Assisted Reproductive Technology and Women's Marriage and Birth Timing: Duration and Competing Risks Analyses

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Abstract:
This paper exploits variation in the mandated insurance coverage of assisted reproductive technology (ART) across U.S. states and over time to examine the connection between the price of ART and women's timing of marriage and childbearing. Since the percentage of women facing infertility increases greatly with age, by making it affordable for women to delay family formation and then use ART to start families later if they face infertility, greater affordability of ART could induce women to delay marriage and childbearing. To formally identify channels through which greater affordability of ART might impact women's decisions about timing of family, the paper develops a theoretical model of the price of ART and women's allocation of time on work and family investment when young and old. The implications of the model suggest that there is a tradeoff between pursuing a family when young, by giving up a steeper wage trajectory, and pursuing a family when older, which is less likely to be realized and may require the use of ART at a price. A fall in the price of ART induces more women along the wage trajectory distribution to use ART and switch from pursuing family when younger to pursuing family when older. To test the implications of the model, duration and competing risks analyses are estimated that show the effects of the ART insurance mandates on women's timing of first marriage and first birth using the 1968-2009 Panel Study of Income Dynamics. The findings suggest that the mandates are associated with delayed marriage and childbearing at younger ages and accelerated first marriage and childbearing after age 30, but only for college graduate women, consistent with the theoretical framework's prediction that women with steeper wage trajectories should be more influenced by the mandates to delay family formation. For the full sample of women, the mandates appear to be associated with accelerated first marriage and childbearing after age 30, but not with delay at younger ages.

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Introduction

This paper uses variation in the mandated insurance coverage of assisted reproductive technology (ART) to examine whether the price of ART is associated with changes in women's marriage and birth timing. The past several decades have seen far-reaching changes in the lives of women. Women have married and started families later or have forgone marriage and motherhood altogether. The number of women in college and professional schools has greatly increased as has the number of women pursuing careers. Over the same period, significant developments in conceptive and contraceptive technologies have provided women more control over their fertility. Several papers have addressed the question of whether contraceptive technology has influenced women's choices beyond the scope of their fertility. This paper examines the connection between the affordability of the conceptive technologies of ART and women's timing of marriage and childbearing.

Goldin and Katz (2002) and Bailey (2006) examine whether the availability of the contraceptive technology of the birth control pill impacted women's life choices both within and beyond the scope of fertility. Goldin and Katz (2002) show that greater access to the pill was associated with being less likely to marry before age 23, more likely to be employed in professional occupations, more likely to never marry, and less likely to be divorced. Bailey (2006) associates early legal access to the pill with a reduced likelihood of a first birth before age 22, an increased number of women in the paid labor force, and an increase in their number of annual hours worked. These papers suggest that the availability of a fertility technology can impact women's choices, not just about their childbearing, but their marriage, education, and other life decisions as well.

While the above papers examined the effects of the diffusion of a contraceptive technology, this paper builds on this literature by investigating the effects of a development in the technology of conception: ART. ART consists of medical technologies that help women and couples with fertility problems conceive a child using such methods as in-vitro fertilization (IVF). This paper investigates whether greater affordability of ART has affected women's decisions about when to start families by examining effects on their timing of marriage and childbearing. Since the percentage of women facing infertility increases greatly with age, by making it affordable for women to delay family formation and then use ART to start families later if they face infertility, greater affordability of ART could induce women to delay marriage and childbearing.

To formally identify channels through which the price of ART might impact women's decisions about timing of starting a family, the paper develops a theoretical framework. The framework models the effect of greater affordability of ART on women's allocation of time on work and family investment when young and old to derive implications for effects on women's marriage and birth timing. The implications of the model suggest that there is a tradeoff between pursuing a family when young, by giving up a steeper wage trajectory, and pursuing a family when older, which is less likely to be realized and may require the use of ART at a price. A fall in the price of ART induces more women along the wage trajectory distribution to use ART and shift from pursuing family when younger to pursuing family when older.

The paper proceeds by testing the implications of the theoretical framework to investigate whether greater affordability of ART has affected women's timing of marriage and childbearing. However, identifying whether advances in the availability and affordability of reproductive technology have in fact affected women's life choices is not straightforward. Over the same period when these technologies became available, women achieved greater educational and career opportunities, and it is these developments that have in turn increased the demand for delayed childbearing and driven developments in the field of reproductive technology. Since the advances in women's education, career, and reproductive technology were co-determined, an analysis must be careful to identify the effects of each of these forces separately. In their analysis of the effects of availability of the birth control pill, Goldin and Katz (2002) and Bailey (2006) exploited cross-state variation in the age of majority and hence legal access to the birth control pill. To identify the effects of greater affordability of ART separately from other forces affecting women's marriage and birth timing decisions, this paper exploits plausibly exogenous state variation in the mandated insurance coverage of ART.

Beginning in 1977 and continuing through 2001, 15 states mandated insurance coverage for ART in some form which facilitated the use of ART by many women for whom it would have otherwise been too costly. The systematic variation in insurance coverage of ART by state and over time provides a strategy for identifying effects of a fall in the price of these technologies. It appears that the mandates have indeed been effectual in promoting the use of ART: several papers find effects of the ART insurance mandates on the use of infertility treatment (Jain, Harlow, and Hornstein, 2002; Bitler and Schmidt, 2006; Bundorf, Henne, and Baker, 2007; Bitler and Schmidt, 2012) and others find effects of the mandates on birth outcomes (Buckles, 2005; Bundorf, Henne, and Baker (2007); Schmidt, 2007; Bitler, 2008; Ohinata, 2011; Buckles, 2012; Hamilton and McManus, 2012). Given that the mandates appear to be effective in making ART accessible for many women, this paper uses the variation in the mandated insurance coverage of ART to examine whether greater affordability of ART is associated with changes in women's timing of family.

While the aforementioned papers examine the effects of the ART insurance mandates on the use of infertility treatment and birth outcomes, few papers examine whether greater affordability of ART has had impacts beyond only the users of ART and the scope of fertility. This paper adds to the literature by considering the effects of the mandates on all women through their expectations about their future fertility options regardless of whether they will ever actually use ART and examines whether advancements in ART are associated with changes in women's timing of family including marriage and childbearing.

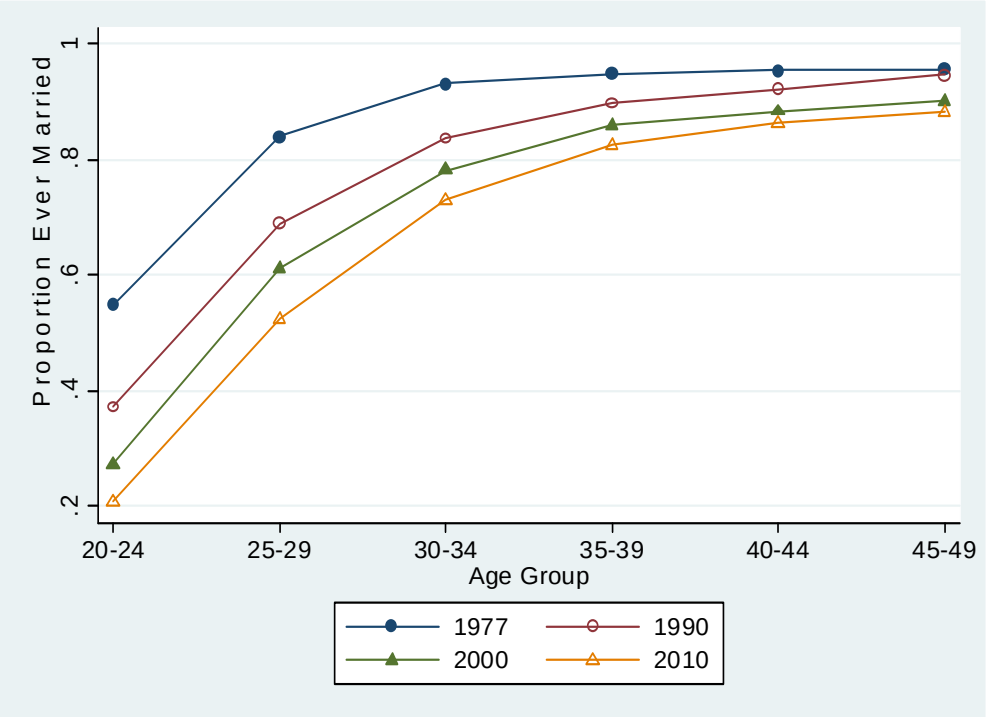
To investigate whether greater affordability of ART is associated with changes in women's timing of first marriage and first birth, the paper uses the 1968-2009 Panel Study of Income Dynamics (PSID) to perform duration and competing risks analyses. The findings suggest that the mandates are associated with delayed marriage and childbearing at younger ages and accelerated first marriage and childbearing after age 30, but only for college graduate women, consistent with the theoretical framework's prediction that women with steeper wage trajectories should be more influenced by the mandates to delay family formation. For the full sample of women, the mandates appear to be associated with accelerated first marriage and childbearing after age 30, but not with delay at younger ages.

The rest of the paper is organized as follows. The next sections provide background on changes in women's timing of family as well as a review of infertility, ART, and the insurance mandates. The section that follows discusses whether the ART insurance mandates have affected utilization of ART and reviews the literature investigating the effects of the mandates. The next section develops a theoretical framework for understanding how ART might affect women's marriage and birth timing decisions. The following sections outline the empirical specifications, present the data used in the analysis, and show results of the analysis. The last section concludes.

Changes in Timing of Family

Over the past several decades, there have been considerable changes in women's propensity to marry and start families and in their timing of marriage and family. As shown in Figure 1, over 1977 to 2010, at all ages, the proportion of women ever married has decreased. While the likelihood of ever having married by older ages has decreased, the likelihood of ever having married at younger ages has fallen dramatically: in 1977, over 50 percent of women ages 20-24 had married, but by 2010, the proportion fell to little more than 20 percent. There has been extensive discussion in the economics and social sciences literature about the drivers and consequences of this change in marriage behavior.

Figure 1: Proportion Women Ever Married by Age Group (1977, 1990, 2000, 2010)



From an economic perspective, understanding individuals' decisions about whether and when to marry is valuable since marriage can affect their work, family, and other life decisions and because it is useful to think of the marriage market itself as analogous to the labor market. Becker's framework (1973, 1974, 1981) suggests that decisions about marriage should respond to changes in the costs and benefits of marriage. This paper will examine whether changes in the

affordability of ART have affected women's timing of marriage and childbearing. However, over the same period that ART became more available, changes in many other factors have been found to contribute to changes in women's timing of family as well.

One of the most important changes in the lives of women has been significantly expanded opportunities in the labor market. Goldin (2006) identifies increased opportunities in the workplace and education as well as developments in household production technology as key factors in women's changing economic roles over the last century and associates women's greater labor market opportunities and a later age at first marriage for women pursuing higher education beginning in the 1970s. Blau, Kahn, and Waldfogel (2000) also find that women's decisions to marry were responsive to their own labor market opportunities as well as men's. Using 1970, 1980, and 1990 Census data they find that women delay marriage when their own opportunities in the labor market improve or when men's opportunities in the labor market worsen. This suggests that greater labor market opportunities are increasingly driving women's decisions about family timing.

In addition to changes in the economic roles of women, changes in general economic conditions have been found to contribute to women's marital delay as well. Wage inequality has increased greatly over recent decades, and if women search longer for a spouse when there is higher male wage inequality, this could be an important factor contributing to delayed marriage. Loughran (2002) and Gould and Paserman (2003) examine the connection between increasing male wage inequality and declining female marriage rates within cities and establish a causal connection between the former and the latter.

Over the same period, changes in social constructs related to marriage have also had the potential to impact women's family timing. Prevalent attitudes have become more tolerant of pre-marital sex, cohabitation, and out-of-wedlock childbearing and reduced the social cost of remaining unmarried. Consistent with these changes, Bumpass, Sweet, and Cherlin (1991) find that individuals are increasingly opting for cohabitation rather than marriage.

At the same time, there have been significant legal and technological developments related to birth timing. Changes in abortion laws made abortion much more widely available, and concurrently, a number of developments in the technology of conception and contraception afforded women more control over their birth timing. Akerlof, Yellen, and Katz (1996) discuss how the legalization of abortion and the increased availability of contraception for unmarried women led to a decline in shotgun marriages. Goldin and Katz (2002) provide evidence that the availability of oral contraception has caused women to delay marriage and Bailey (2006) shows that early legal access to oral contraceptives is associated with women's delay of childbearing and greater labor force participation.

There have been many explanations for the increase in delay of marriage and family of recent decades. This paper continues to examine the propensity of women to delay marriage and childbearing and considers the role of the affordability of ART in this regard. It appears that women take ART into consideration in their expectations about their future fertility: in a survey of high-achieving women, 85 percent responded that they believed that with fertility treatments, most women can get pregnant into their early 40's (Hewlett, 2002). Since the proportion of women facing infertility increases greatly with age, by making it affordable for women to delay

family formation and then use ART to start families later if they face infertility, greater affordability of ART could induce women to delay marriage and childbearing. Further, the social, legal, and economic changes discussed above that make marriage delay less costly can only be effective if women believe they can delay their birth timing as well: in this way, greater affordability of ART may have facilitated the phenomena described above. By identifying systematic variation in the price of ART, it may be possible to estimate the effect of this technology separate from these co-determined factors.

Background on Infertility, ART, and Insurance Mandates

Infertility is defined as the inability to conceive after a year of unprotected intercourse. Infertility treatments in general are defined as medical technologies that help women and couples with fertility problems conceive a child and can include a wide range of services from counseling and fertility testing to surgical procedures. The definition of ART used by the Centers for Disease Control and Prevention (CDC) includes all infertility treatments in which both eggs and sperm are handled. Over 2006-2010, 11.9 percent of women 15-44 years of age had ever received any infertility services, and 1.2 percent had undergone artificial insemination procedures (Centers for Disease Control and Prevention, National Center for Health Statistics, 2012). While women can face infertility at any age, the proportion of women facing infertility increases greatly with age. Table 1 shows the percentage of women facing impaired fecundity and infertility and using infertility services by age group. As can be see in the table, while some percentage of women are afflicted with impaired fecundity and infertility at the ages of 15-29, the percentage with impaired fecundity increases more than four-fold from 11 to 47 percent, and the percentage with infertility more than triples from 8 to 30 percent. Likewise, the percentage ever having received infertility services increase from 3 percent for 15-29 year-olds to 24 percent for 40-44 year-olds. Therefore, while only women facing infertility are likely to use infertility services and these women tend to be at older childbearing ages, a woman may anticipate using infertility services if she has a medical history that might encourage their use or if she plans on delaying marriage to older ages when she is more likely to face infertility.

Table 1: Percentage of Women Facing Infertility by Age Group, 2006-2010[1]

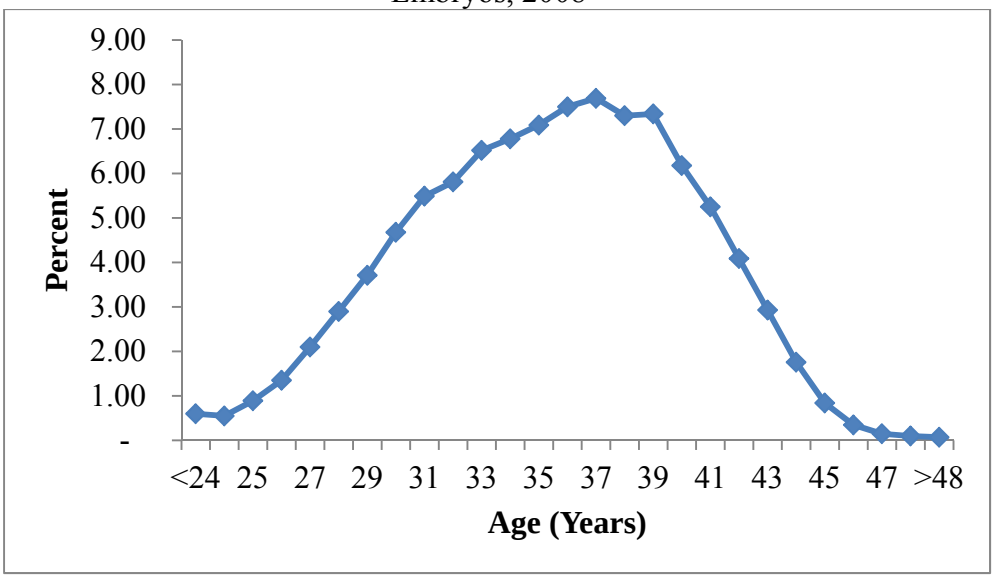
	Percent with Impaired Fecundity	Percent with Infertility	Percent Ever Received Infertility Services
15-29 Years	0.11	0.08	0.03
30-34 Years	0.14	0.09	0.15
35-39 Years	0.39	0.25	0.20
40-44 Years	0.47	0.30	0.24

One of the most well-known ART procedures is in-vitro fertilization (IVF), whereby an egg is taken from the woman's ovaries, fertilized, and then placed in her uterus. The first successful IVF procedure in the United States was performed in 1981, and since that time, ART procedures have become much more effective and widely-used. Other related ART procedures include

[1] Centers for Disease Control and Prevention, National Center for Health Statistics, 2012.

gamete intrafallopian transfer (GIFT) and zygote intrafallopian transfer (ZIFT), but these procedures are much less commonly used as compared to IVF. By 2008, the CDC estimated that ART accounted for slightly more than 1 percent of all U.S. births. In 2008, 71.2 percent of women who had ART cycles using fresh nondonor eggs or embryos had no previous births (Centers for Disease Control and Prevention et al., 2010). Figure 2 shows the age distribution of the users of ART using nondonor eggs or embryos.[2] As can be seen in the figure, while some women use ART with their own eggs or embryos during their 20s, the majority are at least in their 30s, and nearly all women are younger than 45.

Figure 2: Age Distribution of Women Who Had ART Cycles Using Fresh Nondonor Eggs or Embryos, 2008[3]



While the development of infertility treatments has benefitted many women, it must be noted that many women are unable to use these treatments due to their high prices. Hormone therapy can cost between a few hundred and a few thousand dollars, and a single cycle of IVF can cost around $10,000 (Bitler and Schmidt, 2012). Given that less than one-third of ART cycles using nondonor eggs or embryos result in live births (Centers for Disease Control and Prevention et al., 2010), it may take multiple cycles of ART to be successful, and the costs of procedures and medications can quickly become prohibitive.[4]

It would be ideal to examine how the introduction and availability of ART has affected women's expectations and choices about marriage at different ages. However, the introduction of ART was gradual and endogenously driven. Given the inability to identify the effects of the

[2] Age-specific data are only available for procedures using nondonor eggs or embryos. Procedures using nondonor eggs or embryos account for the majority of ART cycles, 70.7 percent in 2008 (Centers for Disease Control and Prevention et al., 2010).
[3] Centers for Disease Control and Prevention et al (2010), p. 28.
[4] Success rates are similar for ART cycles using fresh or frozen nondonor eggs or frozen donor eggs; success rates for ART cycles using frozen donor eggs are higher, but still, only less than one-half of ART cycles using frozen donor eggs result in live births.

introduction of the technology separately from other forces, this paper uses an alternative and potentially exogenous source of variation affecting the use of ART: price.

While the prices of infertility treatment on their own do not vary in a systematic way, insurance coverage of ART does vary systematically by state. ART is generally not covered by insurance unless firms are required by a state mandate to their employees with insurance plans that cover it. In total, 15 states currently mandate insurance coverage for ART in some form. There could be some concern that states with mandates are fundamentally different from those that do not have mandates. It should be noted that the list of mandate states includes a very heterogeneous group of states geographically, politically, and otherwise. Anecdotal evidence suggests that states' adoption of the mandates often comes about due to idiosyncratic factors unrelated to their residents' considerations about delaying marriage and childbearing. The introduction of the ART insurance mandates was part of a greater trend in the implementation of insurance mandates in the United States between the 1970s and 1990s. Lobbying in favor of the mandates has generally been at the national level and has been led by RESOLVE, an organization promoting reproductive health and equal access to infertility treatment. The argument for the mandates is that infertility is a life-altering disease and that individuals should be able to insure against infertility like they would other such conditions. It appears that a primary factor determining whether a state implemented any particular mandate, including ART insurance mandates, was the state's view toward mandates generally, rather than its residents' demand for the particular benefits mandated to be covered. This anecdotal evidence suggests that interests in delaying marriage and childbearing did not drive state's adoption of the mandates. To test for endogeneity of the implementation of the mandates, in this analysis, a lead of the mandate variable interacted with age group was tested in the full empirical specifications, and it was not found to be significant.[5]

The states mandating insurance coverage of ART are Arkansas, California, Connecticut, Hawaii, Illinois, Louisiana, Maryland, Massachusetts, Montana, New Jersey, New York, Ohio, Rhode Island, Texas, and West Virginia. The enactment of the mandates began as early as 1977 in West Virginia and continued until as recently as 2001 in Louisiana and New Jersey. The mandates vary in whether they require that infertility treatment be covered if coverage is offered, known as a "mandate to cover" or only that a plan that includes infertility treatment be offered to firms offering insurance, known as a "mandate to offer." In addition, some of the mandates only apply to health maintenance organizations (HMOs) and some specifically mention that IVF be covered or be excluded from coverage. It is important to note that the mandates do not affect all residents of a state as the Employee Retirement Income Security Act of 1974 (ERISA) designates that state insurance mandates only affect individuals insured through firms that purchase insurance from an outside provider. However, larger firms that self-insure have increasingly provided the mandated coverage (Acs et al., 1996; Jensen and Morrissey, 1999). For example, according to King and Meyer (1997), half of all workers in Illinois were affected by the Illinois mandate in 1993. While it might be a concern that benefits are similar in firms in states that mandate relative to firms in states that do not mandate, Bitler and Schmidt (2012) note that this is not usually the case for infertility treatment, which is rarely covered in the absence of mandates.

[5] This follows Bitler and Schmidt (2012).

Table 2 provides a list of the states with mandates currently in place as well as the date the mandates were enacted and relevant details. It is important to note that while the mandates cover only 15 states, they affect a relatively large share of births in the United States. States with mandates comprised over 47 percent of births in the United States in 2008.[6]

Table 2: States with Mandated Infertility Insurance[7]

State	Year Law Enacted	Mandate to Cover	Mandate to Offer	IVF Coverage	IVF Only
Arkansas	1987	X			X
California	1989		X		
Connecticut	1989	X		X	
Hawaii	1987	X			X
Illinois	1991	X		X	
Louisiana	2001	X			
Maryland	1985	X			X
Massachusetts	1987	X		X	
Montana	1987	X			
New Jersey	2001	X		X	
New York	1990	X			
Ohio	1990	X			
Rhode Island	1989	X		X	
Texas	1987		X		X
West Virginia	1977	X			

Effects of the Mandates

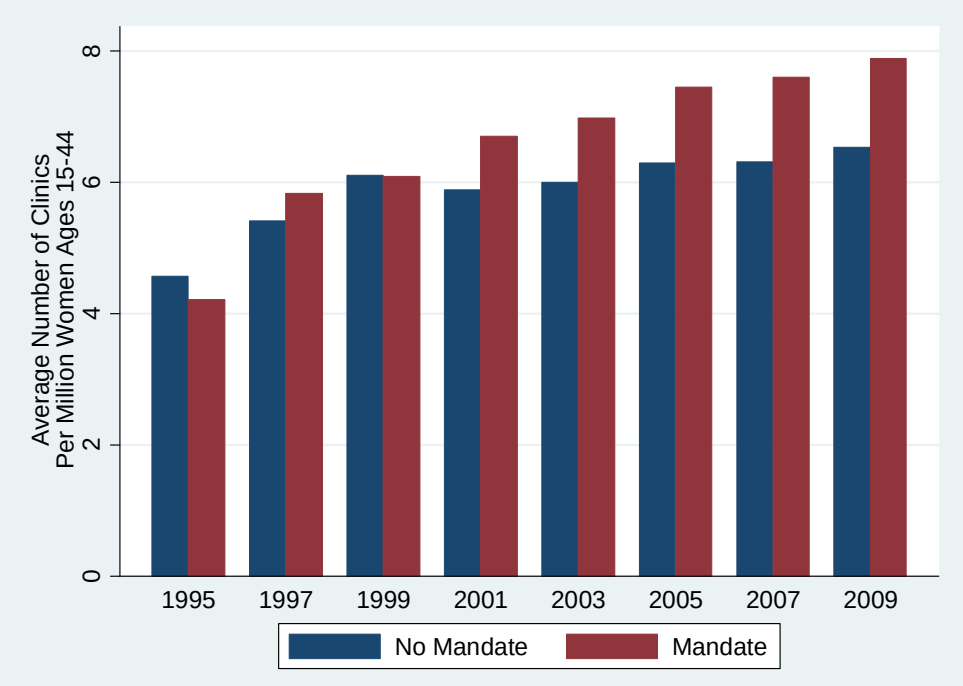
This paper explores whether greater affordability of ART has impacted women's timing of marriage and childbearing using ART insurance mandates as a source of plausibly exogenous variation in the price of ART. To use this variation as an identification strategy, it is necessary to establish whether the mandates have actually resulted in increased use of infertility treatments. This could come about directly, by reducing the price of infertility treatment, or indirectly, by inducing a greater supply of fertility services and greater awareness of the availability of these services. In this way, while the direct effects of a fall in price might only affect users of ART covered by the insurance mandates, the indirect effects of the mandates of greater supply and knowledge of ART could also impact younger women through their expectations about their future fertility options regardless of whether they will ever actually use ART. Considering these indirect channels, Figure 3 shows the average number of fertility clinics per million women ages 15-44 over the 1995-2007 period during and after the implementation of the mandates. At the beginning of the period, it appears that the average per capita number of fertility clinics is quite similar between states with mandates and those without. Over time, the average per capita

[6] Centers for Disease Control and Prevention, National Center for Health Statistics, VitalStats.

[7] Source: American Society for Reproductive Medicine (2011), RESOLVE (2011), Bitler and Schmidt (2012). Connecticut changed its mandate from a mandate to offer in its 1989 law to a mandate to cover in its 2005 law. According to RESOLVE (2011) and as in Bitler and Schmidt (2012), Louisiana is considered to have implemented a mandate to cover beginning in 2001. According to the American Society for Reproductive Medicine (2011) and as in Bitler and Schmidt (2012), West Virginia is considered to have implemented a mandate to cover beginning in 1977. As in Bitler and Schmidt (2012), New York is considered to have implemented a mandate to cover beginning in 1990.

number of fertility clinics increases more quickly in states with mandates than in those without, which could indicate that the mandates are associated with an increase in supply of ART accompanying their effect on lowering the price of ART to consumers.

Figure 3: Number of Fertility Clinics Per Capita by State's Mandate Status 1995-2009[8]



Regardless of whether effects of the ART insurance mandates would come about through direct or indirect channels, extensive work in the economics literature finds effects of the ART insurance mandates on the utilization of ART and outcomes of treatment. Bundorf, Henne, and Baker (2007) find that use of infertility treatments is significantly greater in states adopting comprehensive mandates and that mandated coverage was associated with a relatively large increase in the probability of a multiple birth. Buckles (2012) also finds that strong mandate-to-cover laws are associated with an increase in multiple birth rates for married women, white women, and for women with a college degree. Hamilton and McManus (2012) find that comprehensive mandates result in large increases in access to treatment as well as significantly less aggressive treatment.[9] Bitler and Schmidt (2012) examine whether the mandates affect ART utilization for older, highly-educated women, and find that they have a large and significant effect for this subgroup. All of these papers suggest that the mandates are indeed associated with increased utilization of ART and that this increased utilization is associated with differential birth outcomes.

[8] Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Reproductive Health (2012).

[9] In contrast to Bundorf, Henne, and Baker (2007) and Buckles (2012), Hamilton and McManus (2012) find that the mandates are actually associated with a decrease in the percentage of pregnancies with three or more fetuses. Their contradictory results with respect to the impact of the mandates on aggressiveness of treatment and multiple births could be due to alternative samples and econometric techniques accounting for changes in the population using ART versus changes in procedures and outcomes for the population that would have received treatment without the mandates.

The economics literature has also begun to investigate if there are significant effects of the mandates on larger populations of women, not just the users of ART. The previous literature has focused on examining women at older childbearing ages because they are more likely to be infertile and demand treatment and because they tend to be privately insured at high rates. Several papers find that the mandates are associated with changes in birth rates. Schmidt (2007) uses Vital Statistics Detail Natality Data and Census population counts and finds that the mandates increase first birth rates for women over 35. Buckles (2005) uses Vital Statistics Detail Natality Data to show that mandates that cover IVF are associated with a higher age at first birth. Bitler (2008) finds that the mandates are associated with an increase in the probability of being a twin for children born to older mothers, an increase in the twin delivery rate for older women, as well as negative effects on health-related characteristics for samples of twins and, to a lesser extent, singletons. Only a few papers have considered the effects of the mandates on outcomes not related to births. Cohen and Chen (2011) find that the mandates are associated with increased adoption rates and Appleton and Pollak (2011) put these adoption results in context. Buckles (2005) finds that mandating insurance coverage increases labor force participation for women under 35 and decreases participation for women over 35 while increasing their wages. Lahey (2011) finds that for older women of childbearing age, the mandates do not appear to affect wages, but are associated with a decrease in total labor input.

This paper expands on the literature by considering the effect of greater affordability of ART on women's family timing. While most of the aforementioned papers focus primarily on examining the effects of the mandates on the users of ART, this paper considers the effects of the mandates on all women through their expectations of their future fertility regardless of whether they will ever actually use ART.[10] In addition, this paper adds to the existing literature by examining whether a fall in the price of ART is associated with changes in women's timing of family including marriage as well as childbearing. To identify channels through which a fall in the price of ART might impact women's decisions about timing of family, the paper next develops a theoretical framework models the effect of greater affordability of ART on women's allocation of time on work and family investment when young and old to derive implications for effects on women's marriage and birth timing.

Theoretical Framework

As discussed previously, the empirical literature has found the ART insurance mandates associated with increased used of ART and increased birth rates. While it seems intuitive that making a fertility technology more affordable would impact its use as well as fertility outcomes for older women of childbearing age, it is less clear about whether it would also impact women's timing of childbearing and marriage over the lifetime. To develop a framework for understanding how greater affordability of ART could affect women's family timing, this section presents a theoretical model of ART use as well as time spent in work and family investment. This framework draws from Becker's (1981) model for the allocation of time.

[10] In a working paper, Ohinata (2011) has examined the effects of the mandates on women's timing of childbearing. Her preliminary results suggest the mandates are associated with delayed childbearing only for white women with higher education. This paper uses an alternative sample and different specifications and examines the effects of the mandates on family timing including marriage and childbearing in and out of wedlock rather than only the timing of first birth.

Model Setup

A woman maximizes her utility (U) over two periods, young (Y) and old (O), subject to time and income constraints. Her utility is a function of consumption (C) and family (F). Consider a woman with preferences represented by the utility function:

$$U(C,F) = \alpha \ln(C) + (1-\alpha)\ln(F)$$

The woman can spend her time in family investment or in market work. For time spent working (TM), in the first period she earns a set wage w_Y and in the second period she earns a wage w_O determined by her work time in the first period. Family is formed by some fixed amount of time investment (TF) in marriage, childbearing, and child rearing either when young (I_Y=1, I_O=0) or when old (I_Y=0, I_O=1) such that:

$$\frac{\partial F}{\partial I_Y} = \frac{\partial F}{\partial I_O} = F$$

The model assumes that the likelihood of getting pregnant in the second period is lower than in the first. For simplicity, the model assumes that to pursue getting pregnant in the second period with the same likelihood as in the first, the woman must use ART, and that family investment in the second period cannot take place without ART. A woman chooses whether to invest in family in the first period by forgoing work time or to invest in family initiation in the second period by forgoing work time and paying an additional price to use ART (P_{ART}). The price of consumption is normalized to 1, and nonlabor income is denoted by μ. The utility function is maximized subject to time constraints such that the time spent in work and family investment in each period cannot exceed the total time available in each period and subject to a budget constraint such that consumption cannot excess nonlabor income and income earned from work in each period less expenditures on ART related to family investment in the second period:

$$TM_Y + TF * I_Y = 1$$

$$TM_O + TF * I_O = 1$$

$$C = \mu + w_Y - w_Y * TF * I_Y + w_O(M_Y) - (w_O(M_Y) + P_{ART}) * TF * I_O$$

The model makes several simplifying assumptions. The model assumes that ART and starting a family when younger without using ART and starting a family when older using ART are perfect substitutes. If women prefer to start families when younger, the cutoff values on the wage trajectory distribution would be higher to account for these non-monetary costs. The model also assumes that women know the price of ART and know about a change in the price of ART, and for simplicity, the model assumes ART is only used by older women of childbearing age.

Solving the Model

Using the utility function and time and income constraints, the Lagrangian follows:

$$\mathcal{L} = \alpha \ln(C) + (1-\alpha)\ln(F) + \lambda[\mu + w_Y - w_Y * TF * I_Y + w_O(M_Y) - (w_O(M_Y) + P_{ART}) * TF * I_O - C]$$

Solving for the first order conditions gives:

$$(1)\ \frac{\partial \mathcal{L}}{\partial C} = \frac{\alpha}{C} - \lambda \leq 0$$

$$(2)\ \frac{\partial \mathcal{L}}{\partial I_Y} = (1-\alpha) - \lambda\left[w_Y * TF - \left(\frac{\partial w_O}{\partial I_Y}\right) * (1 - TF * I_O)\right] \leq 0$$

$$(3)\ \frac{\partial \mathcal{L}}{\partial I_O} = (1-\alpha) - \lambda[w_O(I_Y) * TF + P_{ART}] \leq 0$$

$$(4)\ \frac{\partial \mathcal{L}}{\partial \lambda} = \mu + w_Y * (T_Y - T * F_Y) + w_O(F_Y) * (T_O - TF_O) - P_{ART} * TF_O - C \geq 0$$

Since the individual must choose to either invest in family in the first period or in the second period, only one of (2) and (3) can bind. Either (2) binds and (3) does not such that:

$$w_Y * TF - \left(\frac{\partial w_O}{\partial I_Y}\right) * (1 - TF * I_O) < w_O(I_Y) * TF + P_{ART}$$

Here, the foregone first period income and second period wage trajectory are lower than the foregone second period income and the price of ART. Thus, the woman invests in family in the first period, and not in the second.

Alternatively, the foregone first period income and second period wage trajectory may be greater than the foregone second period income and the price of ART:

$$w_Y * TF - \left(\frac{\partial w_O}{\partial I_Y}\right) * (1 - TF * I_O) > w_O(I_Y) * TF + P_{ART}$$

In this case, the woman invests in family in the second period, and not in the first.

From these results, it follows that the users of ART should include women who invest in careers with wage trajectories in the right tail of the distribution of wage trajectories.

Effect of a Change in the Price of ART

The effect of a change in the price of ART differs for women depending on their wage trajectory. A decrease in the price of ART will lower the cost of investing in family in the second period and should induce women with flatter wage trajectories to switch from investing in family in the first period to investing in family in the second period.

Testable Implications and Empirical Questions

Based on the theoretical framework, if ART insurance mandates act to lower the effective price of ART, more women would be expected to switch from starting families when younger to starting families when older consistent with a pattern of delayed marriage and childbearing. Thus, with the mandates, there should be delayed marriage and childbearing at younger ages, but

accelerated childbearing and marriage at older ages. This delay should affect women differentially across the income distribution with the effects of the mandates strongest for women at higher incomes. To examine these implications raised by the model, the empirical analysis will test whether the mandates are associated with delay or acceleration of marriage and childbearing at different ages and at different education levels. The theoretical framework implies that factors that affect wages and the utility from consumption and family investment, such as race, education, and age, should be controlled for in the empirical model.

While the model treats marriage and childbearing as a joint decision, it could be the case that the mandates are only impacting the timing of childbearing separately from marriage. By testing the effects of the mandates separately for marriage and childbearing, it can be determined whether the results are consistent for both choices. If the timing of both choices is impacted in a similar way, treating marriage and childbearing jointly should be appropriate. As a further test of this treatment, the analysis will examine the effects of the mandates on out-of-wedlock childbearing to determine if effects of the mandates on childbearing are associated with childbearing within wedlock or childbearing out of wedlock.

In addition, stronger effects of the mandates should be associated with stronger mandates since the effective price of ART would be lower and more women would switch to older childbearing. To examine whether this is the case, the analysis will test for differential effects of the mandates by the degree of coverage of the mandates. Further, since the response to the price change might be contingent on the diffusion of awareness about the mandates, the analysis will test to see whether the effects of the mandates increase in magnitude as the time since they were implemented increases. Differential effects driven by heterogeneity of the mandates and changes in the effects of the mandates over time since implementation will be examined as robustness checks.

The paper will proceed by outlining the data and empirical strategy used to examine these questions.

Data

The data used in the empirical analysis is the 1968-2009 PSID. The PSID is a longitudinal data set that began in 1968 with a sample of approximately 5,000 U.S. households and has been updated annually through 1997 and bi-annually thereafter. The PSID has attempted to follow all of the individuals from the initial 1968 sample as well as the new families formed by children of the original respondents. The benefit to using the PSID is that it collects data on sample individuals each year, and so it is possible to follow the sample of women through their marriage and childbearing years and identify the month and year of marriage or first birth as well as the state of residence during that time. The drawback to using the PSID data as compared to available datasets of repeated cross sections is that the sample sizes are considerably smaller, making it harder to detect effects of the mandates and limiting the ability to add controls for cohort effects, state time trends, and the like.[11]

[11] Abramowitz (2012) uses Current Population Survey (CPS) data to estimate the mandates' effects on the difference in the proportion married for different age groups; that analysis is less precise, but benefits from a large sample size. The results from this analysis and Abramowitz (2012) can be seen as complementary.

The sample used in the analysis is comprised of at-risk women (single, never married in the case of the marriage analysis, childless in the case of the birth analysis) who enter the sample at age 18 and continue to be followed in the sample until "failing," by marrying in the case of the marriage analysis or having a first birth in the case of the birth analysis, or becoming censored.[12] Therefore, the analysis includes all women from the age of 18 who are single and never married, in the case of the marriage analysis, or have never given birth, in the case of the first birth analysis.[13] 18 was chosen as an appropriate age to begin the analysis since women would be old enough to be living on their own. Women were only included in years in which they were assigned a positive sampling weight,[14] and women with missing years of data were dropped.

For the analysis of transitions to a first marriage, the dependent variable is the duration from the date of the woman's birth until the date of her first marriage, that is, her age at her first marriage, and is measured in months. For the analysis of transitions to a first birth, the dependent variable is the duration from the date of the woman's birth until the date of the birth of her first child, that is, her age at the birth of her first child, and is measured in months. A woman is considered as being affected by the mandate if a mandate was in place at for at least two years in the state in which she is living at the time of the survey.[15,16,17] The two-year lag is used to allow for time for the news of the implementation of the mandates to disseminate and to allow for the time it take to marry and give birth consistent with Schmidt (2007).[18]

Descriptive statistics for the sample can be found in Table 3. Since the samples for the marriage and first birth analyses differ slightly, descriptive statistics are presented for both samples. There are differences in the educational attainment and racial composition of the mandate and non-mandate states, and as such, these factors are controlled for in the empirical analysis. Women in states that ever have mandates appear to marry and have a first birth at older ages than women in states that never have mandates.

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[12] Given this criteria, the sample used in this analysis only includes women born between 1950 and 1991.

[13] 100 individuals who married at ages younger than 18 and 171 individuals who had a first birth at ages younger than 18 were excluded from the marriage and first birth analyses, respectively.

[14] Individuals with sampling weights equal to zero are not considered as sample members; these individuals joined panel families through marriage, cohabitation, or co-residency either as adults or the children of such adults. They are not included in the sample used in this analysis since these individuals may be more likely to enter the analysis due to experiencing an outcome of interest (marriage or birth) and because sample weights are unavailable for these individuals.

[15] For 1997-2009, the PSID only covers odd-numbered years. Residence was extrapolated for even-numbered years.

[16] For the purposes of this analysis, all states with mandates are treated the same. As a robustness check, states with "strong" mandates, those that have mandates to cover and include coverage for IVF, and states with "weak" mandates, those that have mandates to offer or exclude coverage for IVF, are tested separately. This follows Schmidt (2007) and Bitler and Schmidt (2012). Given the small sample size, treating all mandates the same allows for more precise detection of effects of the mandates generally.

[17] The sample includes women who move across states. It could be a concern that women move across states in order to take advantage of the mandates. However, imposing the restriction that only non-movers be included in the sample results in a significant decrease in sample size. Therefore, the main analysis includes women who move across states, but an analysis excluding these individuals is estimated as a robustness check.

[18] As a robustness check, the specifications were estimated both allowing the mandate to have an effect in year of implementation as well as allowing the mandate to have an effect with a five-year lag; results are discussed subsequently.

Table 3: Descriptive Statistics[19]

	Marriage Analysis		First Birth Analysis	
Number of Individuals	6,032		5,659	
Number of Observations	41,749		36,173	
Mean Observations Per Individual	6.9		6.4	
	Non-Mandate	Mandate	Non-Mandate	Mandate
Percent High School or Less	0.46	0.39	0.44	0.38
	(0.51)	(0.47)	(0.51)	(0.47)
Percent Some College	0.31	0.35	0.32	0.35
	(0.48)	(0.46)	(0.48)	(0.46)
Percent College Graduate or More	0.24	0.26	0.24	0.27
	(0.44)	(0.42)	(0.44)	(0.43)
Percent White	0.79	0.73	0.82	0.76
	(0.42)	(0.43)	(0.40)	(0.41)
Percent Black	0.17	0.16	0.14	0.13
	(0.38)	(0.35)	(0.36)	(0.33)
Percent Other Race	0.04	0.11	0.04	0.10
	(0.21)	(0.30)	(0.20)	(0.29)
Median Annual Income ($)	21,996	24,083	21,953	24,099
	(2,809)	(2,795)	(2,798)	(2,793)
Top 10th Percentile Annual Income ($)	54,381	60,264	54,269	60,260
	(2,809)	(2,795)	(7,294)	(8,379)
Female Labor Force Participation Rate	0.56	0.55	0.56	0.55
	(0.08)	(0.06)	(0.08)	(0.06)
Female Unemployment Rate	0.06	0.06	0.06	0.06
	(0.02)	(0.02)	(0.02)	(0.02)
Mean Age at Failure[20]	23.5	24.5	24.3	25.0
	(4.5)	(5.1)	(4.8)	(4.8)

Empirical Specification

To investigate the effects of the ART insurance mandates on women's marriage and birth timing, the analysis uses the Cox proportional hazard model (Cox, 1972) in which the instantaneous hazard rates of first marriage and first birth, respectively, are specified for individual *i*, at age *t*, conditional on having remained single or childless until age *t*, as:

$$\lambda(t \mid \mathbf{X_{it}}) = \lambda_0(t)\exp(\beta \mathbf{X_{it}})$$

The baseline hazard, $\lambda_0(t)$, is a nonparametric, time-varying function; $\mathbf{X_{it}}$ is a vector of regressors that includes a dummy variable indicating whether the woman lived in a state with a mandate in place for at least two years; and β is the vector of coefficients to be estimated.

Exponentiating the estimated coefficients gives the hazard ratio for each of the model parameters, indicating the proportional difference in risk of failure associated with that parameter. Thus, the duration framework allows identification of whether parameters are associated with greater (or lesser) risk of failure which is equivalent to having a shorter (or

[19] Descriptive statistics are calculated using PSID population-representative weights. Standard deviations are in parentheses.

[20] Mean age at failure is calculated only including those individuals who failed.

longer) duration until failure. The duration framework also allows for the right censoring of individuals for whom no failure occurs by the end of the PSID sample period.

Several specifications are estimated to identify whether the mandates are associated with differences in the timing of first marriage and first birth and if there are differential effects of the mandates on women of varying ages and education levels. In all specifications, the data is weighted to be population-representative. First, an across-ages specification is estimated in which the effect of the mandates is assumed to shift the baseline hazard proportionally at all ages. The mandate regressor is an indicator variable equal to one if the woman has lived in a state with a mandate in place for at least two years. The hazard ratio estimated for the mandate regressor estimates the relative level of risk associated with the mandates as compared to the baseline hazard function without the mandates. The mandate will be associated with an increased risk of marriage and birth if the mandates result in women pursuing these earlier; the mandate will be associated with a decreased risk of marriage and birth if the mandates result in women delaying these. The specification includes state fixed effects, to control for time-invariant state characteristics that might affect the timing of marriage and birth; year fixed effects, to control for changes over time across states that might affect the timing of marriage and birth effects; controls for race and education, and controls for labor market conditions at the state level.[21]

Since the effects of the mandates are expected to vary for at-risk women at different ages, the assumption that the effect of the mandates results in a shift the baseline hazard proportionally at all ages may be overly restrictive and produce misleading results. To address this concern, an age group-interacted specification is estimated next, which includes the same controls as in the across-ages specification, but also includes interaction terms for the mandate and three age groups: 18-24, 25-29, and 30 and older.[22] In this specification, the effects of the mandates at each age group are estimated as the sum of the coefficients on the mandate regressor and each mandate-age group interaction term, which, when exponentiated as hazard ratios, reflect the relative level of risk associated with the mandates as compared to the baseline hazard function without the mandates for each age group. Using this specification, the effect of the mandates is still assumed to shift the baseline hazard proportionally within an age group, but can vary between age groups.

There might be some concern that pre-existing age group specific differences exist between states that would ever have mandates and those that would not in the timing of marriage or birth. To address this concern, the age group-interacted specifications are also estimated including an interaction of the dummy variable for whether the state ever enacted a mandate with the age group dummies as well as region controls instead of the state controls. Comparison of the results of specifications with state controls and those with mandate state-age group interactions will be

[21] To proxy for labor market conditions, the state female unemployment rate, female labor force participation rate, median annual income, and top 10th percentile annual income are included as controls.

[22] The bounds of these age groups are chosen as such because they each age group contains a large proportion of the failures in the data for each analysis. It would be interesting to include age groups the facilitate looking more closely at effects of the mandates on older age groups, but given the smaller sample size and small number of first marriages and first births that take place at ages greater than 35 or 40, including these age groups separately was not appropriate for this analysis.

useful in identifying whether pre-existing age group-specific differences between states that would ever have mandates and those that would not are driving any results.

Next, since the theoretical framework predicts that the mandates may have differential effects on women with steeper wage trajectories than those with flatter ones, the analysis tests whether the mandates have differential effects by education level by estimating the age group-interacted specification separately for women with some college education or less and for those with at least a college degree.

While the Cox models above are used to estimate the likelihood of single, never married women to marry or childless women to give birth, it is necessary to use competing risks analyses to examine the effects of the mandates when several mutually exclusive outcomes are possible and there could be correlation between their failure times. For example, it could be the case that ART would induce a woman to wait to marry and then have a child rather than to have a child out-of-wedlock at earlier. In this case, not accounting for the effects on out-of-wedlock births could yield misleading results. Considering the pool of single, never married, childless women, there are two mutually exclusive channels for failure: marrying without children or having a first birth out of wedlock. Alternatively, considering the pool of childless women, there are again two mutually exclusive channels for failure: having a first birth within marriage or having a first birth out of wedlock. Estimating any of the above channels on their own would treat failure to the competing channel as censored and thus would not take into account possible effects on the competing channel and their impact on the channel of interest. Accordingly, competing risks specifications (Fine and Gray, 1999) were estimated to capture these effects.

To investigate whether the mandates are associated with women to "opting in" or "opting out" of marriage, the analysis examines the effects of the mandates on the subhazards of single, never married, childless women for having out-of-wedlock births and marrying without having had children. To investigate whether the mandates are affecting only births within marriage or only those out of marriage, the analysis examines the effects of the mandates on the subhazards of each of these outcomes for childless women. The model for each subhazard follows:

$$\bar{h}(t \mid \mathbf{X_{it}}) = \bar{h}_0(t)\exp(\beta \mathbf{X_{it}})$$

To address the first question, the subhazard is modeled as the instantaneous probability of having an out-of-wedlock birth (marrying without having had children) and is specified for individual *i*, at age *t*, conditional on having remained single *and* childless until age *t*. To address the second question, the subhazard is modeled as the instantaneous probability of having first birth out-of-wedlock (within marriage) and is specified for individual *i*, at age *t*, conditional on having remained childless, whether single or married, until age *t*. In both models, the baseline subhazard, $h_0(t)$, is a nonparametric, time-varying function; $\mathbf{X_{it}}$ is a vector of regressors that includes a dummy variable indicating whether the woman lived in a state with a mandate in place for at least two years; and β is the vector of coefficients to be estimated which follow the same form as in the age group-interacted specification.

The results of the across-ages, age group-interacted, education level, and competing risks specifications follow.

Primary Results

Across-Ages Specifications

Table 4 presents the results for the across-ages hazard model specifications of the transition to first marriage and motherhood. The results show no significant effect of the mandates on the hazard of marrying or on the hazard of having a first birth. As discussed previously, this specification assumes that the mandates affect the hazard of marriage and first birth proportionally across all ages, and since this might be an overly-restrictive assumption given that the mandates may affect the hazards differently at different ages, the age group-interacted specifications are estimated next.

Table 4: Across-Ages Mandate Hazard Ratio Effects

Hazard Ratios	Marriage	Marriage	First Birth	First Birth
Mandate	1.193*	1.176	1.174	1.131
	(0.125)	(0.116)	(0.119)	(0.110)
State Controls	X		X	
Mandate State-Age Group Controls		X		X
Individuals	6,032	6,032	5,659	5,659

Age Group-Interacted Specifications

Table 5 presents the results for the age group-interacted hazard model specifications of the transition to marriage and to motherhood. The results show the mandates are associated with a significant increase in the hazard of marrying for women ages 25 and older and a significant increase in the hazard of having a first birth for women ages 30 and older, but with no significant effect on the hazard of marrying or having a first birth for younger women. The estimations including state controls and those including mandate state-age group controls appear to yield qualitatively similar results.

Table 5: Age Group-Interacted Mandate Hazard Ratio Effects

Hazard Ratios	Marriage	Marriage	First Birth	First Birth
Age<25: Mandate	0.954	0.928	1.145	1.157
	(0.110)	(0.102)	(0.131)	(0.131)
Age 25-29: Age 25-29 X Mandate + Mandate	1.507***	1.551**	1.026	0.8
	(0.233)	(0.284)	(0.150)	(0.128)
Age>29: Age>29 X Mandate + Mandate	2.027***	2.278***	1.57**	1.857**
	(0.395)	(0.704)	(0.292)	(0.506)
State Controls	X		X	
Mandate State-Age Group Controls		X		X
Individuals	6,032	6,032	5,659	5,659

These results suggest that the mandates are not affecting younger women, but are speeding older women's transitions to marriage and motherhood. Of the women who remain single and childless until older ages, it is plausible that the mandates would induce these women to marry

and have children. However, the results do not suggest that the mandates are associated with delay of marriage and childbearing. With regard to fertility, this could be consistent with the scenario that while the price of ART does not affect women's choice about when to begin trying to get pregnant, it may speed the time at which they actually do. With regard to marriage, it is possible that the mandates lead to marriage if an unmarried woman that does not have insurance coverage for ART because she does not work for an employer regulated by the mandate would choose to marry a man working for an employer that is regulated by the mandate in order to get coverage for ART. However, since the theoretical model predicts delay according to a woman's position on the wage trajectory distribution, these results estimated for the full sample may miss the effects of delay induced by the mandates for only some women on the wage trajectory distribution. To explore this question further, results estimated by education level proxying for wage trajectory follow.

Education Level

The results of the age group-interacted specification estimated separately for women with some college or less and for women with at least college degrees are presented next. Table 6 presents the results for the effects of the mandates on the hazard of marrying. These results suggest that for women ages 30 and older in both groups the mandates are associated with an increased hazard of marrying. However, for women with college degrees, the mandates also appear to be associated with women younger than 25 having a lower hazard of marrying. This is consistent with a pattern of marriage delay for more highly educated women as predicted by the theoretical model.

Table 6: Mandate-Age Group Effects for Marriage by Education Level

Hazard Ratios	Some College or Less	Some College or Less	College Graduate or More	College Graduate or More
Age<25: Mandate	0.943	0.984	0.696	0.637**
	(0.124)	(0.123)	(0.156)	(0.141)
Age 25-29: Age 25-29 X Mandate + Mandate	1.358	1.483	1.287	1.319
	(0.287)	(0.375)	(0.310)	(0.357)
Age>29: Age>29 X Mandate + Mandate	1.87**	1.766	1.921**	2.48**
	(0.514)	(0.867)	(0.559)	(0.962)
State Controls	X		X	
Mandate State-Age Group Controls		X		X
Individuals	4,898	4,898	1,134	1,134

Table 7 presents the results for the effects of the mandates on the hazard of having a first birth. Here it appears that for women with some college or less the mandates are associated with an increase in the hazard of having a first birth at all ages, but none of these effects are significant. For women with at least a college degree, the mandates appear to be associated with a lower hazard of having a first birth at younger ages and a higher (but not significant) hazard of having a first birth at older ages. This is consistent with a pattern of delay of first birth for more highly educated women as predicted by the theoretical model.

Table 7: Mandate-Age Group Effects for First Birth by Education Level

Hazard Ratios	Some College or Less	Some College or Less	College Graduate or More	College Graduate or More
Age<25: Mandate	1.108	1.131	0.76	1.032
	(0.139)	(0.138)	(0.237)	(0.360)
Age 25-29: Age 25-29 X Mandate + Mandate	1.276	1.113	0.778	0.494***
	(0.233)	(0.245)	(0.202)	(0.120)
Age>29: Age>29 X Mandate + Mandate	1.274	1.796	1.573*	1.535
	(0.375)	(0.849)	(0.419)	(0.490)
State Controls	X		X	
Mandate State-Age Group Controls		X		X
Individuals	4,547	4,547	1,112	1,112

Again, the estimations including state controls and those including mandate state-age group controls appear to yield quantitatively similar results, and as such, only results of specifications using state controls will be presented subsequently for brevity.

Next, to address whether effects of the mandates on out-of-wedlock childbearing are driving results, the competing risks specifications are presented subsequently.

Competing Risks Specifications

Table 8 presents the results for the age group-interacted specification of the competing risk analysis of the transition to first marriage treating marriage before birth and having an out-of-wedlock birth as competing risks. The results for marriage are consistent with those estimated previously: for single, never married women ages 25 the mandates are associated with an increased hazard of marrying. The results for out-of-wedlock births do not suggest that the mandates are associated with an increased hazard of having a first birth out of wedlock at any age.

Table 8: Competing Risks Mandate-Age Group Effects for First of Marriage or Birth

Hazard Ratios	Marriage without Children	Out-of-Wedlock Births
Age<25: Mandate	0.902	1.307
	(0.117)	(0.248)
Age 25-29: Age 25-29 X Mandate + Mandate	1.656***	1.018
	(0.279)	(0.414)
Age>29: Age>29 X Mandate + Mandate	1.957***	1.152
	(0.455)	(0.776)
State Controls	X	X
Individuals	5,600	5,600

Table 9 presents the results for the age group-interacted specification of the competing risk analysis of the transition to first birth treating birth within marriage and out-of-wedlock births as competing risks. The results for giving birth within wedlock are consistent with the first birth results estimated previously: for single, never married women ages 30 and older, the mandates are associated with an increased hazard of having a first birth within marriage.[23] However, the results do not suggest that the mandates are associated with an increased hazard of having a first birth out of wedlock.

Table 9: Competing Risks Mandate-Age Group Effects for First Birth

Hazard Ratios	Birth in Wedlock	Birth out of Wedlock
Age<25: Mandate	0.995	1.232
		(0.234)
Age 25-29: Age 25-29 X Mandate + Mandate	1.090	1.036
		(0.419)
Age>29: Age>29 X Mandate + Mandate	1.557	1.195
		(0.781)
State Controls	X	X
Individuals	5,520	5,520

The results of both competing risks specifications suggest that the mandates are affecting women's timing of first birth within marriage, providing a basis for the results on timing of marriage presented earlier. However, these results do not suggest that the mandates are affecting women's timing of out-of-wedlock births. Interestingly, the results of acceleration of births appear to only be apparent for births within marriage suggesting that marriage may be a key channel for this effect. This would be consistent with the scenario that the mandates may induce women to marry in order to obtain the benefits associated with the mandates that they would not have otherwise had access to through their spouse's employer.

Thus far, the analysis has considered the effects of the mandates on the hazard of marrying and the hazard of having a first birth for the full sample and by education level at different ages as well as the hazards of having a first birth within and out of marriage. While the paper has addressed the main testable implications of the theoretical model, proceeding results investigate other potential effects of the mandates. Next the effects of the mandates conditional on marriage are examined considering only women who have married during the sample period in the analysis. Differential effects of the mandates by race and whether the mandates are associated with changes in men's timing of marriage and childbearing are subsequently examined.

Further Results

Mandate Effects Conditional on Marriage

Thus far, the analysis has considered the effects of the mandates on the hazard of marrying and the hazard of having a first birth both within and outside of marriage, but has not yet considered

[23] Standard errors were not estimable for the specification for birth within marriage; however, the magnitudes of the hazard ratio estimates are consistent with those estimated for births within and out of wedlock.

the effects of the mandates on behavior conditional on marriage. To establish whether the mandates are associated with changes in fertility timing conditional on marriage timing, the effect of the mandates on timing between marriage and first birth for those who have married is estimated. To understand whether the mandates are associated with longer lasting marriages, the effect of the mandates on the time between marriage and separation for those who have married is also estimate.[24] Results of these estimations are presented in Table 10.

Table 10: Mandate Effects Conditional on Marriage

Hazard Ratios	Time Between Marriage and First Birth	Time Between Marriage and Separation
Mandate	1.095	0.885
	(0.131)	(0.156)
State Controls	X	X
Individuals	2,085	2,755

Results show no significant effect of the mandates on either time between marriage and first birth or time between marriage and separation. Given that the sample sizes for these estimations are smaller due to the inclusion of only married individuals, additional analysis using larger samples could be beneficial.

Race

Thus far, the analysis has treated the effects of the mandates as the same for women of all races, but it may be the case that the effects of the mandates vary by race. Bitler and Schmidt (2006) find no evidence that the mandates ameliorate racial, ethnic, and education disparities in the use of infertility treatment suggesting that there may be differential effects of the mandates on these groups which could correspond to differences by race in the effects of the mandates on the timing of marriage and first birth.

Table 11 presents the results for the age group-interacted hazard model specifications of the transition to marriage and to motherhood separately for whites and blacks.[25] The results for white women are consistent with those for the full sample: the mandates appear to be associated with a significant increase in the hazard of marrying for women ages 25 and in the hazard of having a first birth for women ages 30 and older, but with no significant effects for marriage or first birth for younger women. For black women, the mandates are associated with a marginally significant increase in the hazard of a having a first birth over the 18-24 age range and a marginally significant decrease in the hazard of a having a first birth over the 25-29 age range, but with no significant effect for younger or older women. This is consistent with the findings of Bitler and Schmidt (2006) suggesting differential effects of the mandates by race.

[24] Both of these specifications include all of the controls used in the across-ages specification except for controls for age group. In addition. a control for age at marriage is included. The mandate term is not interacted with age group since the sample includes only married individuals and the specification includes controls for age at marriage.
[25] Since individuals of other races make up a very small proportion of the sample, specifications were only run separately for whites and blacks.

Table 11: Mandate-Age Group Effects for Marriage and First Birth by Race

Hazard Ratios	Marriage Whites	Marriage Blacks	First Birth Whites	First Birth Blacks
Age<25: Mandate	0.931	1.689*	1.13	1.41
	(0.119)	(0.531)	(0.156)	(0.350)
Age 25-29: Age 25-29 X Mandate + Mandate	1.63***	1.303	1.124	0.481*
	(0.273)	(0.565)	(0.180)	(0.193)
Age>29: Age>29 X Mandate + Mandate	2.097***	1.959	1.761***	0.492
	(0.476)	(0.846)	(0.354)	(0.270)
State Controls	X	X	X	X
Individuals	2,962	2,687	2,956	2,348

Men

Since any changes affecting women's marriage decisions have the potential to affect men's marriage decisions as well, the full specification was also estimated for men. Table 12 presents the results for the age group-interacted hazard model specification of the transition to marriage and fatherhood for men. The results show the mandates are associated with a significant increase in the hazard of marrying for men at all ages. However, the results do not show the mandates to be associated with any significant difference in the hazard of having a first birth for men at any age group. An explanation for this could be that as women at these ages become more likely to marry as a result of the mandates, they marry men at these ages and thus men are more likely to marry. Another explanation could be that the increased availability and affordability of ART makes older women more marriageable and men are finding marriage more attractive given the larger pool of marriageable women.

Table 12: Mandate-Age Group Effects for Men

Hazard Ratios	Marriage	First Birth
Age<25: Mandate	1.209	0.928
	(0.151)	(0.126)
Age 25-29: Age 25-29 X Mandate + Mandate	1.396**	0.771
	(0.209)	(0.123)
Age>29: Age>29 X Mandate + Mandate	1.665***	1.121
	(0.312)	(0.183)
State Controls	X	X
Individuals	6,218	6,164

Robustness

To consider the robustness of the analysis, alternative estimations are performed. These estimations account for heterogeneity of the mandates, time since mandate implementation, and moving across states.

Heterogeneity of Mandates

In the empirical analysis, all states with mandates related to ART were treated the same. The theoretical model predicts that more comprehensive versions of the mandates are associated with stronger effects. To understand whether different degrees of the mandates are associated with different outcomes for women's marriage and birth timing, the results were estimated with interacted controls for states with "strong" mandates, those having both mandate-to-cover laws and IVF coverage, and for states with "weak" mandates, those having either mandate-to-offer laws, exclusions of IVF coverage, or both. Table 13 presents these results.

Table 13: Mandate-Age Group Effects – "Strong" Versus "Weak" Mandates

Hazard Ratios	Marriage	First Birth
Strong		
Age<25: Mandate	0.883	0.737
	(0.154)	(0.143)
Age 25-29: Age 25-29 X Mandate + Mandate	1.463	1.373
	(0.345)	(0.288)
Age>29: Age>29 X Mandate + Mandate	2.464***	1.777**
	(0.715)	(0.479)
Weak		
Age<25: Mandate	0.994	1.354**
	(0.136)	(0.177)
Age 25-29: Age 25-29 X Mandate + Mandate	1.535**	0.865
	(0.278)	(0.158)
Age>29: Age>29 X Mandate + Mandate	1.872***	1.486*
	(0.422)	(0.328)
State Controls	X	X
Individuals	6,032	5,659

In general, the results suggest similar effects of the mandates on both the hazards of marrying and having a first birth for women ages 30 and older across states with strong mandates and states with weak mandates, but the effects tend to be greater in magnitude in states with strong mandates. This is consistent with the expectation that stronger mandates should have stronger effects on women's behavior. An interesting result is that for women ages 18-25 the mandates appear to be associated with a lower hazard of having a first birth in states with strong mandates, but with a higher hazard of having a first birth in states with weak mandates.

Next, the question of whether the effects of the mandates have changed the longer the mandates have been in place is addressed.

Time since Mandate Implementation

In this paper's main analyses, a woman is considered as being affected by the mandate if she is living in a state with a mandate in place at for at least two years. As robustness checks, the specifications were estimated first allowing the mandate to have an effect in year of

implementation and next allowing the mandate to have an effect only if it was in place at for at least five years. In both cases, the results were found to be similar, though not as strong.

These specifications assume that once a mandate has gone into effect, its impact is the same regardless of the time since its implementation. However, the effects of the mandates could change over time if, for example, diffusion of awareness about the mandates takes time. To investigate whether the effect of the mandate changes over time, instead of a mandate dummy variable, a control for years since mandate implementation was used and interacted with the age group controls. Table 14 presents the results of this specification for marriage and first birth. The marriage results show that an additional year since mandate implementation is associated with a significant increase in the hazard of marrying for women ages 25 and older but with no significant effect on younger women. The first birth results show that an additional year since mandate implementation is associated with a significant increase in the hazard of having a first birth for women ages 30 and older, but with no significant effect on younger women. These results suggest that the longer a mandate has been in place, the greater its effect, which is consistent with the idea that knowledge about the mandates has diffused over time.

Table 14: Years since Mandates Effects by Age Group for Marriage and First Birth

Hazard Ratios	Marriage	First Birth
Age<25: Years Since Mandate	0.992	1.012
	(0.008)	(0.008)
Age 25-29: Age 25-29 X Years Since Mandate + Years Since Mandate	1.022**	1.001
	(0.011)	(0.011)
Age>29: Age>29 X Years Since Mandate + Years Since Mandate	1.042***	1.039***
	(0.016)	(0.015)
State Controls	X	X
Individuals	6,032	5,659

Moving Across States

In this paper, women who moved across states over the sample period were included in the analysis. In order to address the concern the women might be moving across states in response to changes in states' mandate status, as a robustness check, the specifications were estimated including only women that did not move states from the age of 18 for the duration of their time in the sample. This significantly reduced the sample's size, and the results were found to be similar, though not as strong.

Discussion and Conclusions

This paper examined the effects of greater affordability of ART on women's timing of family. The paper developed a theoretical model to understand the effect of a change in the price of ART on women's allocation of time on work and family investment when young and old and to derive implications for effects on women's marriage and birth timing. The implications of the model suggested that a fall in the price of ART induces more women along the wage trajectory distribution to use ART and switch from pursuing family when younger to pursuing family when older. The paper then used duration and competing risks analyses exploiting variation in

the mandated insurance coverage of ART across U.S. states and over time to investigate whether the mandates have affected women's timing of first marriage and first birth. The findings suggest that the mandates are associated with delayed marriage and childbearing at younger ages and accelerated first marriage and childbearing after age 30, but only for college graduate women, consistent with the theoretical framework's prediction that women with steeper wage trajectories should be more influenced by the mandates to delay family formation. For the full sample of women, the mandates appear to be associated with accelerated first marriage and childbearing after age 30, but not with delay at younger ages. This suggests that, for women with greater educational attainment, the mandates may be associated with substituting time when young from family investment to work and then spending more time in family investment when older along with using ART. For women with less educational attainment who may be less career-driven, the results do not suggest that the mandates are associated with a change in family investment or work-related behavior at younger childbearing ages, but only suggest that the mandates are associated with faster marriage and childbearing at older ages. With regard to fertility, this could be consistent with the scenario that while the price of ART does not affect women's choice about when to begin trying to get pregnant, it may speed the time at which they actually do. With regard to marriage, it is possible that the mandates lead to marriage if an unmarried woman that does not have insurance coverage for ART because she does not work for an employer regulated by the mandate would choose to marry a man working for an employer that is regulated by the mandate in order to get coverage for ART. Interestingly, the results of acceleration of births appear to only be apparent for births within marriage suggesting that marriage may be a key channel for this effect.

The paper's results are consistent with those using repeated cross-sections. With regard to first birth, Schmidt (2007) also finds that the mandates are associated with more births among women over age 35 using Vital Statistics Detail Natality Data. With regard to marriage, Abramowitz (2012) using the 1977-2010 Current Population Survey finds that for white women, the likelihood of marrying over the 30-34 to 35-39 age groups is 22 percent higher for the full sample, and for white women with at least a college degree, the likelihood of marrying over the 20-24 to 25-29 age groups is 13 percent lower, and the likelihood of marrying over the 30-34 to 35-39 age groups is 23 percent higher for women living in states with mandates as compared to those living in states that do not have mandates.

The results of the analysis are useful from a policy perspective. It does appear that the mandates are associated with an increase in births among women of older childbearing ages. However, while the mandates and greater availability of ART generally may have been intended to provide a means for women and couples with fertility problems to have a child, an unintended consequence may be that women then choose to delay marriage and childbirth in response to the mandates and greater availability of the technology, resulting in them being more likely to face fertility problems and pursue ART procedures, which as this paper highlighted, are very costly. However, while there is evidence of delay for women with some college education, who comprise 30 percent of the adult female population,[26] for the general population, the mandates only appear to make marriage and child birth an option when they otherwise would not be. In addition, while the mandates do appear to increase the likelihood of births within wedlock for

[26] Of women ages 25 and older according to 2011 Current Population Survey data.

women at older childbearing ages, it does not appear that the mandates are inducing women to "opt-out" of marriage to pursue single motherhood.

A limitation to interpreting the effects of the mandates as a proxy for access to ART is that knowledge and access to the mandates may be heterogeneous. While all women may be able to benefit by the lower price of ART due to the mandates, some women may have more knowledge of the mandates and their effects on the cost of ART than others. For instance, a 35-year-old woman who is concerned about her fertility options may have reason to obtain greater knowledge of her fertility options and their costs than a 25-year-old woman. On the other hand, if the diffusion of information is relatively widespread, the information gap between groups of women may be small. In addition, since the mandates can only affect the cost of ART through insurance markets, such an identification strategy may not capture the effect of lower costs and availability of ART on a larger scale. This may particularly be the case for lower income women, and could explain why the effects of the mandates estimated separately for women with less education appeared to be insignificant.

Overall, the paper makes several main contributions. First, the paper provides a theoretical framework for understanding the effect of greater ability to use ART on women's allocation of time on work and family investment when young and old and derives implications for effects on women's marriage and birth timing. Second, the results increase understanding of the factors that influence women's marriage and birth timing. Third, the paper uses panel data and duration analysis to gain a more thorough understanding of the effects of ART insurance mandates revealing that the mandates affect both highly educated women at younger childbearing ages through their expectations about their future fertility in addition to women at older childbearing ages.

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