The Power of Time: The Impact of Free IVF on Women's Human Capital Investments

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Abstract

Women's time-limited fertility window, compared to men's longer period of fecundity, could be a key constraint shaping the gender gap in career choices and hence outcomes. Israel's 1994 policy change to make in-vitro fertilization free provides a natural experiment for how fertility time horizons impact women's investment choices. We find that following the policy change women complete more college and graduate education. We then present evidence suggesting that these larger investments contributed to better labor market outcomes, reducing the gender gap in career achievement. This implies that persistent labor market inequality may be partly rooted in biological asymmetries.

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1 Introduction

The persistence of the gender wage gap has been the subject of much exploration in the economics literature. It is now clear that a significant part of this gap is a direct consequence of women's choices, including over college major, career track, working hours, and workplace amenities. However, it is less well established whether these divergent choices result from inherent differences in women's preferences or abilities,[1] or if they are the product of differing constraints. We know that control over fertility is important to women's ability to invest in their careers from literature showing that the introduction of modern contraception increased women's education and career outcomes (Goldin and Katz, 2002; Bailey, 2006; Bailey et al., 2012). In this paper, we test the hypothesis that women's time-limited fertility window is a key constraint shaping women's career investment choices.

Women's fertility begins to sharply decline in their mid-thirties, whereas men can successfully reproduce for many years after.[2] Anticipating this decline, women may cut short career investments in order to search for a partner, marry, and have their desired number of children before the fertility window closes. *In-vitro* fertilization (IVF) is a technology that addresses women's age related infertility and can potentially extend female fecundity beyond menopause. Thus, Israel's unprecedented decision to provide IVF free of charge to all citizens provides a natural experiment on how anticipating a longer fertility time horizon may impact early life investment decisions.

In Gershoni and Low (2020), we present evidence that this policy change altered women's marital prospects and hence marriage and birth timing. The introduction of free IVF increased women's average age at marriage, both by increasing marriage probabilities for older women and by encouraging young women to delay marriage, and similarly led to a retiming of fertility across the lifecycle. Importantly, because *young* women's decisions were altered, even before they were in the position to use the technology themselves, we may expect the intervention to also impact these young women's human capital investments and career planning. This setting allows a unique empirical test of a theoretical literature suggesting that women's fertility time horizons are an important determinant of their earlier human capital investments (Low, 2019; Zhang, 2018).

Using measures of both investments and outcomes, we exploit a difference-in-differences (DID) design that compares Jewish-Israeli women's education outcomes to those of two separate comparison groups: Jewish-Israeli men, whose *own* fecundity horizons were naturally not affected by

[1] E.g., taste for competitiveness (Niederle and Vesterlund, 2007) or even distribution of intelligence (Wai et al., 2010).

[2] Women lose 97% of eggs by 40 (Kelsey and Wallace, 2010), while remaining egg quality declines (Toner, 2003). Pregnancies are rarer (Menken et al., 1986), more likely to end in miscarriage (Andersen et al., 2000), and more likely to result in fetal abnormalities (Hook et al., 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%.

access to IVF,[3] and Arab-Israeli women, who were much less likely to use IVF at the time of the policy change due to religious restrictions. This approach allows us to separate the impact of IVF from other potential changes and general time trends around the policy event. We also look at the change in the gender gaps in labor market outcomes for the Jewish population, which we expect to be affected by IVF availability, and for the Arab population, where IVF should not cause any change.

Israel added virtually unlimited IVF to a "basket" of free health services provided by the public insurance system in 1994. This policy was (and still is) unique since it provided free access to a relatively new, unknown and very expensive technology. The fact that it applied equally to all residents regardless of their income, marital status, or age, facilitated a sharp increase in IVF usage. This was in turn reflected in a discontinuous and large increase in the number of live deliveries using IVF (this number more than tripled within three years since the policy change). Consequently, Israel has clearly become a world leader in IVF availability as shown, for example, in the 2004 report issued by the International Committee for Monitoring Assisted Reproductive Technologies (ART), which attributes this fact to the "policy framework and the availability of public or third-party payment for ART cycles" in Israel (Sullivan et al., 2013).[4] Combined with extensive media coverage, this change motivated a quick, generalized and substantial shift in beliefs regarding later-life reproductive possibilities for women, to the extent that it was referred to by scholars as the Israeli "fertility revolution" (Hashiloni-Dolev, 2013).

We use the discontinuous nature of this shift to identify the impact of changing fecundity expectations on cohorts that were young enough to alter their long term career decisions. In particular, we examine college and graduate education, labor force participation, full-time work, participation in prestigious occupations, and income. We present detailed figures that compare changes over time for the treatment and the two control groups, and base our causal inference on the apparent and striking differential change for the treatment group at the effective time of the policy change. Then, to measure the magnitude of this impact we use a DID regression analysis. Because the IVF policy change was introduced several years after the mass-migration to Israel from the former Soviet Union, we limit our sample to native-born Israelis, and hence our estimates measure the differential impact on native-born Jewish Israeli women relative to the two comparison groups.

Our first comparison, to Jewish men, enables us to control for other events that may have affected both men and women's educational attainment and labor market prospects over the same

[3] The policy also impacted treatment of male infertility via access to sperm donation and to ICSI (a procedure that allows to use a single sperm-cell to fertilize an egg), this is "primary" rather than "secondary," meaning age-related, infertility, and thus does not affect time horizons. Nevertheless, men did update their beliefs about potential female partner's fecundity as we claim in Gershoni and Low (2020).

[4] This report also shows that Israel, in the first place in 2004, had almost *twice* as many treatment cycles per million population as Denmark, in second, and almost 8 times as in the US.

time period, as Jewish men come from the same cultural background, face similar military requirements, and a similar labor market as Jewish women. Nevertheless, factors that impact only women over time could potentially confound this analysis.

Our second comparison to Arab-Israeli women targets precisely this shortcoming of the first. As mentioned above, Arab-Israeli women were negligibly impacted by the new funding policy because their access to fertility technology was limited due to religious restrictions.[5] Moreover, Arab women in Israel get a relatively early start on higher education and family formation since they are not required to contribute two years of military service as Jewish-Israeli women do. They also tend to come from more traditional and religious backgrounds where marry and start families at earlier ages. Thus we expect the limited fertility horizon for women to be less restrictive for this group. Complementary to the first comparison group, this second control group allows us to address confounding factors that impact particularly *women*, especially worldwide trends towards increased female education and other policies within Israel that may differentially impact women. One example which we will explore later on, is the substantial expansion of higher education in Israel, that impacted Arab-Israeli women just as much, if not more than, Jewish-Israeli women.

Using this strategy, the main hypothesis that we test is that the *option* to use IVF in the future changed the perceived cost of career investment for young women, leading them to increase long-term investments such as college and graduate education. Moreover, having a longer horizon could push women towards career tracks that require longer on the job investment, which are typically also considered more prestigious. These augmented choices would in turn lead to increased income, and thus less gender inequality. Data from the 2008 Israeli population census merged with administrative tax data on income allows us to address this wide range of education and labor market outcomes. Importantly, our theory of impact does not rely on the affected women actually using the technology themselves. Rather, the future availability provides a form of insurance against age-related infertility. In 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 et al., 2012).

We find that women's college and graduate education completion increased substantially for the cohorts entering these educational levels at the time of the change. These results are remarkably consistent across the two comparison groups, and also when we use a continuous measure of exposure to treatment to account for the variation in college entrance age. Importantly, the rate of increase in women's graduate education is larger than the equivalent increase in college completion, supporting our hypothesis that the fertility constraint (which is expected to especially limit long investments) played an active role in these changes. Moreover, we present evidence suggesting that these investments paid off in terms of career outcomes. More specifically, we find that gaps

[5] As explained in section 3.2, there is substantial variation in the attitudes of different religions to the usage of ART (see e.g. Birenbaum-Carmeli (2003)).

in full-time employment, participation in prestigious (high-investment) occupations, and income decreased, when comparing affected and unaffected cohorts of men and women close to the policy cutoff for the Jewish population of Israel (but not for the Arab population).

To further support our suggested mechanism of impact and to rule out potential alternative explanations, we present multiple robustness and placebo checks. First, we directly address educational expansion in Israel by controlling for its rate, using data on the precise years of new academic colleges approval, also allowing this expansion to have a gender and population-group differential impact. In addition, we show that there was no similar differential increase in high school completion which is a decision less likely to be affected by fertility planning. We then use international census data to show that the findings cannot be attributed to some general global change for women, since the change in education rates for women in other, similar countries, including the United States, have been smooth over time relative to men, unlike the trend break Israel exhibits. Finally, we use the 1995 Israeli Census to perform a placebo test, demonstrating that the structural breaks we show in the data are unprecedented historically, and use a permutation analysis to demonstrate that the effects are uniquely empirically large.

Together, our findings indicate that mitigating women's concerns for age-related infertility alters women's education decisions, leading to better career outcomes. This bolsters the theory that fertility time horizons are an important factor in women's family and career decisions. More broadly, this research stresses the role of biological differences in divergence of economic outcomes, and thus the potential role of policies in blunting this effect.

The remainder of the paper proceeds as follows: Section 2 discusses prior literature; Section 3 describes the empirical setting for our project and the data we use; Section 4 presents results and tests their robustness, and Section 5 concludes.

2 Related Literature

Numerous papers document and aim to explain the evolution of the gender pay gap and its persistence over the last two decades in the US and in other developed economies.[6] A significant part of the lack of convergence between genders is attributed to human capital factors, including choices of college majors (Zafar, 2013; Bronson, 2015), entry into different professions and industries (Bertrand et al., 2010; Goldin, 2014; Buser et al., 2014), and cumulative labor force experience, driven by part time work and time out of the labor force (O'Neill and Polachek, 1993). In addition, although women's college attainment rates exceed those of men (Goldin et al., 2006), evidence on differential returns to college due to the lack of high-paying non-college job opportunities for women could imply that women's true "steady state" level of college going could be even higher if later

[6]See Blau and Kahn (2017) for evidence on the US and an extensive discussion and review on the possible sources of the phenomenon.

barriers to career were removed (Chuan, 2019).

Previous literature establishes that control over fertility for young women, namely the ability to avoid unwanted pregnancies, plays an important role in women's career choices. Goldin and Katz (2002) (and later Bailey (2006); Bailey et al. (2012); Myers (2017)) use the expansion of access to oral contraception (or abortions) to demonstrate that the ability to delay motherhood enabled women to make greater educational and labor market investments. Numerous additional studies support these findings, and use various methods to establish and quantify the tradeoff between family and career for women (Loughran and Zissimopoulos, 2009; Buckles, 2008; Blackburn et al., 1993; Taniguchi, 1999; Gustafsson, 2003; Miller, 2011; Avellar and Smock, 2003; Wilde et al., 2010). Moreover, recent work directly connects raising children to substantial wage declines for women (Adda et al., 2017; Kleven et al., 2019; Angelov et al., 2016). Lundborg et al. (2017) also shows a substantial "motherhood penalty," using quasi-random successful IVF treatments.

On the other hand, women who choose to delay fertility in favor of career investments risk not achieving their desired family size, in addition to expected difficulties on the marriage market (Low, 2019; Siow, 1998; Dessy and Djebbari, 2010; Bronson and Mazzocco, 2015). In Gershoni and Low (2020), we show that increased access to IVF enables women to postpone marriage and childbearing. These findings are in line with studies that exploit variation in mandated insurance coverage of ART (including IVF) across US states and over time to determine how more coverage affects marriage and birth timing and find impacts supporting the hypothesis that access to infertility treatments (that will primarily be helpful later in life) may influence the decisions of younger women (Ohinata, 2011; Abramowitz, 2017, 2014). The only evidence on career outcomes comes from an unpublished work by Buckles (2007), who finds suggestive evidence that infertility insurance mandates led to increased labor force participation for women under the age of 35 (but a decrease for older women), and from Kroeger and La Mattina (2017), who present evidence on changes in occupational choices towards "more professional" careers for college educated women who were younger than 35 at the time of the change.

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. Due to the gradual and moderate increase in IVF usage, it is not clear if knowledge about the change could reach the young population by observation and discontinuously shift their perceptions. Moreover, insurance status may be the result of marital and career choices. This limits the ability to study the potential impact on *young* women's educational and career choices. In addition, it is impossible to establish that the timing of mandates was exogenous and that pre-trends are parallel. More generally, there is mixed evidence on how state health insurance mandates influence the insurance and labor market equilibrium: mandates may increase insurance premiums more significantly for the most affected workers and therefore negatively affect their wages and employment (Lahey, 2012).[7]

In light of this, using a discrete policy event such as the Israeli 1994 policy is called for, despite its inherent disadvantage. Having only over-time variation creates a challenge for identification and estimation, but can facilitate an immediate change in planning horizons which is required to test our main hypothesis. Moreover, given that the coverage is publicly funded, there are no concerns that the observed changes in women's career investment are driven by a shift in employers' costs and preferences for employing women. Hence, this paper is the first to explore the impact on young women making their choice of human capital investments concurrently with the policy change.

3 Setting and Empirical Approach

3.1 IVF in Israel

In 1982, the first Israeli and the fifth ever "test tube baby" was born in Israel, placing Israel as one of the world's leaders in IVF technology. During the 1980s, research on this innovative technology highlighted the potential of IVF to address age related infertility for women, especially as the options of egg donation and egg and embryo freezing evolved. Although other ARTs existed and effectively assisted infertile couples prior to IVF, none of the alternative technologies offered such a revolutionary change for older women's fecundity prospects.

Nevertheless, in the early 1990s IVF technology was still not prevalent worldwide and involved high levels of uncertainty with regards to outcomes and impacts on mothers' and children's health. In addition, the technology was very expensive both in absolute terms and relative to other ARTs, especially for older women who require a relatively large number of treatment cycles to conceive and deliver a live baby. Although IVF treatments were covered at least to some extent by Israel's four main health plans,[8] in practice, couples often had to pay substantial fees to access services.[9] Moreover, the terms for eligibility and extent of coverage varied between health plans and, in many cases, were vague or a priori undetermined.[10] Membership in health plans was mostly based on political affiliation and parents' membership, and switching between them was difficult (especially for individuals with pre-existing conditions or of older-age).

[7] With any employer-provided insurance benefit, wages may fall to reflect the presence of the benefit to employees, and cost to employers. Lahey (2012) presents evidence on infertility mandates suggesting that in addition to these falling wages, because wage changes will not fully offset the increased premium costs for women in affected age groups, employment opportunities (and thus labor force participation) for this group decreases.

[8] The four health plans were partially subsidized by the government, but also relied on the membership fees they collected. Approximately 5% of the population, had no health insurance at all.

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

[10] The most generous coverage was offered by the largest health plan ("Clalit"), which placed almost no limitations on usage, but due to difficulty tracking treatments, rather than official policy (Birenbaum-Carmeli, 2004). The other health plans offered a limited number of treatment cycles and placed substantial age restrictions on use, in addition to requiring long qualification periods. For example in the "Leumit" health plan the number of treatment cycles was limited to six and the maximal age was 40.

In 1994, the Israeli parliament (the Knesset) decided that IVF treatments, including all associated tests and medications, will be fully covered by all health plans, for up to two children per couple. This type of coverage was unprecedented worldwide, both because it defines eligibility by treatment outcomes (as opposed to extent of treatment, e.g. limited number of treatment cycles) and because the eligibility is per couple and not per individual, namely with each new spouse the individual entitlement is reset. Also, the law grants childless single women with the same rights. Importantly, no limit was placed on the age of the IVF patient. This is in stark contrast to most Israeli HMO policies prior to 1994 and to other public funding policies around the world.[11]

This policy was enacted as part of a major reform in public health care in Israel, the National Health Insurance Law (NHI) of 1994, that received substantial attention and provoked public debates on many issues, including the usage of IVF. Generally, this reform standardized and equalized the extent of health services coverage for all Israelis and regulated the structure and budget for the public health system. More specifically, it enforced a health tax that replaced the membership fees that were paid directly to the HMOs and consequently changed the way money flowed between the government, the HMOs and the health service providers. However, it did not change the ratio between private and public health expenditures in Israel.

The new policy and the attention it received obviously increased general awareness of the innovative technology and its potential to boost older women's fecundity. Advocates of the health reform, including the minister of health, publicly touted the benefits of IVF funding in interviews as a reason to support the policy change.[12] Importantly, the passing of the law was driven by a pro-natalist agenda, rooted in the Jewish tradition of familism, rather than pro-women or "feminist" impulses which may have carried other effects.[13] 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.[14]

During this period of 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.[15] Figure 1(a) shows that 1994 saw a spike in newspaper coverage of IVF and funding issues surrounding it. This spike is similar in magnitude to the one observed for news coverage of organ transplants when this technology was first used in Israel in 1986. Figure 1(a) also shows that other

[11]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).

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

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

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

[15]For example, "World record: woman aged 60 gave birth to girl," *Yedioth Ahronoth*, February 22, 1994. In addition, local success stories were celebrated as "national accomplishments and symbols of local scientific excellence" (Birenbaum-Carmeli, 2004).

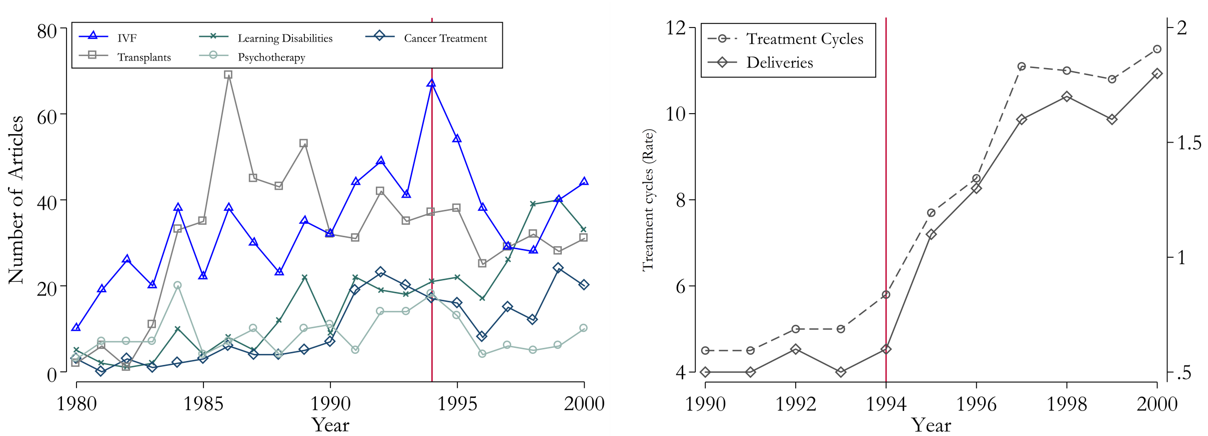
medical issues which also received some additional funding in 1994, did not raise media attention as IVF did, thus supporting the hypothesis that awareness of IVF technology and its potential substantially and discontinuously increased in 1994.

Consequently, usage of IVF technology spiked immediately and live deliveries using IVF doubled within just one year, as shown in Figure 1(b). The figure plots the number of IVF treatment cycles and the number of live births following IVF treatments relative to the population of fertile women (women aged 15-49) in the years before and after the policy change. In 2012, the Israeli parliament issued a report that described this dramatic change and attributed it to the regularization and expansion of IVF funding under the NHI law.

Figure 1: IVF Usage and Awareness

(a) IVF News Coverage

(b) IVF Usage



Notes: Figure (a) 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. Figure (b) shows the rate of IVF treatment cycles and deliveries per 1,000 women aged 15-49, based on administrative data from Israeli Ministry of Health, covering all women in Israel. Note that a variation of these figures was previously published in Gershoni and Low (2020).

In Gershoni and Low (2020) we show that the rate of women aged 41-47 who give birth increased immediately after the policy change by approximately 30%.[16]. What is unique about this impact is that it can be easily observed by the public, and has the potential to shift young women's beliefs regarding future fecundity, even without direct knowledge on IVF funding policy.

In Appendix table A1 we present evidence on the beliefs of young Israelis about natural and IVF assisted fertility at different ages. These estimates are based on a survey of undergraduate students as reported by Hashiloni-Dolev et al. (2011) and demonstrate that at the age when individuals decide on education and career tracks, they are well aware of the decline in female fecundity

[16]This increase is measured between 1993 and 1995, since pregnancies that start at 1994 are expected to end during 1994-1995 (so 1994 could be partially "treated")

with age.[17] Moreover, according to their perceptions, IVF technology allowed a substantial delay in commencing childbearing without a decrease in expected fertility, making women in their late thirties as fertile as those age 20-35. A comparison to medical data on success rates shows that respondents tended to be over optimistic about IVF success rates for older women.[18] Such perceptions have the potential to significantly alter the decisions of young women on whether or not to invest in time consuming human capital investments, especially long-term investments.

3.2 Empirical Design and Data

We aim to study how knowledge of IVF access, and thus a longer expected fertility time horizon, affected higher education attainment and career outcomes for women. We expect these impacts regardless of whether these women actually end up using the technology, as IVF, in a sense, provides insurance against age related infertility. Additional human capital investments might come at the cost of delaying marriage and childbearing, and therefore lower expected fertility. Thus, knowledge of later life IVF availability may encourage further investments before commencing childbearing. In Israel, due to a 2-3 years mandatory military service (for Jewish men and women), even early educational and career investments (such as completing college) may infringe on a woman's planned reproductive years, and potentially limit family size.[19] Therefore, we examine both college and graduate education as outcomes, in addition to full-time work, career field, and earnings.

As previously mentioned, the 1994 Israeli IVF policy applied to all Israeli citizens. This provides the advantage of quickly shifting widespread beliefs about reproductive time horizons, but the disadvantage of not providing statutory variation for identification. We thus employ a DID strategy, comparing groups which are expected to be more versus less affected by the policy, within the country. We use multiple control groups, detailed figures of the raw data, and a number of robustness and placebo checks to present a collage of evidence that the policy indeed causally impacted the outcomes we examine.

Our data comes from the 2008 Israeli population census, covering approximately 20% of Israeli households. This data is combined with administrative tax data, to accurately measure income. Our analysis is restricted to native-born Israelis, to avoid potential bias from substantial immigrant inflows over time, especially the mass migration from the former Soviet Union that was at its height

[17] The study was conducted in 2009. There is no similar study prior to 2009, so we are not able to offer direct evidence that beliefs evolved over time.

[18] For example, students believed that IVF would be 32% effective for women 40-43, whereas the true rate is around 20%, and the gaps are even larger for older ages.

[19] While in the US or in European countries women around age 24 (women's average age at first marriage in Israel at the time) would mostly be "too old" to make decisions on college going, Israel's mandatory military service requirement substantially postpones such decisions. The median age at college entry for Jewish women at the time was 22.5, as reported by the Israel Central Bureau of Statistics. Mandatory military service following high school takes between two and three years (including pre-service training or waiting periods between highschool completion and induction). It is also typical to require an additional year after military service to take entry exams and prepare applications, in addition to the fact that military service may start and end "off cycle" with the academic year, further delaying college entry.

from 1989 to 1992 (Goldner et al., 2014). Our "treated" group is Jewish-Israeli women, who are most likely to be responsive to a change in IVF access.

We use Jewish men as a comparison group to absorb changes that could have affected the overall educational market for Jewish Israelis, such as changing life expectancies, economic shifts or changes in labor demand, and demographic change. Given that men do not experience the same drop in fertility with age as women, IVF funding is unlikely to affect their expectations for age-related levels of fecundity.[20] They may, however, be affected through the choices of their female partner or by equilibrium effects, but these indirect effects are not expected to exceed the initial impact on women.

We use Arab women to absorb changes that could have affected specifically *women* in Israel, distinctly from men. One important example is an ongoing reform in Israel that increased access to higher education, especially for disadvantaged populations in peripheral areas, and hence may have impacted women differentially, if moving away from home to acquire education is more costly for women than for men, or if it helped remove cultural barriers to women's education. When it comes to IVF availability, however, Arab women are not expected to be affected similarly to Jewish women. First and foremost, they were much less likely to use IVF at the time of its introduction (Remennick, 2010). Whereas Judaism allows essentially all ART practices, Islam places significant restrictions on use (especially on surrogacy and egg and sperm donations (Birenbaum-Carmeli, 2003)). Secondly, Arab women are exempted from military service and hence begin college on average 3-4 years younger than Jewish women (Danziger and Neuman, 1999). This creates a lower concern for the impact of college education on future fertility.[21] While this strategy may have its own potential confounding factors, they should be orthogonal to any issues presented by the male control group. Thus, if we estimate similar effects using the two strategies, it is unlikely that they are both caused by a single omitted factor.

The main identifying assumption in the DID framework is that pre-trends are parallel for the treatment and control groups. Although in many places women and men were exhibiting substantially different trends as educational gaps were narrowing during the last decades, as we show below in Figure 2, for the cohorts that are considered here, native-born Jewish women had already caught up with men in levels of graduate education and exceeded men in levels of college education.[22] Therefore, when we compare these two groups, pre-trends are quite similar. Unfortunately, this is not the case for the Arab and Jewish women groups, for which levels are extremely different

[20] Similarly to how in Jayachandran and Lleras-Muney (2009), women's life expectancy was updated by declines in maternal mortality, while men's was unaffected.

[21] See for example CBS report "Arabs in Higher Education in Israel - First Year Students for First Degree in 2011/12" issued October 21st 2014. It should also be noted that the variation in the age of college applicants is much larger for the Jewish population (based on CBS data processed and presented by Mr. Aviel Kranzler, Higher Education and Science department at the CBS.)

[22] This early catch-up relative to other countries could be for multiple reasons, including men's longer period of military service or the low educational rates among ultra-Orthodox men.

and pre-trends for college exhibit some differences (with Jewish women increasing their college attainment faster than Arab women prior to 1994).

To address this limitation, we base our causal interpretation of the differential changes on the detailed figures of the raw data that we present, which shows a discontinuous change for the 1994 college cohort. Our regression analysis supplements these figures by demonstrating the magnitude of the impact and statistical significance levels. Our regression results are robust to the inclusion of group-specific time trends, and we show specification both with and without to confirm that the results are not sensitive to this choice.

Given that our data is from a single 2008 cross-section, we limit the sample to Jewish women born between 1954 and 1975 to avoid censoring.[23] We identify as treated in this case those from cohorts that were still at the relevant age for educational decisions at the time that they learned about the increased access to IVF. In our main specification, we use the median age at college or graduate school entry (based on Macro-level data) in the relevant period to determine which cohort is the first to be affected by the policy change with regards to the outcome variable. Because there are substantial differences between the treatment and control groups, the treated cohort is calculated separately for each group, based on its specific median age. The median Jewish man enters college and graduate school one year later than the median Jewish woman, and the median Arab woman enters three years earlier. We thus align the groups by college (or graduate school) cohort rather than by year of birth, meaning that we use Jewish men that where born one year earlier than our treated women as the control, and Arab women that were born three years later.

For most of the analysis the definition of treatment by cohort is binary, simply indicating whether or not an individual belonged to the cohort most relevant for college (or graduate school) going in 1994 or after. For college education, we do a secondary analysis using a continuous definition of treatment, based on the age distribution at college entry for each individuals' gender and population group pre-treatment. This distribution is calculated using the 1995 census data that indicates for each individual whether they are currently enrolled in college and for which year of studies. Then, by year of birth, we take the share of individuals that were not yet enrolled in college and could therefore alter their college enrollment decisions in 1994 (or after). Note that this is imputed based on the distribution for 1993, the last year pre-treatment and in a different sample than the one we use for our analysis (the 1995 census sample versus the 2008 census sample). The intensity of treatment naturally increases by year of birth for each group, as younger individuals were more likely to have not yet entered school, and thus be able to respond to the introduction of IVF and potentially change their human capital investments accordingly. This approach also takes into account that the variation in college age is larger for men compared to women and for

[23] 1954 is chosen as the beginning of the range to have a reasonable number of observations for Israeli-born Jews (the state of Israel was founded in 1948). The end of our data range is chosen to avoid censoring in educational outcomes among individuals who may not have completed their education by the time of the 2008 Census, thus we analyze Jewish women no younger than 33 years old.

Jewish-Israelis compared to Arab-Israelis.

In our main DID specification we estimate the following equation, separately for each of the two control groups:

$$Education_{i,c} = \beta_1 treated_i + \beta_2 treated_i \times post_c + X_i'\gamma + \delta_c + \epsilon_i$$

where $Education_{i,c}$ is an indicator for individual i from college (graduate school) cohort c completing a college (graduate) degree. $treated_i$ indicates that the individual is a Jewish-female, and $post_c$ indicates whether the cohort was young enough to enter college (graduate school) after the policy change, X_i is a vector of individual level characteristics including parents' origin and religiosity level, and δ_c is a cohort fixed effect. In addition, we include linear group-specific time trends to account for the differences in pre-trends that are present especially for the Arab-women control group. However, because in some settings adding such trends could actually bias the estimated effects, we also estimate the same specification without these time trends to show that the results are not sensitive to this choice. As mentioned above, for college, we also estimate the same equation using a continuous measure of exposure to treatment (or gradual exposure).

We cluster our standard errors at the $group \times cohort$ level. Then, to address concerns for serial correlation, we also collapse the data to group-cohort cells and run Generalized Least Squares (GLS) regressions with an explicit AR(1) error structure that allows for correlation both *across* and *within* panels, (as in Chandra et al. (2010)).[24] In addition, 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.

Because there may have been other long-term societal trends that could have divergent effects for different population groups, we perform several analyses to provide further evidence that the 1994 IVF policy change drives our results. We first show that high school graduation, which would not be affected by fertility concerns, is not affected by the 1994 IVF reform. Having already shown that Arab women were not equally affected, we then test for whether there is any possibility that a broader expansion of higher education happening over time had a differential effect for Jewish women. To do this, we run the main regressions with explicit controls for the number of colleges and number of teacher-training colleges that were open each year, allowing for a differential impact by population group. Then, to rule out that broader international trends, such as the global trend in women seeking more education, are responsible for our results, we conduct placebo analyses in several other countries, showing that no country saw a similar discontinuous increase in education for the 1994 cohort. To verify that censoring due to the retrospective nature of the data does not bias the results, we compare our main findings to a placebo analysis using the exact same techniques

[24]The within-panel correlation factor accounts for serial correlation, assuming an AR(1) process with a unique autocorrelation parameter for each panel (i.e., gender).

in the 1995 Census. All of these exercises confirm that our effect is not driven by educational trends in Israel, nor broader global trends, thus attributing the increase in education to the expected future availability of IVF.

We then look at women's career outcomes and income as dependent variables and compare them to men to examine whether these "treated" cohorts of women actually benefited in labor markets. Our main aim is to assess whether this change contributed to narrowing the gender gap. In this case, the Arab control group is not appropriate, but to show that what we capture is not just a gender differential pre-existing trend in labor markets, we compare the results for the Jewish population to a placebo analysis on the Arab population.

Table 1 shows summary statistics for our sample, comparing Jewish women to Jewish men and Arab women in the pre-period. First, it is apparent that the means for educational outcomes as well as income differ substantially between the Jewish and the Arab populations. Jewish men and women are more similar in education levels, though not in income. Although Jewish women exceed men in higher education levels even in the pre-change period, this should not be interpreted as a sign of lack of gender-divergent constraints. In the US and many developed countries, women now exceed men in college education, but still earn substantially less. Since women may experience differential returns to college education (see Section 2), it is possible that without reproductive limits, and the anticipation of these limits as a barrier to future career investment, women's "steady state" level of attending college would be even higher in the counterfactual.

In the bottom lines, the pre-trends in education are compared across the three groups. These pre-trends are relatively small for all groups. However, while for college, our treatment group exhibits a slightly stronger pre-trend, the opposite is true for graduate education. As mentioned above, we control for these differential pre-trend in our regressions. Nonetheless, in the next section, we proceed by examining how these outcomes evolve over time in more detail in figures 2.

4 The Impact of Extended Fecundity on Women's Education

4.1 Main Results

As explained above, we expect Jewish women's decisions on both college and graduate education to be affected by the change in expected fecundity, because in our high-fertility, late college-entry setting, even college-going decisions can potentially be constrained by the expected decrease in fecundity with age.

We first plot these outcomes for the treatment and two control groups, using the raw data, to examine if there was a shift in higher education attainment for the treatment group, that stands out relative to the trends of both control groups. We focus mainly on the analysis of these plots because both of the control groups that we use have limitations (as discussed above) and because

Table 1: Summary Statistics

Pre-1994 college cohorts:	Jewish women N=53,014		Jewish men N=49,657		Arab women N=20,152	
	Mean	SD	Mean	SD	Mean	SD
Ultra-Orthodox	0.06	0.23	0.06	0.24	N/A	N/A
European-born mother	0.25	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
European-born father	0.29	0.43	0.28	0.45	N/A	N/A
Asian/African-born father	0.53	0.50	0.52	0.50	N/A	N/A
Income in Shekels	98,167	92,393	186,757	173,543	53,299	49,999
Age	45.42	5.39	47.46	5.34	42.24	5.66
Age at first marriage	23.57	3.91	25.86	3.86	21.03	4.11
Highschool completion	0.9	0.30	0.84	0.37	0.44	0.5
College Degree	0.33	0.47	0.28	0.45	0.09	0.29
Graduate Degree	0.12	0.33	0.11	0.31	0.02	0.12
College Degree pre-trend (SE)	0.006	(0.0004)	0.005	(0.0004)	0.003	(0.0004)
Graduate Degree pre-trend (SE)	0.0003	(0.0005)	0.0018	(0.0005)	0.0004	(0.0003)

Notes: Data from the 2008 Israeli population census (20% sample), restricted to Israeli-born. The sample is the pre-1994 college cohorts, namely individuals below the median age at college entry for their population group (at the time). Thus, for Jewish women the sample is those born 1954 - 1970, for Jewish men 1953 - 1969 and for Arab women 1957 - 1973.

pre-trends are not always parallel. Therefore, regression result cannot be interpreted as causal without a careful inspection of the patterns in the raw data.

In the top panel (a) – (b), we show average education level by college (or graduate) cohort, which is defined according to the median age at college (or graduate school) entry for each group separately. For example, for Jewish women the median age for college just before 1994 was approximately 23, and therefore the women that are considered as the 1994 college cohort are the ones that turn 23 that year (i.e., born in 1971). Panel (a) clearly shows an increase in college attainment rates for Jewish women after the policy change, which is not matched by either control group. This is even more apparent when, in panel (c), we zoom in on the five-year periods immediately before and after the change, and de-mean the figures in order to bring the plots closer to each other. In panel (e) we plot the differences between the treatment and each control group. We use the same scale over a different range in order to overlay the two plots, since the baseline differences are not the same between the two control groups. Despite an apparently stronger differential pre-trend for the Arab control group, this figure shows a remarkably identical discontinuous change in differences for both control groups after the new policy was introduced.

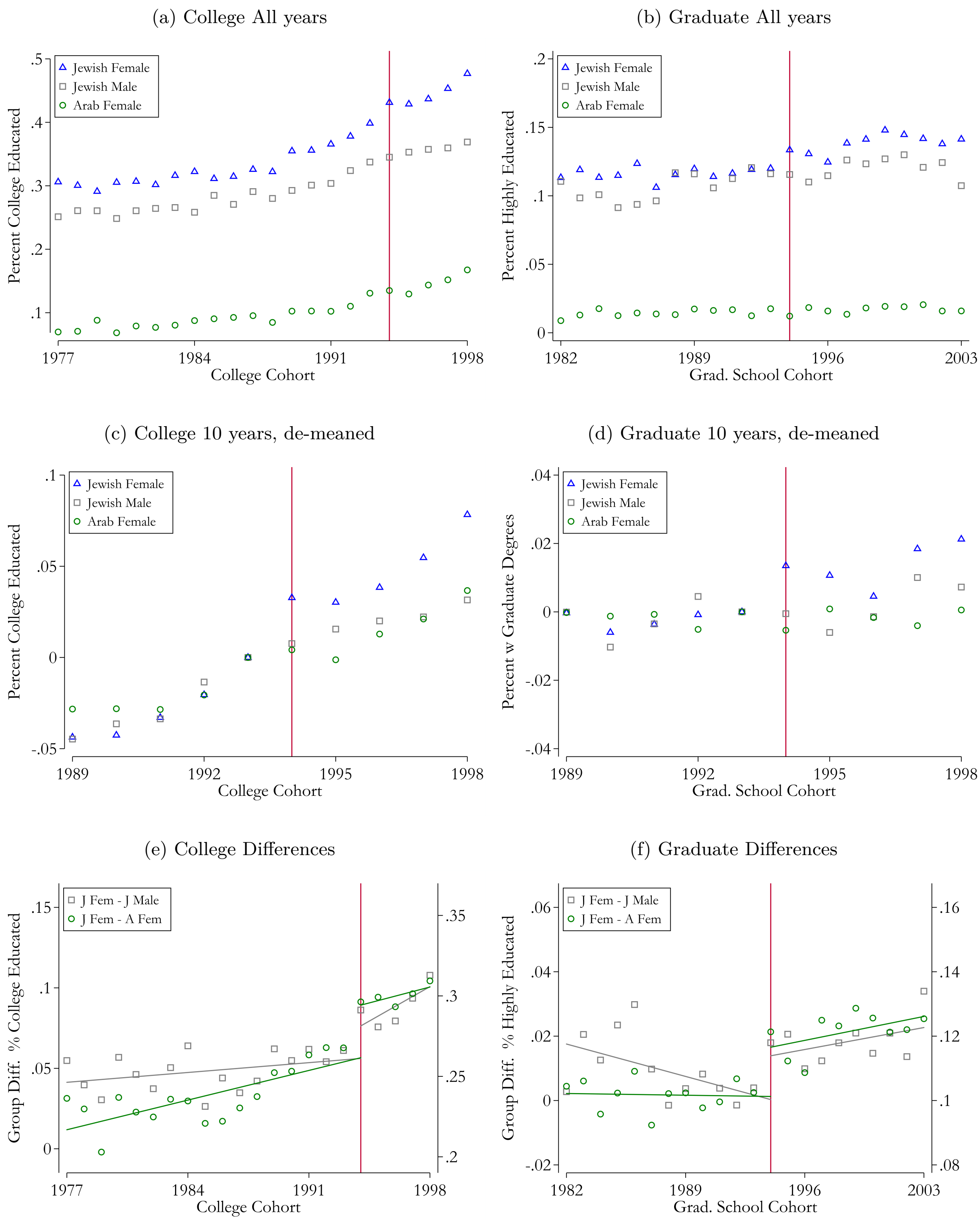
Panels (b), (d) and (f) present the same plots for graduate level education, and lead to similar conclusions. Here, again, there is a strikingly similar discontinuous increase for Jewish women relative to both control groups. The pre-trends for this outcome are much flatter for all groups, however we observe an irregularity in the trend for the graduate school cohorts of Jewish men between 1983 and 1986. These cohorts appear to have lower shares of graduate degrees relative to the general trend which could be attributed either to the events of the 1982 Lebanon war or to the period of hyper-inflation in Israel between 1980-1985.[25] Nevertheless, the increase for Jewish women in the post-period relative to the Jewish men and Arab women in the years closer to the 1994 cutoff is very clear. Panels (d) and (f) show that the magnitude of the increase is strikingly similar relative to both control groups.

An additional pattern that is seen for both outcomes, for both control groups in panels (e) and (f) is that the differences keep increasing post-treatment. This makes sense both because the way we define treatment is by the median, which means that as we look at later cohorts, there are potentially more un-decided individuals that could be affected by the treatment. In addition, since in order to be effective, the new IVF possibilities need to become widely known, it is plausible that more and more people become aware over time (perhaps through observing others successfully having children with IVF) and that therefore, the impact of the policy change keeps increasing after 1994.

Tables 2 and 3 present regression results that allow us to more precisely quantify the size of the effect, when individual characteristics are controlled for. We show the results for three different

[25]These years also stand out relative to cohorts earlier than 1982, which are not shown in the figures here. If anything, this irregularity would bias our results downwards if we ignore pre-trends in the regression analysis.

Figure 2: Higher Education Rates - Jewish Women vs. Comparison Groups



Notes: Figure (a) shows average college attainment for Jewish women, Jewish men and Arab women by college going cohort, based on the median age at college entry for each group. Figure (c) presents the same averages de-meaned (using the pre-treatment mean) for a period of 10 years around the year of change (1994). Figure (e) plots the differences in average college attainment between Jewish women and men, and between Jewish and Arab women. Figures (b), (d) and (f) present the same measures for graduate education by graduate school cohort. Data from the 2008 Israeli population census, restricted to Israeli-born.

specifications using the two alternative control groups. Columns (1) and (2) in Table 2 show that the differential impact on college graduation for Jewish women relative to either control group is 2.7 percentage points (approximately 6.75% increase relative to the 1993 level) when group specific linear time trends are accounted for. The estimated effects are slightly larger for the male control group and more than double for the Arab control group when these trends are not included in the regression. Based on Figure 2, we think that these later estimates are less reliable, especially for the Arab control group, however, we show both specifications to demonstrate that the positive impact is not driven by the choice of specification.

To account for variation in college entry age, and thus treatment status, in columns (5) – (6), we present a regression that classifies a portion of each cohort in each group as potentially exposed to treatment based on which percentage of individuals would have not yet entered college, according to data from the 1995 Census on college entry ages. These percentages are allowed to be different for each gender and population group, which accounts for the different distribution of age at college entry among these groups.[26] The results again show a significant positive impact of being in the affected cohorts for Jewish women.

Table 2: College Attainment Rates

	Binary Treatment Timing				Gradual Exposure	
	(1) Jewish Men	(2) Arab Women	(3) Jewish Men	(4) Arab Women	(5) Jewish Men	(6) Arab Women
Treated × Post	0.026***	0.027***	0.038***	0.059***		
	(0.005)	(0.006)	(0.003)	(0.005)		
Treated × Exposure					0.021*	0.086***
					(0.011)	(0.029)
Group time trend	√	√				
Cohort FEs	√	√	√	√	√	√
Observation	144889	102829	144889	102829	144889	102829

Notes: All columns present estimates based on an OLS difference-in-differences regression with cohort fixed effect, using either Jewish men (in the odd numbered columns) or Arab women (in the even numbered columns) as a control group. In columns 1—4 the cohort is defined by college-going year for the median student in the group, and in columns 5—6 by year of birth. In columns 1—4 "post" indicates that the individual belongs to a cohort which is young enough to change decisions on college education. This is determined based on the median age at college entry when the IVF policy change was announced. In columns 5—6 we use a measure for the level of exposure for each cohort, which is calculated based on the entire distribution of age at college entry for each specific group (Arab women, Jewish women, Jewish men). In columns 1,3, & 5 we also control for religiosity and parents' origin (These controls are not relevant for the Arab population). Robust standard errors clustered at the group × cohort level in parentheses. Data from the 2008 Israeli population census, restricted to Israeli-born individuals.
*** p<0.01, ** p<0.05, * p<0.1

Proceeding with our analysis to graduate education, in Table 3, we see an impact of between 1 and 1.8 percentage points, for the male and Arab control groups, respectively. This implies an

[26]The differential and gradual exposure to treatment specification captures a separate non-linear time trend for each group. For this reason, we do not include the group specific time trends in this specification. In addition, we use year of birth rather than cohort fixed effects.

increase of between 8.3 and 15 percent, relative to the 12% share of Jewish women with graduate degrees in the 1993 cohort. In the case of graduate education, due to the irregularity for men in the earlier years of the pre-period, the Arab control group may be more reliable. However, in both cases, the percentage increase in graduate education is larger than in college education. This makes sense intuitively, as fertility constraints may be more of a concern for educational investments that occur later in life.

In columns (5) and (6), we estimate the effect on graduate education conditional on completing college education. We use this last specification to understand whether graduate education has increased as a natural consequence of the increase in college education, or whether there has been an increase in graduate education over and above the mechanical impact of increasing the pool of college graduates. We already have some evidence that it is the latter, given that the timing of the effect is for the 1994 graduate cohort, who was not yet "treated" in their college-going. Nonetheless, in column (5) and (6) we see this directly, observing that there is an impact on graduate school even conditioning on college going (although the estimate is not significant for the male control group). Because we are conditioning on an endogenous variable, as college education is also impacted by the treatment, the magnitude of this effect should be interpreted with caution. Nonetheless, both the larger results for graduate education, and the further increase conditional on college education, support our main hypothesis that extended later-life fertility for women drives the observed shifts, since decisions on graduate education are made at an older age, when expected fertility plays a much more important role and portray the type of long investments that we believe to be constrained by fecundity horizons.

4.2 Robustness Checks and Alternative Explanations

In this section, we first discuss potential data and estimation issues and then conduct different tests to establish that the effects we report are most likely driven by the IVF reform rather than other events or policy reforms.

Alternative approaches to standard-errors calculations In micro-data DID studies, one may be concerned that a high degree of intra-group correlation or correlation across time periods is driving the significance of the results. We first address this issue by providing GLS estimates that are collapsed to the cohort-group level and allow for correlation within groups and across years. This strategy was explained in further detail in section 3.2 above. The results are reported in table 4, which presents estimates for college and graduate education, both with and without group specific time trends. All estimates are similar in magnitude and significant at conventional levels, except for the coefficient in column 5, for graduate education with the male control group which is of similar magnitude but not statistically significant. As mentioned above, the time series for men has several unusual values in the beginning of the pre-period, which may decrease the precision of

Table 3: Graduate Education Rates

					Conditional on College	
	(1) Jewish Men	(2) Arab Women	(3) Jewish Men	(4) Arab Women	(5) Jewish Men	(6) Arab Women
Treated × Post	0.010**	0.018***	0.006**	0.023***	0.023	0.037**
	(0.004)	(0.003)	(0.003)	(0.002)	(0.018)	(0.018)
Group time trend	√	√				
Cohort FEs	√	√	√	√	√	√
Observation	144889	102829	144889	102829	48614	30321
R-Squared	0.0456	0.0278	0.0456	0.0278	0.0159	0.0210

Notes: All columns present estimates based on an OLS difference-in-differences regression with cohort fixed effect, using either Jewish men (in the odd numbered columns) or Arab women (in the even numbered columns) as a control group. In columns 1—4 the cohort is defined by college-going year for the median student in the group, and in columns 5—6 by year of birth. In columns 1—4 "post" indicates that the individual belongs to a cohort which is young enough to change decisions on college education. This is determined based on the median age at college entry when the IVF policy change was announced. In columns 5—6 we use a measure for the level of exposure for each cohort, which is calculated based on the entire distribution of age at college entry for each specific group (Arab women, Jewish women, Jewish men). In columns 1,3, & 5 we also control for religiosity and parents' origin (These controls are not relevant for the Arab population). Robust standard errors clustered at the group × cohort level in parentheses. Data from the 2008 Israeli population census, restricted to Israeli-born individuals.
*** p<0.01, ** p<0.05, * p<0.1

our estimates, especially with this collapsed data.

As an additional check that our estimates are large relative to the variation in the data, we also perform a permutation analysis on the treatment effect coefficient for our main outcomes. The results of this analysis are presented in Figures A2. To plot these distributions of effect sizes, we randomly draw a number of years equal to our true number of treated years from the entire study period, and run our baseline regression (including group specific time trends) with these randomly selected years as the "treatment" period (for an example of this approach, see Agarwal et al. (2014)). This approach accounts for intra-group correlation and other non-standard error structures. We perform 1,000 such random draws, and compare our true treatment coefficient to the resulting distributions. Our true effect is outside of the curve or in the far right tail, with less than 5% of the values above it, for every outcome measure and for each comparison group.

Censoring or other data issues A different possibility is that the effect we observe is an artifact created by looking at outcomes retrospectively in cross-sectional data. We already minimize this concern as we carefully choose the years and cohorts which constitute the sample for each outcome, and compare the groups by college (or graduate school) cohort, which overcomes potential differential censoring across groups. However, to further verify that the retrospective nature of the analysis could not create similar breaks in the data *without* a real policy effect, we use the 1995 Israeli Population Census to conduct a placebo test. We replicate our analysis for a fake "policy change" in 1981 (14 years prior to the Census year, as the real 1994 policy change is 14 years before

Table 4: GLS Regressions for Education Outcomes

	College				Graduate			
	(1) Jewish Men	(2) Arab Women	(3) Jewish Men	(4) Arab Women	(5) Jewish Men	(6) Arab Women	(7) Jewish Men	(8) Arab Women
Treated × Post	0.025***	0.027***	0.045***	0.050***	0.009	0.017***	0.010**	0.018***
	(0.006)	(0.009)	(0.007)	(0.011)	(0.008)	(0.003)	(0.004)	(0.005)
Group time trend	√	√			√	√		
Cohort FEs	√	√	√	√	√	√	√	√
Observation	44	44	44	44	44	44	44	44

Notes: All columns present estimates based on a Generalized least squares difference-in-differences regression with data collapsed to the gender—population-group—cohort level. All specifications include cohort fixed effects, and use either Jewish men (in the odd numbered columns) or Arab women (in the even numbered columns) as a control group. In columns 1—4 the dependent variable is college attainment and cohort is defined by college-going year for the median student in the group. In columns 5—8 the dependent variable is graduate-school attainment and cohort is defined by graduate-school-going year for the median student in the group. "Post" indicates that the individual belongs to a cohort which is young enough to change decisions on college education in columns 1—4 or on graduate education in columns 5—8. This is determined based on the median age at college or graduate-school entry in 1994. 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 individuals.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

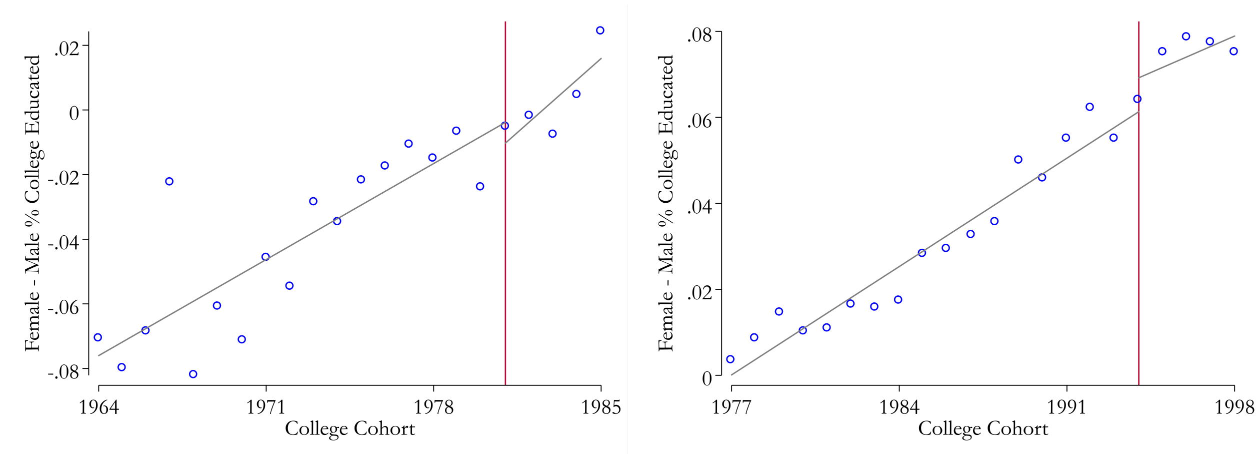
the 2008 Census) and find no evidence of a break in college or graduate education, as shown in Figure 3(a).

Global shock After establishing that the break we observe is genuine and significant, we turn to explore the possibility that we have misattributed the source of this dramatic change and explore several alternative explanations to these findings.

To verify that broader international trends during the nineties are not responsible for our effects, we conduct placebo tests in the United States as well as four other OECD countries with GDP per capita similar to Israel, and Census data availability: Greece, Spain, France, and Portugal. Results for college education in the four "comparable" countries are shown in Appendix figure A3. We also look at the United States American Community Survey in Figure 3(b). None of these placebo tests show a positive differential change for women compared to men as we see in Israel, indicating that there was no broader global shock affecting those entering college in 1994.

Other health expansions Another possible explanation to the observed changes in women's outcomes specific to Israel could be the general change in health services provided by the NHI law. Although improved health services could have some effect on education (due to an increase in life expectancy for instance) or on marital outcomes (if we believe that age serves as a proxy for spousal health in general, rather than just fertility), it seems less likely to explain the gender differential change that we identify. Moreover, only a very dramatic change in access to health services would have an impact on either life expectancy or age related health perceptions. In practice, only 5%

Figure 3: Historical and US Placebo Tests



Notes: Figure (a) shows a placebo test for a global 1994 shift by plotting the difference in college attainment between women and men in the US by college cohort (based on the median age for college entry in the US). Data from the 2008 American Community Survey. Figure (b) shows the difference in college attainment between women and men in Israel using the 1995 census with a placebo treatment timing in 1981, 14 years before the census year.

of the population had no health insurance prior to the reform. The remaining 95% were covered by one of the four HMOs, and experienced a very moderate change in coverage, except for very specific services such as IVF.[27] In addition, in Gershoni and Low (2020) we show that total health expenditures, both privately and from the government, changed smoothly around the time of the policy change.

It should also be noted that during 1994, before the reform was actually executed, many people thought that it was bound to increase the cost of health care, and decrease the quality of the services.[28] Due to the complexity of the reform, mainly aimed at changing the institutional structure of the health system in Israel, the uncertainty over the actual results of the reform continued for decades, and even nowadays these consequences are being debated.[29] Therefore, it is plausible to assume that in 1994 the reform generated some uncertainty or confusion regarding its costs and benefits, which did not have a systematic effect on young people's health expectations.

Higher-education reform To rule out a general change in education-seeking, either by the treated cohort or based on other things happening in 1994, we perform a placebo test using high school completion. Those on the margin of completing highschool are unlikely to make this choice based on older-age fertility prospects. Figure 4 demonstrates that, as expected, there is no impact

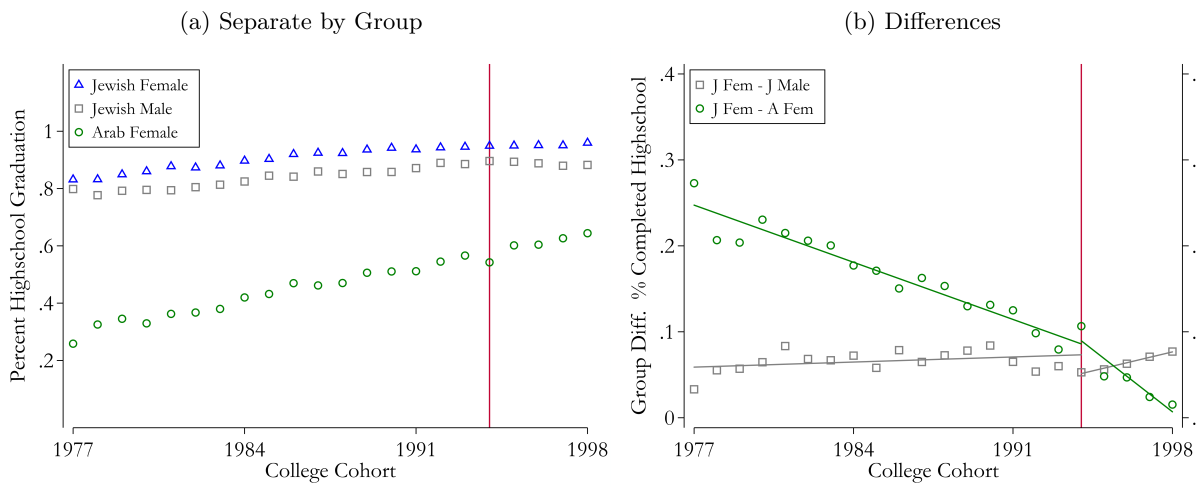
[27] Additional significant changes were made in coverage of learning disabilities treatment and psychotherapy, as well as in tests for early detection of cancer.

[28] The slogan of the anti-reform campaign was "pay more, get less", see *Yedioth Ahronoth*, December 15, 1994.

[29] See for example reports issued by the Ministry of Health: "20 Years to the NHI Law" (May 2015) "Light and Shadow in the evolvement of the NHI Law" (February 2010).

on this outcome for the 1994 college cohort.[30]

Figure 4: High-school Graduation Placebo



Notes: Figure (a) shows average highschool completion rates for Jewish women, Jewish men and Arab women by college going cohort, based on the median age at college entry for each group. Figure (b) plots the differences in average highschool completion between Jewish women and men, and between Jewish and Arab women. Data from the 2008 Israeli population census, restricted to Israeli-born.

We then consider the higher education reform in Israel, which materialized throughout the eighties and nineties, as an alternative explanation. Prior to this reform only universities could grant academic degrees. Starting in the seventies, colleges gradually began to receive permission to grant academic degrees equivalent to the ones given by universities. This process accelerated during the eighties and early nineties, culminating in an official and comprehensive plan for the development of academic colleges. In the decade between 1992 and 2002 the number of students in academic programs approximately doubled (the effect of the reform was already apparent in the early nineties, but really started to build up in 1997-1998 (Volanski, 2005; Bernstein, 2002)). It is important to note that although the changes were substantial, this reform was gradual, and thus is already partially ruled out as an alternative explanation by the discontinuous nature of the change as shown in Figure 2.

Nonetheless, to directly rule out this alternative explanation, in Table 5 we implement regressions controlling for a group-specific impact of the expanded educational access. We include controls for the number of academic colleges and teacher-training colleges by year,[31] also interacted

[30] This result is also supported by macro-level data on the number of high school students passing the matriculation exams (“Bagrut”). According to this data, while the number of students passing the test increases for both genders, the ratio of women to men remains stable for the Jewish population of Israel, while there is an increase in this ratio for the Arab population of Israel.

[31] Although the number of students varies by college, controlling for the number of students would be endogenous,

with group, to allow the additional educational access to have a differential effect for each group. Even with these additional controls for the direct impact of the educational reform, the 1994 break remains positive and significant for all outcomes, and point estimates are similar in magnitude (or even slightly larger).

Table 5: Higher Education Rates Controlling for College Expansion

	College		Graduate		Graduate|College	
	(1) Jewish Men	(2) Arab Women	(3) Jewish Men	(4) Arab Women	(5) Jewish Men	(6) Arab Women
Treated × Post	0.032***	0.046***	0.016***	0.022***	0.040**	0.047**
	(0.007)	(0.008)	(0.003)	(0.003)	(0.016)	(0.022)
Group time trend	√	√	√	√	√	√
Cohort FEs	√	√	√	√	√	√
Observation	144889	102829	144889	102829	48614	30321

Notes: All columns present estimates based on an OLS difference-in-differences regression with cohort fixed effect, using either Jewish men (in the odd numbered columns) or Arab women (in the even numbered columns) as a control group. In columns 1—2 the cohort is defined by college-going year for the median student in each group, and in columns 3—6 by graduate-school entry year for the median student in each group. "Post" indicates whether the individual belongs to a cohort which is young enough to change decisions on college education in columns 1—2, or on graduate education in columns 3—6. This is determined based on the median age at college or graduate school entry in 1994. In columns 1,3, & 5 we also control for religiosity and parents' origin (These controls are not relevant for the Arab population). Robust standard errors clustered at the group × cohort level in parentheses. Data from the 2008 Israeli population census, restricted to Israeli-born individuals.
*** p<0.01, ** p<0.05, * p<0.1

In addition, given its aims and target population, it is highly unlikely that our main results stem from this reform. At the time of the education reform, women already constituted more than 50% of undergraduate students. The main purpose of the reform was to make higher education institutions more accessible to a lower socioeconomic status population, mostly concentrated in peripheral regions (Volanski, 2005; Shavit et al., 2007), and increase higher education supply to match the rapidly increasing demand.[32] Numerous studies were conducted to document the reform's consequences, none of which report a distinctive effect on women's participation in higher education (see for example Volanski (2005)). In fact, the percentage of female students in colleges (the previously "non-academic" institutions) was actually lower than in universities.[33] On the other hand, based on these studies, Arab-Israelis were much more likely than Jewish-Israelis to be affected by the higher-education reform, because they have relatively low high-school achievements and are more concentrated in peripheral areas (Volanski, 2005). Thus, the increase we observe for Jewish women relative to both Jewish men and especially relative to Arab women cannot be plausibly

and thus the number of institutions provides a better measure of the exogenous change.

[32]The demand increase stems from the growing rate of high-school graduates that received certificates in matriculation exams (which are needed when applying for college) (Shavit et al., 2007).

[33]The only exception is teacher's training colleges, where there is a vast majority of female students, however the academization process for those colleges took place in the early eighties. In addition, the students in these institutions constitute only a small share of the number of college students overall.

attributed to the impact of the higher education reform.

Finally, Similar reforms in other countries were not found to affect women differently than men. One example is the higher education reform in Spain, which was enacted at approximately the same years as in Israel, and did not change the trend of women's education or of women's marriage decisions (Mora, 1996).[34]

5 Gender Gap in Labor Market Outcomes

Our results show that the cohorts of Jewish women that experienced a change in the fertility "deadline" due to the introduction of IVF invested the extra time in higher-education, yielding both college and graduate degrees. In this section we present evidence that this additional investment in human capital translated into improved labor market outcomes, and played a role in narrowing the gender gap for the Jewish population of Israel, but not for the Arab population, where women were less likely affected by the new technology. If the educational effects of the policy translated into better career outcomes (rather than women achieving high-powered education, but then dropping out of professional occupations, as in Bertrand et al. (2010)) it would suggest that differential fertility time horizons can meaningfully contribute to disparities in labor market outcomes.

As opposed to contraception methods (or abortions) whose availability impacts very early decisions and constraints for women and thus may determine whether a woman works at all, the availability of fecundity extending technology would alleviates constraints for women who consider longer or more demanding career investments. Therefore, it is less likely to impact the decision *to* work, but it should allow women that already aim to work to prolong career investments and make more ambitious choices rather than settle for lower level or part time jobs.

Table 6 presents DID estimates that measure the gender differential impact on several labor market outcomes for cohorts that were affected by the policy change. The top panel presents the change in the gender gap for the Jewish population and the bottom panel shows the same for the Arab population, where we do not expect to see an impact, as a placebo test. It should be noted that although the Arab population is much more traditional on average, this population also experienced improvements for women versus men in education and employment for the relevant cohorts. Therefore, this placebo test can refute concerns that the effects shown for the Jewish population are driven by these more general trends for women versus men.

Because we use outcomes that were reported at the year of the census (2008), we restrict this analysis to a ten-cohort interval for each of the populations to minimize variation by age. We align these cohorts (as before) by the college going cohort, which we regard as the treatment timing. For Jewish women, the sample includes women that were born between 1964 and 1973, meaning that

[34] The lack of a differential shift for women in Spain is also demonstrated by our placebo analysis in Appendix figure A3.

the youngest woman is 35 years old in 2008 (the time when the outcomes are measured) and the oldest is 44. Jewish men are one year older, Arab women are 3 years younger and Arab men are 2 years younger.

As expected, in the top panel of the table, in columns (1) – (2), we do not see an impact on labor force participation or on employment for Jewish women. This provides a useful falsification test that we are not picking up broader changes in gender outcomes over time. However, the share of women who are employed full-time (35 hours a week or more), shown in column (3), increased by 2.5 percentage points (an almost 5% increase relative to a baseline of 55% pre-change), and this increase is highly significant.

Additionally, the share of women who are employed in prestigious occupations (column 4), occupations that either require an academic degree (except school-teachers) or include managerial duties,[35] increases by 1.6 percentage points which closes almost one quarter of the 7 percentage points gap pre-change. Some examples of such occupations are engineers, lawyers, executives, university lecturers and professors, managers, and government officials. Last, in column (5) we show that employed women's income, measured by tax data, also increases substantially by 6%.

One may worry that these estimates are picking up differential time trends in women's versus men's career outcomes over time, i.e., gender equity progress. We already account for this by the inclusion of gender-specific time trends, which account for linear progress over time. Nonetheless, we can also use the Arab population as a placebo group, to see if there is a more general trend toward gender equity in Israel. Using the same outcomes and specifications for the Arab population, point estimates show very small, inconsistent and insignificant changes for women, except for a substantial decrease in women's income.[36] These results help establish that labor market outcomes improved specifically for Jewish women, who were also the ones most impacted by the IVF reform.

This improvement in labor market outcomes, showing an increase in full-time employment, employment in prestigious occupations, as well as increased earnings, demonstrates that the increase in human capital investments shown for the 1994 college cohort was directly linked to other later-life career investments and thus improved outcomes. By relaxing the gender-specific fertility time constraint, free IVF in Israel may have allowed women to delay marriage and childbearing in order to pursue more high powered careers.

[35]The latter are classified by the Israeli CBS as "managerial occupations".

[36]Because participation and employment rates for Arab women are extremely low (even nowadays) and many of this population work in the informal sector (and hence their income does not show in our data which is based on tax records), this result could be just noise. Note that the other outcomes in Table 6 are based on the census survey data, and are hence less likely to be biased by this informal work.

Table 6: Gender-Gaps in Labor Market Outcomes

	(1) In Labor Force	(2) Employed	(3) Employed Full-Time	(4) Prestigious Occupation	(5) ln(Income) | Employed
Jewish Population -					
Treated × Post	-0.004	-0.003	0.025***	0.016**	0.061**
	(0.006)	(0.005)	(0.008)	(0.007)	(0.023)
Observation	72,272	72,272	72,272	72,272	62,135
Arab Population -					
Treated × Post	-0.001	0.004	0.009	-0.007	-0.114***
	(0.010)	(0.010)	(0.011)	(0.012)	(0.034)
Observation	27,255	27,255	27,255	27,255	13,520
Group time trend	√	√	√	√	√
Cohort FEs	√	√	√	√	√

Notes: All columns present estimates based on an OLS difference-in-differences regression with cohort fixed effect. In the top panel, the sample includes Jewish individuals and in the bottom panel Arab individuals. In all columns and panels women are compared to men, and "post" indicates that the individual belongs to a cohort which is young enough to change decisions on college education (which is determined based on the median age at college entry in 1994). The outcome variables are specified above each column. In the top panel we control for religiosity and parents' origin (these controls are not relevant for the Arab population). Robust standard errors clustered at the group × cohort level in parentheses. Data from the 2008 Israeli population census, restricted to Israeli-born individuals.

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

6 Conclusion

Increased access to *in vitro* fertilization offers women the security of a second-line option in case they do not naturally achieve their desired level of fertility. Like any insurance, this guaranteed access to IVF may influence individual behavior: women may be more willing to incur delays to marriage and childbearing in order to make human capital investments that yield future earnings. We show that when Israel made IVF free, the cohort entering college the year of the policy change was substantially more likely to complete college degrees, receive graduate education, and go on to higher paying, more prestigious occupations.

We use the empirical strategy of comparing Jewish-Israeli women's outcome before and after the policy change to those of both Jewish-Israeli men and Arab-Israeli women. Men's reproductive time horizons were not directly affected by the policy change, and Arab-Israeli women were much less likely to use IVF. Defining the treated cohort as those young enough to be entering college (or graduate school) at the time of the change, we find a 6.75% increase in college completion, an 8-15% increase in graduate education, and a 6% increase in income conditional on employment. Our analysis is robust to including group specific time trends, using a GLS model to explicitly account for serial correlation, and a permutation approach to standard errors. Moreover, we use several placebo tests including the US, the previous Israeli census, and other OECD countries to help verify the source of impact.

Our findings demonstrate that the beneficiary population extends far beyond the women who actually use IVF or other assisted reproduction technologies. Rather, because the guaranteed access acts as insurance in case natural conception fails, all women considering further educational investments or delayed marriage may benefit. This is relevant because the cost per user of free IVF with Israel's generous coverage is quite large, 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. The potential benefits on younger women from the "insurance" effect are not something policymakers have typically considered when weighing IVF funding.

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. When better insured against later life infertility, women invest in more education and have better career outcomes. In the absence of such insurance, this female-specific sharp decline in fertility may contribute to lower human capital investments by women during their reproductive years, and consequently the gender wage gap. In Israel, changing fertility horizons appears to substantially impact college and graduate education, both because women start families quite young and have relatively high desired fertility rates, and because obligatory military service already delays any decision women make by at least two years. In other OECD countries, however, this investment tradeoff may take place after women have completed their education, when further on-the-job investments are required in order to climb the corporate ladder: late nights at the law firm, medical residencies, or the tenure sprint. Thus, depreciating reproductive capital may help to explain the lack of women in higher-level management positions as well as the high-skill gender wage gap. A wide range of policies, such as increased support for child-rearing in two-career households and access to maternity leave and career re-entry, in addition to access to assisted reproduction technologies, could help alleviate this tradeoff.

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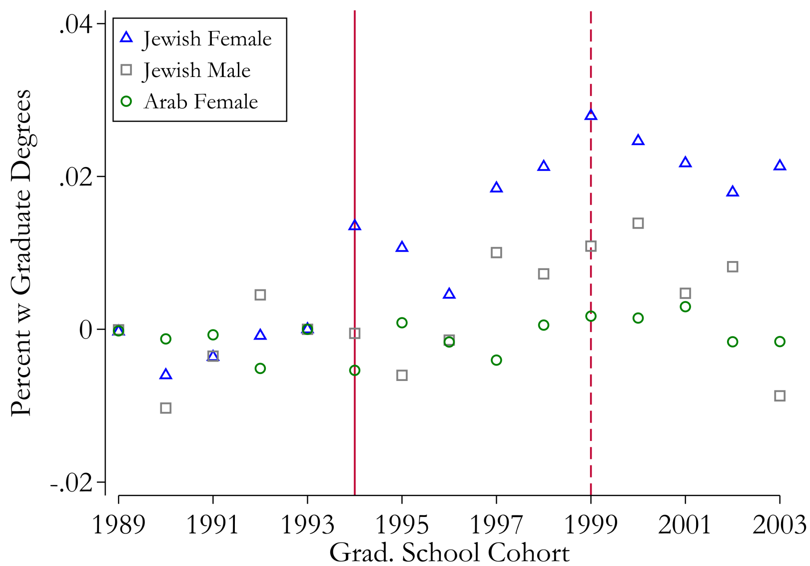
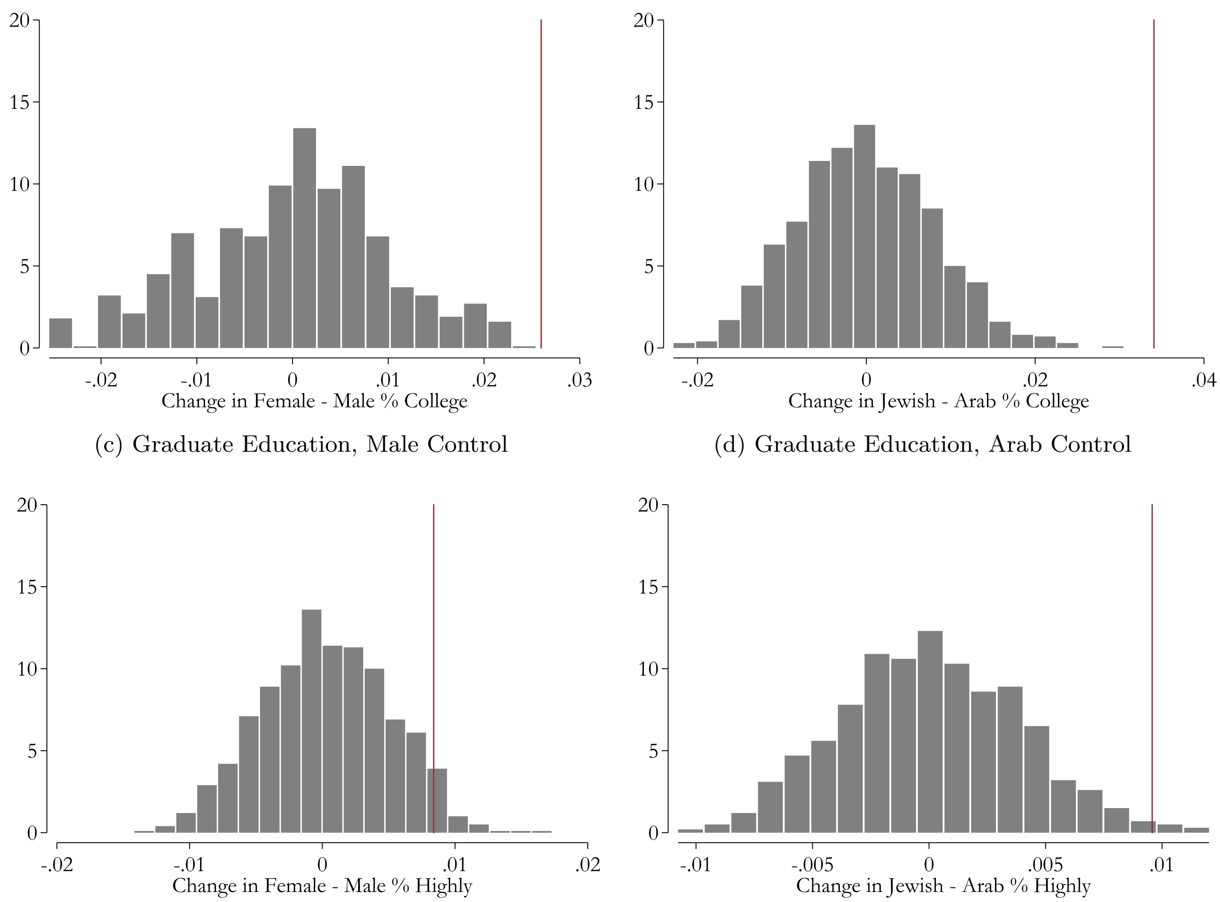
7 Appendix

Figure A1: Graduate Education including Treated College Cohorts



Notes: The figure shows average rates of graduate education for Jewish women, Jewish men and Arab women by graduate-school cohort, based on the median age at graduate-school entry for each group. The solid vertical line indicates the timing of the policy change for cohorts that make decisions on graduate education. The dashed vertical line indicates the timing of the policy change for cohorts that were young enough to change decisions both for college and for graduate education.

Figure A2: Permutation Approach to Significance Levels



(a) College Education, Male Control

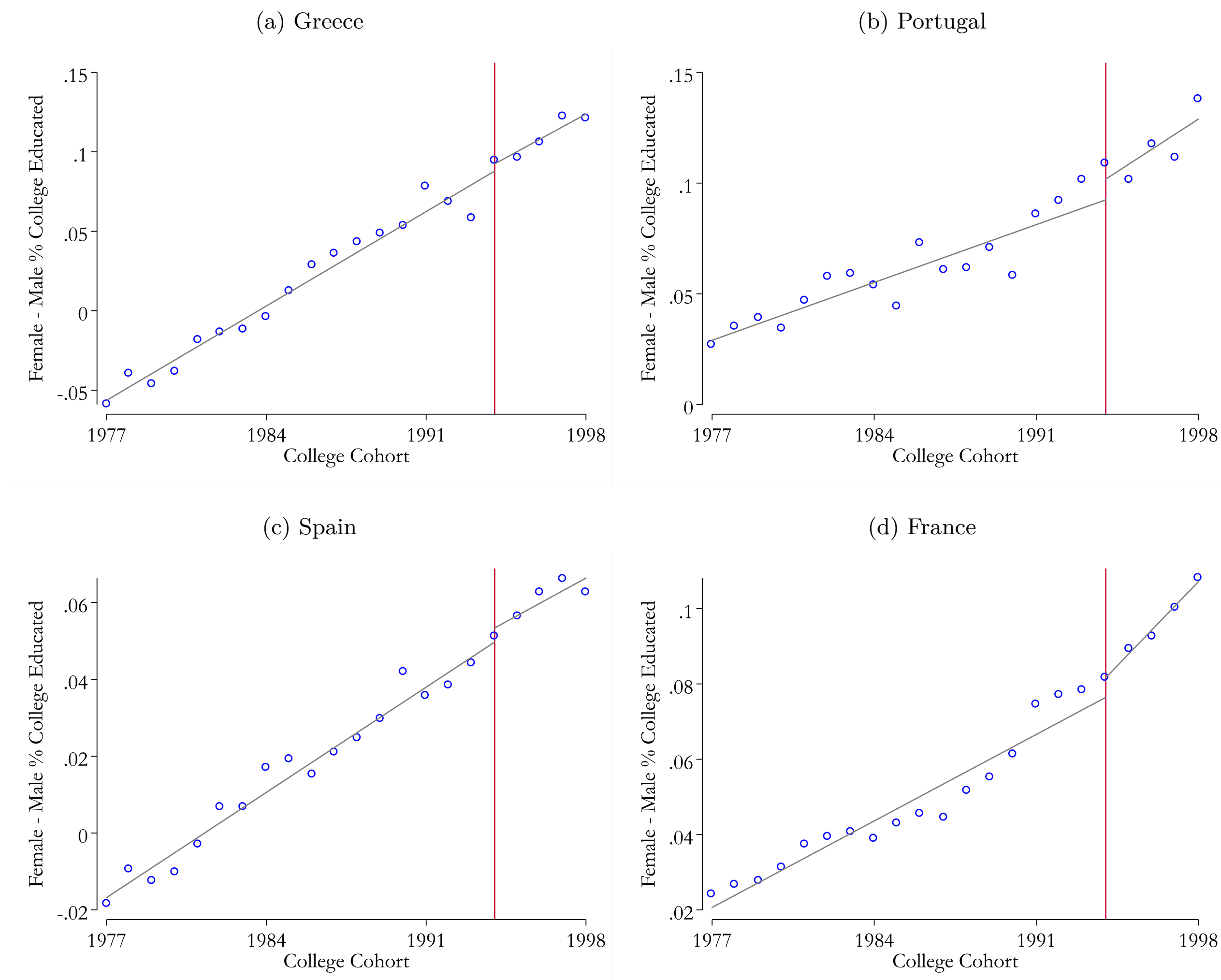
(b) College Education, Arab Control

(c) Graduate Education, Male Control

(d) Graduate Education, Arab Control

Notes: The figures plot the distribution of estimated effect sizes for college or graduate education from a regression as in the main specification using the same number of "treated" years as in the true model, but randomly drawing them from the study period (for an example of this approach, see Agarwal et al. (2014)). We perform 1,000 such random draws. The red line marks the effect size of the actual treatment year. The figure on the left hand side performs this analysis using Jewish men as control whereas the figure on the right hand side uses the Arab women control group.

Figure A3: International Placebo Tests



Notes: The figure presents placebo tests for a global 1994 shift by plotting the difference in college attainment between women and men in four different countries — Greece, Portugal, Spain and France — by college cohort (based on the median age for college entry in each country). Data from .....

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

Woman's age	Natural fertility success rate %	Success rate with IVF %	Improvement 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 et al. (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 rate with IVF relative to baseline success.