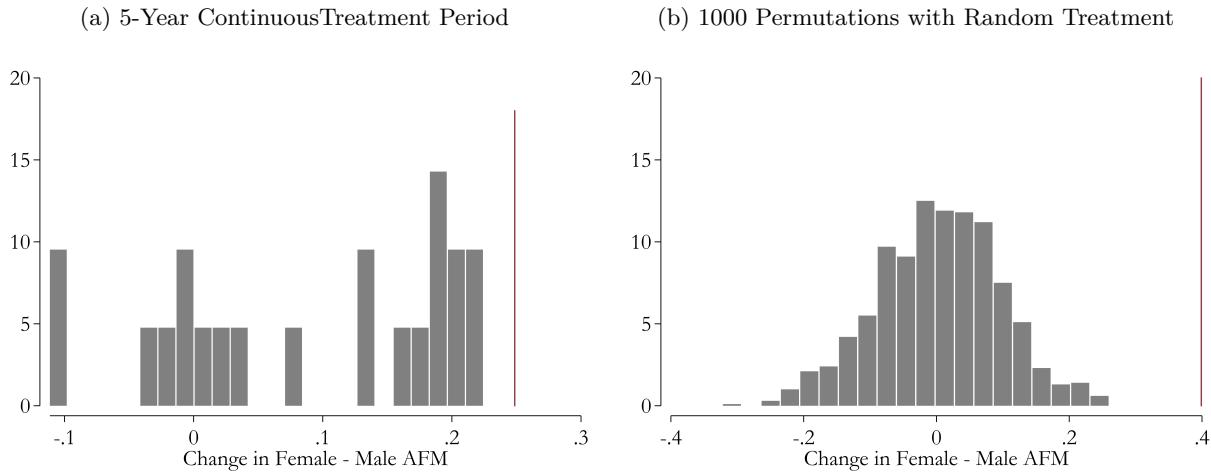
Notes: Imputed estimates from Hashiloni-Dolev, Kaplan and Shkedi-Rafid (2011) survey of Israeli male and female college students. Estimates for natural fertility success rates for given age ranges created by fitting a fifth-order polynomial to survey responses, which were for different age ranges. Total success rates computed by multiplying IVF success rates from the survey by the natural fertility failure rate, then adding to the natural fertility success rate. Percent improvement is the success attributed to IVF divided by baseline success.

Figure A2: Regression Coefficients for Effect of IVF Law on Marrying by a Given Age: Men's Ages Shifted



Notes: The figures present the point estimates and confidence intervals of the coefficients on (a) the interaction term $\text{fem} \times \text{post}$ and (b) the interaction term $\text{fem} \times \text{post} \times \text{time}$, for regressions where the outcome is a binary variable indicating whether or not the individual got married at or before a certain age, and the specification is as in column (4) in table 2. In this version of the figure, we compare women's marriage rates by X age to men's marriage rates by $X+3$, to account for the age gap in average age at marriage between men and women. Data from the 2008 Israeli population census, restricted to Israeli-born Jews.

Figure A3: Permutation Analysis of Average Age at First Marriage Effect Size



Notes: The figure on the left is created by running a similar regression as our column 1 specification, except with a ten year data period, with five years control and five years treatment, sequentially, for every possible ten year period in our data range. The red line represents the effect size of the actual treatment year, with this ten-year data period (the ten-year approach allows us to compare our actual treatment to other break points, with the same number of years before and after). The figure at right uses the same number of “treated” years as in the true model, but randomly draws them from the study period (for an example of this approach, see [Agarwal et al. \(2014\)](#)). We perform 1,000 such random draws.

Table A2: Age at First Marriage (Triple Differences)

	Dependent variable: Age First Marriage			
	DiD		Slope-Change DiD	
	(1)	(2)	(3)	(4)
jewish × fem × post	0.719 (0.131) ^{***} [0.315] ^{**}	0.720 (0.105) ^{***} [0.315] ^{**}	0.003 (0.202)	0.004 (0.153) [0.239]
jewish × fem × post × time			0.097 (0.022) ^{***} [0.044] ^{***}	0.097 (0.019) ^{***} [0.044] ^{**}
YOM FEs		YES		YES
Observation	242381	242381	242381	242381
R-Squared	0.1808	0.1809	0.1811	0.1813

Notes: Ordinary least-squares triple-differences regression using micro data (no controls included since religiosity and parents' origin controls used only apply to Jewish population). Robust standard errors clustered at the group × year level in parentheses; robust standard errors clustered at the group × geography level in square brackets. Data from the 2008 Israeli population census, restricted to Israeli-born.

*** p<0.01, ** p<0.05, * p<0.1

Figure A4: Average Age at First Birth, by Child's Year of Birth, with Arab Comparison

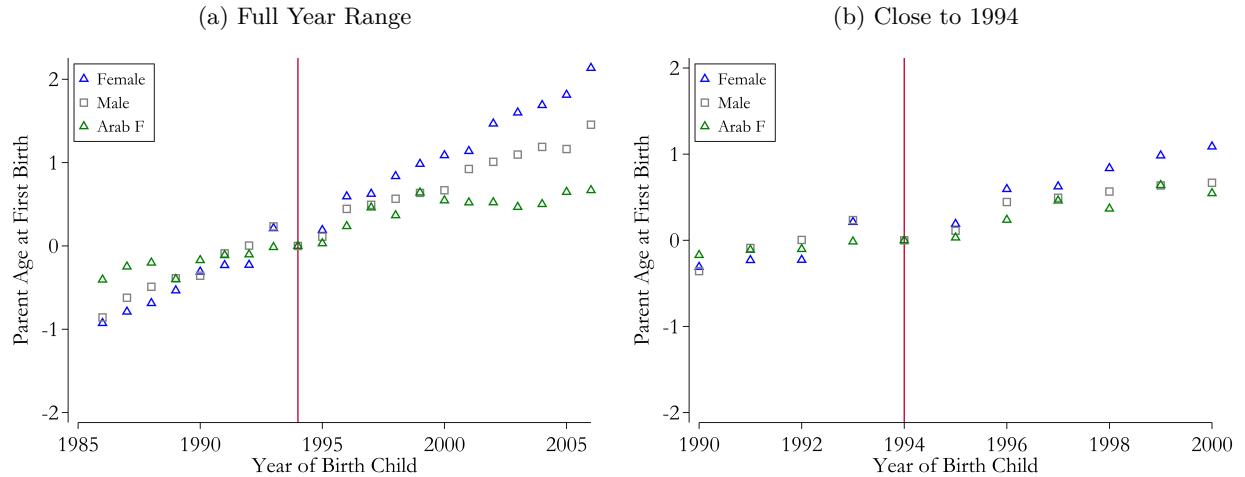
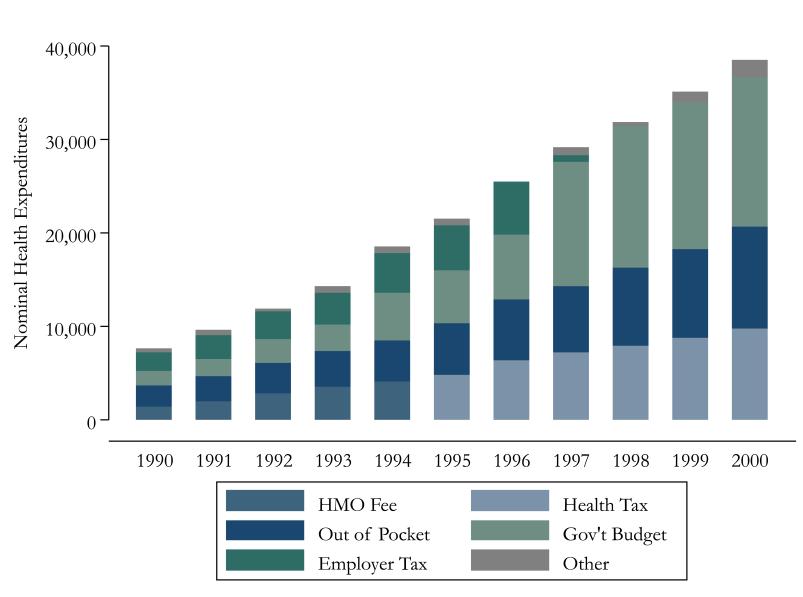


Figure A5: National Health Expenditures, by Funding Source, 1990-2000



Notes: The figure presents the nominal national expenditure on health divided by the source for the funding in the years around the 1994 NHI law, 1990-2000. Data from Israeli Central Bureau of Statistics, publication number 1316, 2008.