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Effects of Increased Access to Infertility Treatment on Infant and Child Health Outcomes

Evidence from Health Insurance Mandates

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Effects of Increased Access to Infertility Treatment on Infant and Child Health Outcomes: Evidence from Health Insurance Mandates[1]

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Abstract

Reproductive technologies have radically improved since the introduction of the first fertility drugs in the late 1960s. These technologies make conception possible for many couples who otherwise would have been unable to reproduce. Many of these technologies increase the probability of having a multiple birth, typically a more risky pregnancy. These technologies also provide women considering delaying reproduction with insurance against later infertility.

Live births resulting from use of advanced reproductive technology and other infertility treatments are a tiny share of all births (around 0.5% of all births in 1999 were due to use of advanced reproductive technologies), making it difficult to detect impacts of the advanced technologies. Detecting impacts of infertility treatments in general is difficult in public-use data because such data do not record use of such treatments. To detect impacts of the advanced technologies, we first restrict ourselves to a sample—twin births—where births related to reproductive technologies are much more common. About 6% of twin births in 1999 were the product of in vitro fertilization or other advanced reproductive technologies. To examine impacts of infertility treatments more broadly, we also consider a sample of singletons.

We analyze the association between the dissemination of advanced reproductive technologies and other infertility treatments and infant and child outcomes during the 1980s and 1990s. We rely on variation in access to advanced reproductive technologies (ART) and other infertility treatments induced by state-level insurance mandates forcing insurers to cover or offer to cover use of infertility treatments, thus subsidizing use of these treatments.

We find significant impacts of the mandates on fertility and birth outcomes. First, we document that the mandates have affected fertility. Using the Detailed Natality data, we find that for mothers 30 and older, state infertility mandates are associated with a statistically significant 10 percent increase in the twin birth rate. Twin pregnancies are typically more dangerous than singleton pregnancies. The mandates are also associated with a statistically significant increase in the mixed-sex twin birth rate (mixed-sex twins must be dizygotic).

Subsidized infertility treatment as proxied by the mandates is also associated with small but statistically significant negative effects on birth weight, gestation, and the 5-minute Apgar score for the older mothers. Effects for singletons are smaller in magnitude as would be expected given that use of infertility treatment in general and ART in particular is less common for mothers of singletons.

We then examine whether there are longer-term impacts of this increased access to infertility treatments. Using data from the 2000 Census and 2001–2002 American Community Survey (ACS), we replicate our finding from the birth certificate data that twin births to older women are more common in states with mandates. Our Census/ACS findings suggest that twins born to older mothers in mandate states are slightly more likely to have a long-lasting condition limiting basic physical activities but that impacts on sensory impairments or conditions limiting the ability to learn, remember, or concentrate are more mixed.

Our findings for twin birth outcomes suggest that positive effects of investment by older mothers in their pregnancies are outweighed by negative impacts of either the infertility treatments themselves or by the selection into pregnancy of women with reduced fecundity.

1 Introduction

Reproductive technologies have improved drastically in the last 40 years. Beginning in the late 1960s when the first ovulation-inducing drugs were approved in the U.S., and continuing with the use of new technologies such as in vitro fertilization (IVF), these advances have enabled hundreds of thousands of pregnancies around the world. An implicit assumption behind the widespread use of these technologies is that children born to women using advanced reproductive technologies (ART) or other infertility treatment are similar to other children. In this research, we test this assumption by estimating the demographic and health effects of infertility treatments. Because we cannot simultaneously observe use of infertility treatments and birth and child health outcomes in standard data sets, we rely on variation in state-level mandates that require insurers to cover or offer to coffer infertility treatment. These mandates implicitly subsidize use of infertility treatment. We estimate reduced-form regressions relating fertility and infant and child health to the mandates.

This paper contributes to the literature on the effects of health insurance mandates. This paper also contributes to the ongoing debate about birth selection in health economics. At least three mechanisms could lead to children born via use of infertility treatment differing from other children. First, their parents might be different from other children's parents. For example, the probability that a woman will be infertile (raising demand for ART and other infertility treatment) increases with age. Many infertility treatments such as ART are also expensive, so parents using them are likely to be wealthier. Second, because these technologies are resource-intensive, in both time and money, these would-be parents are likely to value their children very highly and, thus, are also likely to take other steps to improve child health (such as obtaining high-quality prenatal care). Third, it is possible that some of the same medical issues that make it difficult for some women to conceive could directly affect the health of the infant—either through a genetic correlation between maternal and child health or through making it difficult for the mother to support the fetus.

These issues are of interest for several reasons. Understanding the impacts of mandates concerning infertility treatment is important given the ongoing debate about expanding these mandates. Health economists are interested in the effects of mandates. Use of infertility treatments and ART is of interest to the medical community and to potential parents; thus, the demographic and health impacts of these technologies should also be of interest. Additionally, infertility treatments such as ART generate an archetypal birth-selection problem. As in the earlier literature on birth selection through the use of abortion (e.g., Gruber, Levine & Staiger (1999)), these infertility treatments affect the infant health distribution, but not by affecting the health of a fixed infant population. Instead these infertility treatments make it possible for a new subset of children to be born. Such birth selection raises important methodological and conceptual issues into which this work provides important insight.

Births after using ART or other more common infertility treatments are a tiny share of all births, so sample sizes from typical survey data sets are likely to be too small to detect direct impacts of access to ART on birth outcomes. However, many infertility treatments increase the probability of having a multiple birth—for example, use of IVF in 1998 was associated with a 30 percent chance of having twins compared to a chance of 2 percent without any infertility treatment.

We first investigate whether the twin birth rate has increased as use of infertility treatment has spread. Because births due to use of ART or other intense infertility treatments are rare in the population of singleton births, we then focus primarily on the relation between infertility treatment and health outcomes among twins. Births to women who use infertility treatment are a substantial share of twin births by the end of the sample period. Thus, we should be able to detect differences between twin birth outcomes for women using infertility treatment and other women, if such differences exist.

Our main source of identifying variation is state laws mandating insurance coverage of infertility treatment. A number of states passed laws in the late 1980s and early 1990s mandating that health insurers either cover or offer coverage of infertility treatment. These state mandates lower the price of obtaining infertility treatment for women seeking such treatment. By using variation from these mandates, we can differentiate between the impact of age versus that of gaining access to subsidized infertility treatment.

Using a subsample of singleton and twin births from the Detailed Natality data for 1981–1999, we find for older mothers that state mandates—which increase access to infertility treatments—are associated with a statistically significant increase of between 10 and 24 percent in the twin birth rate and about an 18 percent increase in the mixed-sex twin birth rate.

We then use the Natality data to estimate reduced-form regressions relating the state-level mandates to birth weight, gestation, and other outcomes separately for twins and for singletons. Our results suggest that twins whose mothers live in states with mandates have statistically significantly lower birth weights and shorter gestation durations, and that the effects are larger for older women. We find smaller impacts for singletons as expected given the smaller share of singleton births that are due to ART or other infertility treatments.

Pooling 1-percent and 5-percent Public-Use Microdata Sample (PUMS) data from the 2000 Census and the 2001 and 2002 American Community Survey (ACS), we construct a panel of children born between 1982 and 1997. With these data, we replicate our finding that for older women, living in a mandate state the year before the child is born is associated with an increased probability of the child being a twin. Our findings concerning the longer-term health effects of having been born to an older mother in a mandate state are mixed. Our Census/ACS findings suggest that twins born to older mothers in mandate states are slightly more likely to have a long-lasting condition limiting basic physical activities. Evidence about the association between being born to an older mother in a mandate state and sensory impairments or conditions limiting the ability to learn, remember, or concentrate is more mixed.

The rest of the paper proceeds as follows. Section 2 discusses infertility and infertility treatment. Section 3 discusses related work and provides a theoretical motivation. Section 4 describes the Detailed Natality and PUMS/ACS data used here. The empirical models are presented in Section 5 and the main results and extensions in Section 6. Finally, Section 7 concludes.

2 Infertility and infertility treatment

Infertility is generally defined by clinicians as the inability to conceive after 12 months of unprotected intercourse (6 months for older women).[1] A related reproductive problem is impaired fecundity. Unlike infertility, which as commonly defined only applies to cohabiting and married women, any women could be considered as having impaired fecundity. A woman is considered to have impaired fecundity if she is not surgically sterile, and has had problems conceiving or carrying a pregnancy to term, or has been unable to conceive after a three year period of unprotected intercourse (Chandra & Stephen (1998)).

The three largest factors associated with infertility and impaired fecundity in women are problems in ovulation, blocked or scarred fallopian tubes, and endometriosis (the presence in the lower abdomen of uterine tissue). Sexually transmitted diseases are the most common preventable cause of damaged fallopian tubes. Among men, the most common causes of infertility are abnormal sperm or too few sperm. The Office of Technology Assessment (1988) reports that around one in five cases of infertility is not diagnosable.

Infertility and impaired fecundity are common. Abma, Chandra, Mosher, Peterson & Piccinino (1997) report that 2.1 million couples or 7.1% of married couples were infertile in the 1995 National

[1] Much of the information in this section is drawn from Office of Technology Assessment (1988). Women must also not be surgically sterile to be considered infertile.

Survey of Family Growth (NSFG) versus about 2.3 million couples in the 1988 NSFG and 2.5 million in the 1982 NSFG. While age-specific infertility rates have not increased over time according to the NSFG, the share of infertile couples trying to have a first birth rose dramatically between 1965 and 1988. Rates of impaired fecundity have risen considerably over the 1980s and 1990s. Chandra & Stephen (1998) report that rates of impaired fecundity rose from 8% of women 15-44 in 1982 to 13% in 1995.

Infertility treatment can be a long, arduous, and expensive process. The first stage of infertility treatment is a thorough examination of each partner's reproductive organs and their circulatory, endocrine, and necrologic functions. An early stage of treatment for women not ovulating normally is treatment with a fertility drug to stimulate ovulation. Drugs of various potencies are available, such as clomiphene citrate and gonadotropin-releasing hormones. The first of these drugs were approved for use in the U.S. in the late 1960s. Endometriosis can also often be treated with hormones.

More aggressive techniques such as in vitro fertilization (IVF), gamete intrafallopian transfer (GIFT), and zygote intrafallopian transfer (ZIFT) were pioneered in the early 1980s. In IVF, the oocytes (eggs) and sperm are combined in a laboratory. Once early embryos develop, they are transferred into the uterus. In GIFT, the oocytes are transferred immediately into the fallopian tubes and fertilization happens there. In ZIFT, the embryos are placed in the fallopian tubes. The first successful applications of IVF and GIFT in the U.S. led to babies born in 1981 and 1985, respectively. Currently, use of GIFT and ZIFT is relatively rare compared to use of IVF.

Another frequently used procedure that increases the likelihood of conceiving is intrauterine insemination (IUI). In this procedure, a woman is often given medication to stimulate multiple egg development and to help time when the egg(s) will be in the fallopian tubes. The sperm to be used is separated from the other components of semen in the laboratory, and then the concentrated sperm is placed in the cervix or high in the uterus using a catheter. Because women undergoing IUI are often superovulating, there is a non-trivial risk of multiple pregnancies with IUI.

Treatments for male infertility include artificial insemination and intracytoplasmic sperm injection (a form of micromanipulation, introduced in the 1990s, where sperm are injected directly into the eggs) as well as IUI. Surgery is also a treatment for some forms of male and female infertility.

Fertility services are used by a large and growing number of women. The 1995 round of the NSFG found that of 60.2 million women of reproductive age in 1995, 9.3 million or about 15% of women had ever sought treatment for infertility. The comparable figure in 1988 was 12% of women aged 15–44. Abma et al. (1997) report that in 1995, 2% of women of reproductive age had an infertility visit in the last year, 3% had ever taken ovulation-inducing drugs, and 1% had ever used advanced reproductive technologies.

Infertility services can be quite expensive and are not covered by all insurance plans. A number of states have passed laws requiring insurance plans to cover or offer to cover infertility treatment (see Table 5 for a list of these states). The Office of Technology Assessment (1988) estimated that in 1988, a simple diagnosis of scanty or infrequent menstruation followed by treatment with fertility drugs would have cost around $3,668. At this time, around 30% of the couples would have successfully conceived via this treatment. A comprehensive evaluation for non-ovulatory causes of infertility would have cost a further $2,905. Tubal surgery to deal with blocked or damaged fallopian tubes would have cost around $7,118, and IVF around $9,376 for two cycles (two sets of fertilized eggs implanted in the woman). In 1988, Office of Technology Assessment (1988) estimated that around 70% of infertile women would have become pregnant by one of these treatments, under some assumptions about how many women would succeed at each stage of treatment. Neumann, Gharib & Weinstein (1994) calculate that the cost of a successful delivery via IVF ranged from $44,000 to $211,940 in 1992, depending on the cause of infertility, the age of the mother, and other factors. While these figures are dated, they show that infertility treatment can be quite costly. This suggests that having access to insurance coverage for infertility treatment might be quite valuable.

3 Literature Review and Theoretical Perspectives

First, we touch on the mostly descriptive medical and public health literature on the association between prior infertility or impaired fecundity and subsequent fertility and infant health. We only discuss the papers most relevant for this study, namely ones comparing the birth outcomes of women using infertility treatment with those of other women in a cross-sectional or case-control research design. We note the difficulties associated with interpreting these previous findings as causal, referring to the existing economics literature on the production of infant health.

We then touch on existing work on health insurance mandates and their impacts on fertility and infant and child health. Finally, we present our theoretical framework and discuss the birth outcomes and child health outcomes that are the focus of the empirical work.

3.1 Infertility treatment, fertility behavior, and infant and child health

A number of papers in medical and public health journals examine trends in multiple births, in the use of infertility treatments, and in the outcomes of infants conceived via use of ART. The findings of the clinical literature on the association between infertility and birth outcomes are mixed. Some studies find that infertility is associated with having small-for-gestational age and preterm births while other studies find no such association. Many of the studies note one difficulty in identifying an association between infertility and birth outcomes. Infertile women who become pregnant are often older than other women, and age is independently associated with some negative birth outcomes.[2]

Schieve, Meikle, Ferre, Peterson, Jeng & Wilcox (2002) use registry data on all ART-assisted births for 1996 and 1997. They compare outcomes for infants conceived via ART with those for the full universe of infants born in 1997, finding that ART infants are of lower birth weight than the general infant population. Using Swedish data, Bergh, Ericson, Hillensjo, Nygren & Wennerholm (1999) find an increased risk of multiple births and an increased risk of prematurity and low birth weight for IVF singletons and for all IVF births relative to non-IVF births. They also find some increase in the frequency of congenital malformations among IVF singletons as compared to singleton births in the general population.[3] Dhont, Sutter, Martens & Bekaert (1999) find perinatal outcomes of singleton pregnancies conceived via use of ART are significantly worse than those of singleton pregnancies conceived spontaneously. Zhang, Meikle, Grainger & Trumble (2002) use a cross-section of births from 1995–1997 to examine the characteristics of women having multiple births. Compared to women having singletons, women having multiple births were more likely to be older, non-Hispanic white, more highly educated, married, and not to have any previous live births. These women had earlier and more frequent prenatal care. In this cross-section, Zhang et al. (2002) find that twins born to older mothers were at no higher risk than other twins, and triplets born to older mothers were at lower risk than other triplets, of being very premature, of being very low birth weight, or of dying in their first year. This pattern was reversed for singletons born to older mothers.

In the last few years, several studies have appeared that examine the longer-term health impacts of ART on children. Sutcliffe (2004) summarizes this literature, concluding that when born mature, ART children are as healthy as other children with the exception that ART children have higher rates of congenital anomalies.

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[2] See Varma & Patel (1987), Sheiner, Shoham-Vardi, Hershkovitz, Katz & Mazor (2001), Levi, Raynault, Bergh, Drews, Miller & Scott (2001), and Tan, Doyle, Campbell, Beral, Rizk, Brinsden, Mason & Edwards (1992).

[3] Saunders, Spensley, Munro & Halasz (1996) use Australian data to match IVF infants with infants from the general population, finding similar results to Bergh et al. (1999).

These last studies mentioned have the same goal as this paper, namely to identify the causal impacts of ART or infertility treatments more broadly. Clearly, the fact that mothers of multiples in the cross-section differed systematically along many observable dimensions from women having singletons raises questions about a causal interpretation of the Zhang et al. (2002) results. It is possible that women of higher socioeconomic status are positively selected along some unobservable characteristics or alternatively have access to better medical care. Either way, there could be a positive association between pregnancy outcomes of these women and their unobservable characteristics that offsets a possible increase in risk associated with being older and/or using infertility treatments. Similarly, many of the other findings discussed are based on cross-sectional comparisons of ART infants and children with other infants and children, again raising questions of causality.

3.2 Birth outcomes and selection

We turn to a discussion of the economics literature on birth production functions, which focuses more attention on possible selection bias. Fertility behavior has been the focus of a considerable economics literature, beginning with Becker (1991). An extensive line of work looks at infant health in a production function context; this work is surveyed in Wolpin (1997). Beginning with Rosenzweig & Schultz (1983), papers have estimated birth outcome production functions and input and output demand functions for infant health. A frequent question of interest here is whether health inputs such as prenatal care are associated with any impact on infant health.

Selection is an important issue when evaluating the impacts of various inputs on infant health. Women who use a health input may differ systematically from other women in ways that are both unobservable to the analyst and unrelated to the use of the health input. Comparing outcomes for the two groups of women will show that they are systematically different, yet we know it is because of their unobservable differences and not because of differential use of the health input. There can be selection both in which women use health inputs and in the health distribution of infants who are actually born. Both types of selection can bias findings.

Some papers hypothesize that women who anticipate adverse birth outcomes because of information available to them (but not to the analyst) may be more likely to invest in these inputs, biasing down estimates of the positive effects of prenatal care, for example. An alternate hypothesis posits positive selection; women who initiate care early may engage in other forms of healthy behavior, leading researchers to overestimate the positive impacts of prenatal care.

Grossman & Joyce (1990) emphasize that the resolution of the pregnancy itself may also be characterized by selection (e.g., women who think they have very unhealthy fetuses may choose to abort these fetuses). Grossman and Joyce find evidence of positive selection among black but not white women choosing to carry their pregnancies to term. Donohue & Levitt (2001) find that introduction of legalized abortion is associated with a decrease in crime rates for cohorts born after legalization although Joyce (2004) questions this finding, while Donohue & Levitt (2004) defend it. Gruber et al. (1999) show that average outcomes of infants born after the legalization of abortion were better than those of infants born before legalization, suggesting that access to legal abortion led to positive selection among children who were born. In a more recent paper, Ananat, Gruber & Levine (2004) suggest that this selection was due to a permanent and not transitory decline in births for some women.

This previous literature on birth selection suffers from an inability to separate out heterogeneity or selection among mothers from the impact of investment by mothers. Both heterogeneity and investment are expected to affect birth outcomes in the same direction. Our analysis does not suffer from this drawback. Users of ART and other infertility treatment are infertile and may have more difficulty supporting a fetus through an entire pregnancy than do other mothers despite having invested heavily in their pregnancies. The selection biases from these two factors (heterogeneity and investment) are expected to go in opposite directions.

Another literature, touched on above, documents that women in the U.S. are delaying childbearing, perhaps to accumulate more human capital or to advance in the labor market. This delay in fertility may bear costs if there is a substantial age-gradient in fertility, confounding the selection bias discussed above. Royer (2003) uses panel data to study the impact of age at birth on children's outcomes, finding that women over 35 and women under age 18 are more likely to have a preterm delivery than women 26-29, and that women over 35 also face a higher risk of infant death and of having infants with some abnormal condition.[4] It is important that we also control for this age gradient in order to identify a selection effect due to ART or other infertility treatments rather than confounding it with one due to delayed childbearing. We discuss this below in more detail, but point out that our use of variation induced by insurance mandates allows us to compare outcomes for older women in mandate states with that of other, observationally similar, older women.

[4] Royer's estimates account for unobserved maternal differences using correlated random-effects. Notably, while her correlated random-effects estimates are quite different from the fixed-effects estimates, they are fairly close to her own adjusted cross-sectional estimates, which are similar to those from the medical literature (e.g., Cnattingius, Forman, Berendes & Isotalo (1992)).

3.3 Insurance mandates

Without asymmetric information, economic theory provides clear predictions for the impact of mandates on employers on wages, employment, and insurance coverage; namely that they should all decrease (e.g., Summers (1989)). In such a setting, with homogeneous workers, wages should fall until (almost) all of the cost is covered by the worker's lower wages. With heterogeneous workers, firms may respond by cutting insurance availability or shifting employment. All of these predictions hold to some extent for the case of group-specific mandated benefits. However, in the presence of informational asymmetries, theoretical implications for the effect of health insurance mandates on coverage and on health outcomes are less clear. For example, with adverse selection, even if individuals value a particular form of coverage above than their own actuarially fair price, they may not be able to obtain coverage in the individual market without a mandate.

Practically, the Employment Retirement Income Security Act (ERISA) of 1974 exempts self-insured firms from state-level mandates, suggesting that imposition of mandates may encourage firms to self insure. To the extent that it is more expensive for small firms to self-insure, this suggests the costs of mandates may fall disproportionately on smaller firms (Jensen & Morrisey (1999)). A large share of workers are employed by self-insured companies, and presumably these firms are not affected by the mandates. However, depending on the correlation between demand for the service covered by the mandate and worker productivity, mandates could also compel self-insured firms to offer benefits they otherwise would not offer in order to retain highly productive employees.[5] Theoretical ambiguities about the impacts of mandates suggest we turn to empirical evidence. However, the empirical literature on the effects of mandated health benefits on health insurance and health outcomes is mixed, with some papers finding little or no significant impact of mandates on health status or health care utilization (e.g., Klick & Markowitz (2003), Pacula & Sturm (2000), Bao & Sturm (2004)), while other papers find some significant impacts on health utilization and health status (e.g., Liu et al. (2004)).

There is little social science literature about how state-level mandates to cover new reproductive technologies have altered the price of having children or child outcomes for women with impaired fecundity.[6] Recently, several clinical papers have used cross-sectional data to examine the impact of insurance mandates on use of IVF and pregnancy outcomes. Massachusetts imposed a broad mandate to cover infertility treatment in 1987. Griffin & Panak (1998) use administrative insurance company

[5] Liu, Dow & Norton (2004) touch on possible spillovers of "drive through delivery" laws mandating minimum hospital stays for women post-delivery to women not directly covered by the laws.

[6] Exceptions in the economics literature include papers by Schmidt (2005), Buckles (2005), Hamilton & McManus (2004*b*), and Hamilton & McManus (2004*a*), discussed below.

data from Massachusetts for nine large insurance plans for 1986–1992. They find imposition of the mandate is associated with increased use of ART and a small increase in the per capita cost of providing infertility services for Blue Cross Blue Shield but a decrease in per capita cost for HMOs. Jain, Harlow & Hornstein (2002) compare aggregate numbers of IVF cycles and live births in 1998 for states with no coverage of IVF, partial coverage of IVF, and full coverage of IVF.[7] They find that women at clinics in full-coverage states underwent more cycles (per capita) than did women in partial-coverage or no-coverage states. However, women in full-coverage states also transferred fewer embryos, suggesting that insurance coverage of IVF might be associated with a decrease in the risk of high order births.[8] One problem with these studies using insurance coverage is their reliance on cross-sectional data.

Schmidt (2005) uses Detailed Natality data from 1981–2000 and differences-in-differences techniques to see whether first birth rates are higher in states with mandated coverage, controlling for age, race, state, and year. She finds that first birth rates are statistically significantly higher for women over 35 in states mandating coverage.[9] Buckles (2005) also uses the Detailed Natality data to look at age at first birth, finding mandates are associated with higher average age at first birth and more deliveries per first birth. She also considers effects of mandates on human capital accumulation, labor market participations, and wages.

In a series of papers (e.g., Hamilton & McManus (2004*a*), Hamilton & McManus (2004*b*)), Barton Hamilton and Brian McManus create a theoretical model of the behavior of infertility clinics under competition and mandates and of the use of ART such as IVF. They test their model using data from infertility clinics. Hamilton & McManus (2004*a*)) uses clinic data for 1995–2001 and 1987 on use of IVF, the number of cycles undergone, the number of embryos transferred, the birth rate, and the rate of multiple births. Because their clinic data only contains information on cycles of ART such as in vitro fertilization, Hamilton and McManus differentiate between mandates that include IVF and are "universal" and other mandates. They find that universal insurance mandates increase cycles of IVF but cut the number of embryos transferred. That find that competition between clinics increases the number of ART cycles as well. Their clinic data do not allow them to tell whether more women are obtaining access to ART or whether women who already had access are undergoing more cycles of

[7] Recall that one IVF cycle can involve implantation of one or, frequently, more than one fertilized embryo in the woman.

[8] Reynolds, Schieve, Jeng & Peterson (2003), using microdata for 1998, find that while women in states that mandate coverage of IVF indeed transfer fewer embryos, this only translates into a lower triplet or higher order birth rate for one state, Massachusetts.

[9] Schmidt's data consist of birth rates within 5-year-age-group by race by state by year cells. Her findings are robust to controlling for cohort-year interactions, and account for a variety of other factors that are known to influence fertility behavior (e.g., abortion restrictions in the state).

ART.

Hamilton and McManus's data do not contain information about use of other infertility treatments, thus their data cannot capture all impacts of the insurance mandates unless the mandates had no effect on use of any infertility treatments but ART. Further, no states adopted mandates during their sample period, so they cannot include state fixed effects in their estimates. They argue that states with mandates are similar to states without mandates (and thus that there is no need to control for time-invariant differences across states). They support this contention by looking at treatment rates in 1987 as a function of the later mandates. Hamilton & McManus (2004*b*) looks at the impacts of competition on technology choice for clinics for 1987–2001, finding clinics in competitive markets were quicker to adopt new technologies.

3.4 Theoretical perspectives

Improvements in infertility treatment lower the cost to infertile women of having their own children rather than going without or adopting. This may increase fertility among couples who would have been unable to conceive before these new technologies were widely available. In effect, these technologies may have shrunk the tail of the fecundity distribution. If women at the lower tail of the fecundity distribution are more likely to have infants at the lower tail of the infant health distribution, all other things being equal, subsidized infertility treatment might be associated with worse infant and child health outcomes.

Alternatively, some types of infertility problems may have little or no correlation with infant health (e.g., blocked fallopian tubes). The existence of advanced reproductive technologies might also provide some women with insurance against being infertile, enabling them to delay childbearing. If there is an important age-gradient in birth outcomes, these women's infants may have worse health outcomes than if the women had not delayed childbearing. However, if these women accumulate sufficient human capital, or achieve higher socioeconomic status, they may invest more in the health of the infants, suggesting a possible offsetting effect of increased inputs on infant health. The overall effect of technology and its possible insurance value is theoretically unclear.

Any woman who goes through the more invasive medical interventions described above in Section 2 clearly wants any resulting children very much. Thus, one expects that women who respond to the insurance subsidies or who delay childbearing will invest more in fetal health during their pregnancy than will other women.

By using a pooled series of cross-sections of singletons and twins over the period 1981–9999, we can assess whether either the twin birth rate or twin birth outcomes have changed over time as use of ART and other technology has spread. By also examining Census data on the prevalence of blindness, deafness, physical disabilities, and other conditions, we can see whether the health differences we observe at birth have longer-term effects. By using data spanning a period before ART was used in the U.S., we ensure that the early period comparisons do not mix women who did and did not use ART. In the absence of both better technology for saving premature and otherwise at-risk infants and changes in the age structure of women giving birth, the pre-ART outcomes provide a benchmark against which to compare the later, partially ART-induced outcomes. We control for technology improvements in neonatal care by comparing outcomes for children of older versus younger mothers in each period; each group should have some access to neonatal care. We further control for improving neonatal care and other changing trends by including both year fixed effects and state-specific linear time trends. Finally, our differences-in-differences strategy uses state-level over-time variation in access to infertility treatments induced by infertility insurance mandates to compare women who have enhanced access to infertility treatments (because they live in states with mandates) to other women.

First, we use a random subsample of twins and singletons to show that the mandates have indeed resulted in changes in the twin birth rate. We then focus on birth outcomes—birth weight, gestation, and Apgar score—that have been linked to later infant health. A large medical literature links low birth weight with adverse infant health outcomes (e.g., McCormick (1985) and Rees, Lederman & Kiely (1996)). A less settled literature examines the impacts of low birth weight on child morbidity (e.g., McCormick, Brooks-Gunn, Workman-Daniels, Turner & Peckham (1992)). Wolpin (1997) surveys the literature on the observed relation between birth weight and infant mortality. A series of studies by economists and others have found that birth weight is also correlated with later outcomes such as self-reported health status, earnings, and educational attainment (e.g., Behrman & Rosenzweig (2001) and Currie & Hyson (1998)). Almond, Chay & Lee (2004) discuss the existing literature on the importance of birth weight and offer evidence that the 5-minute Apgar score may be a better predictor of infant mortality among twins.[10]

There is also considerable evidence that premature infants are at risk of worse health outcomes later in life (e.g., McCarton, Wallace, Divon & Vaughan (1996) and ACOG Committee on Practice Bulletins—Obstetrics (2002)). For example, nearly one-fifth of all very preterm births in 1999 did not

[10]The 5-minute Apgar score is used to evaluate the condition of the newborn infant at 5 minutes after birth (Division of Vital Statistics, NCHS (2000)). It is a good predictor of surviving the first year. It is a summary measure of the infant's condition based on heart rate, respiratory effort, muscle tone, reflex irritability, and color. Each of these is given a score of 0, 1, or 2; their sum is the Apgar score. A higher score is better.

survive the first year (Martin, Hamilton, Ventura, Menacker, & Park (2002)). The categories of low birth weight and very low birth weight, like the indicators for being premature, are taken from the International Classification of Diseases-Ninth Revision (ICD-9), and are key cutoffs in the birth weight and gestation distributions reported for births by the NCHS. "Extremely low" birth weight (being < 1000 grams) is a cutoff found by Almond, Chay & Lee (2002) to be correlated with a increase in infant mortality for twins.

Our results suggest that for twins, being born in a mandate state to an older mother is associated with having a lower birth weight, a shorter gestation, and a lower Apgar score. This finding combined with the clinical evidence linking and extremely low birth weight births and developmental outcomes motivates our analysis of the association between being born in a mandate state to an older mother and these longer-term health outcomes.

We pool data from the 1-percent and 5-percent PUMS data and the 2001 and 2002 ACS to examine some longer-term child health outcomes. Our outcomes are measures of disability status asked of all persons 5 or older. The four measures we examine are (1) does the person have long-lasting blindness, deafness, or a severe vision or hearing impairment?; (2) does the person have a long-lasting condition that substantially limits one or more basic physical activities?; (3) because of a physical, mental, or emotional condition lasting 6 months or more, does the person have difficulty learning, remembering, or concentrating?; and (4) because of a physical, mental, or emotional condition lasting 6 months or more, does the person have difficulty dressing, bathing, or getting around inside the home?[11]

We selected these outcomes for two reasons. The first is that these outcomes are ones the clinical literature associates with being born very preterm or of extremely low birth weight. For example, in a recent article, Vohr, Wright, Dusick, Mele, Verter, Steichen, Simon, Wilson, Boryles, Bauer, Delaney-Black, Yolton, Fleisher, Papile & Kaplan (2000) report neurodevelopmental, neurosensory, and functional outcomes of extremely low birth weight (401–1000 gram) survivors being tracked by the NICHD Neonatal Research Network. Extremely low birth weight children born in 1993 and 1994 were assessed at age 18–22 months. 51% of the children had normal neurodevelopmental and sensory assessments, and outcomes worsened as birth weight decreased. Colvin, McGuire & Fowlie (2004) review the evidence about neurodevelopmental outcomes after preterm birth, noting that very preterm infants (many of whom are also low birth weight) are at increased risk of vision and hearing problems, even though most preterm infants have good neurodevelopmental outcomes. The second and more

[11] We also plan to look at children's grade-for-age in future work but need to augment the 2000 PUMS data with data from the 1990 Census to do so.

practical reason for looking at these outcomes is that they are the only long-term health outcomes we are aware of available in the Census or any other large, public-use data set.

Next, we turn to a more detailed discussion of the data sets we use.

4 Data

This paper uses two large data sets, pooled birth certificate data from 1981–1999 and pooled 1-percent and 5-percent PUMS data and 2001 and 2002 ACS data. First, we discuss the Natality data and present basic summary statistics. We briefly discuss time series trends in the use of ART. We then describe and present summary statistics for the PUMS/ACS data.

4.1 Detailed Natality data

The data used in this paper are a subset of the National Center for Health Statistics Detailed Natality Data for the years 1981–99 (Division of Vital Statistics, NCHS (Various years)). The Detailed Natality data are either a one-half sample or the universe of birth certificates for live births in the U.S., depending on the state and year. The data include demographic information about the parents such as education, age, and marital status. For the analysis of birth rates, the data consist of one in fifty random sample of both singleton and twin births. For the analysis of infant health outcomes, the data includes all twin births in the Detailed Natality data or a one in fifty random sample of singleton births.[12] The data also include many pregnancy outcomes.

For a large subset of the twin data, it is possible to probabilistically match the two twins in the pair as in Almond et al. (2002).[13] For matching records, we create indicators for whether the twins are both boys, both girls, or mixed-sex.

Mixed-sex twins must be dizygotic while same-sex twins can be either monozygotic (identical) or dizygotic (fraternal). Mixed-sex pairs and same-sex fraternal pairs will on average share 50% of their genetic material while, in the absence of mutations, same-sex identical twins will share 100% of their

[12]From 1985 through 1999, the Detailed Natality data include all births born to U.S. residents. Before 1985, some states submitted a 50% sample of birth certificates; for these years, the microdata contain a weight or one or two that allows calculation of statistics representative of the full population. Some states did not report maternal education or Hispanic ethnicity until the early 1990s; all regressions include dummy variables for these variables being missing or unreported.

[13]We match records for groups of births with the same maternal and paternal characteristics, the same date and place of birth and delivery, and the same gestation and prenatal care initiation. Using this algorithm, 88 percent of the total records were matched to one other record, about 12 percent were matched to zero other records, and less than 0.05 percent were matched to more than one other record. Any match where one of the records had a weight of two (indicating it was from a state reporting only 50% of the birth certificates that year) was dropped (this resulted in dropping 1.3% of the matches).

genetic material. Since twins that result from infertility treatment are less likely to be identical than are naturally occurring twins, an larger increase in the share of twins that are mixed sex than the share that are single sex suggests that more twins may be the result of infertility treatment. Many infertility treatments explicitly involve fertilizing and implanting more than one egg in order to increase the chances of a successful pregnancy. Use of some ovulation-inducing drugs can cause more than one egg to be released, also leading to an increase in the chance of having a multiple birth (Callahan, Hall, Ettner, Christiansen, Greene & Crowley (1994)).

Figure 1 shows the average share of infants that are multiples during 1981-1999, by state. Clearly, there has been an increase over this period in the share of live infants who are multiple births. The upward trend seems to pick up around the late 1980s. Figure 2 shows the average age of mothers of twins, by state, for the same period. This figure shows also that the average age of twin mothers has risen considerably over the period.

Average birth weight and gestation for twins have also gone down over time (not shown). This decrease in birth weight and gestation may partially be due to the dissemination of and tremendous improvements in technology for keeping infants alive over this period, and motivates inclusion of state-specific time trends in all regressions.[14] The composition of the pool of women giving birth to twins has also changed over this period (not shown). The share of twins that are mixed-sex has increased from 29% of twins in 1981–88 to 33% in 1995–99. This is consistent with an increase in the share of twins born to women treated for infertility as many treatments either encourage production of more than one egg or, like IVF, usually involve transferring more than one fertilized egg into a woman.

Our empirical strategy relies on variation in state infertility mandates. Thus, it is interesting to see whether outcomes and demographics vary by whether the mother's state of residence had a mandate in effect the year before the birth.

Table 1 contains means for the twin birth rate, and for the mixed-sex and same-sex (girls or boys) twin birth rate over two periods: One when there was no state mandate for infertility treatment in effect during the year before the infant was born (column 1) and the other when there was such a mandate in effect (column 2). The twin birth rate is for the entire sample of twins and singletons. Twins that could not be matched with another twin are dropped from the calculation of type of twin (mixed-sex, boy-boy, and girl-girl), thus the sum of the three twin types does not equal the overall rate.

This table shows that twins are a larger share of births when mandates were in effect (this difference

[14]For a discussion of the benefits of these new technologies, see Cutler & Meara (2000). For a discussion of factors affecting their dissemination, see Baker & Phibbs (2002).

is highly significant, with an F statistic of 70). The increase is about evenly split between the different types of twins that can be matched.

Tables 2–4 contain means outcomes and some maternal and child demographics over the two time periods (mandates/no mandates) for the sample of twins. Table 2 shows that average gestation is slightly lower when mandates are in effect while birth weight is the same in both periods and Apgar scores are higher when mandates are in effect. Of all the comparisons of outcomes across periods, only birth weight and low birth weight are not statistically significantly different from one another. Table 3 shows average maternal age and the share of twins born to women in various age groups across the same two time periods. The share of twin births to older mothers is much higher in states with mandates in effect. The share of twin births to women 40 and older was 0.014 in no mandate state-years cells but 0.030 in mandate state-year cells. Table 4 shows means of educational attainment among women of various age groups having twins across the two time periods. Means and sample sizes are only presented for records reporting educational attainment; the number of records for which education is missing is also reported. Clearly, educational attainment of twin mothers has increased considerably, and the increase is larger (as a share of twin births in the age group) for older mothers.[15]

There has been a large shift in the distribution of women who had twins over the past 20 years. Twin births are more likely in mandate states. Twin mothers look quite different depending on whether a mandate was present. These mean differences may be the result of the mandates or they may merely reflect changing trends. Next we discuss recent trends in ART use.

4.2 Use of advanced reproductive technologies

Beginning in the mid-1980s, the Society of Assisted Alternative Reproductive Technology of the American Fertility Society (later known as the Society for Assisted Reproductive Technology and the American Society for Reproductive Medicine, respectively) began a voluntary registry of clinic data on IVFs, embryo transfers, and other ART treatments and their outcomes. In 1992, Congress passed the Fertility Clinic Success Rate and Certification Act, which requires the CDC to publish clinic-specific success rates for ART procedures in the U.S. As a result, the total number of pregnancies and live births resulting from ART as well as the number and type of ART cycles are available from the registry and/or the CDC data. Unfortunately, registry data are not publicly availably at the state-by-year level. Data on the number of ART-associated deliveries are only available from 1989–1998. Figure 3 shows the total

[15] These differences are statistically significantly different between the two periods in this table for women 30 and older.

number of pregnancies, deliveries, and live births over the period. While there are no registry data for the period before 1985, it is unlikely that there were many ART-related pregnancies before that; the first live birth in the U.S. from an IVF procedure occurred in 1981. Even in 1985, only 2389 IVF cycles, 26 frozen embryo transfers, and 56 GIFT procedures were performed, eventually resulting in just 160 live births (Medical Research International, American Fertility Society Special Interest Group (1988)). Figure 3 shows that the number of total pregnancies, deliveries, and live infants born after use of ART has increased considerably over the 1990s, again with much of the increase occurring after or around 1989, shortly after the first state-level laws would have impacted deliveries. Figure 3 also shows that many of the deliveries after 1989 were multiples (if all births were singletons, then the number of deliveries and live infants would be the same). While they show unadjusted means, the figures suggest that increases in the use of ART and the multiple birth rate occurred around the same time as the first mandates were implemented (the late 1980s).

4.3 PUMS and ACS data

The PUMS are 1- or 5-percent samples of data for occupied or vacant housing units, collected as part of the 2000 decennial Census. The American Community Survey collects information for about one million households each year. The PUMS/ACS data include information on age, state of birth, race and ethnicity, disability status, educational attainment, and a host of other variables. We pool the two PUMS samples with the 2 ACS samples to maximize sample size. By taking children aged 0–17 from the PUMS/ACS, one can create a panel of children still alive in 2000–2002 who were born from 1982–2002. The only children omitted from this sample are children with no permanent home, children residing in group quarters, children who have died between birth and the survey, and children who have left the U.S. between birth and the survey.

For children in the primary family, we also know their relationship to the householder and can infer whether their mother is in the household. By matching children of the same age and the same relationship to the householder whose age and relationship variables were not allocated, one can identify multiple births. For example, two children would be identified as twins if they were the only two children in the primary family of the same age and the and same relationship to the householder. Because the 2000 PUMS and the ACS do not contain quarter of birth, this procedure will incorrectly identify some sets of siblings who were born only 9–11 months apart as multiple births. However, this measurement error should attenuate our coefficients rather than introducing systematic bias. Further, since many disabilities are more common as children age, this should also bias against finding any long term impacts.

By restricting the sample to grandchildren or children of the householder, we are more certain these "twins" are primarily biological siblings. We also link the children's records to information about their "mother." If the child is a biological child of the householder, the "mother" will be the biological mother if she is the householder and the wife of the biological father otherwise. If the child is a grandchild, we can use the subfamily number and subfamily relationship to tie children to their likely "mothers."[16]

For these grandchildren and children of the householder, we can estimate the mother's age at the child's birth as the mother's current age minus the child's age. Unfortunately, the only educational attainment measure we have for the mothers is current education, which is not necessarily the same as the mothers' education at the time of the birth(s). We can then link the child's record to characteristics of the state where the child was born in by state of birth and the approximate year the child was conceived. Year of conception is defined as $2000 - age - 1$. Because the disability measures are only reported for children aged 5 and up, we only present results which restrict the PUMS/ACS sample to children aged 5–17 (we also discuss the twinning results for the sample of kids 0–17).

Table 6 contains means for children 5–17 who are singletons or twins, who are grandchildren or children of the householder, whose records have no allocated data on age or householder relationship, and whose "mother" is in the household. Column 1 contains the average probability of being a twin for children born in states with no infertility treatment mandate the year they were conceived and column 2 for children born in states with mandates while they were conceived.[17] We see that in the PUMS/ACS data, as in the Detailed Natality data, twin births are more likely in mandate states. Table 7 contains summary statistics for the disability measures, for the twin sample only, by mandate status during the year of conception. Here we see that impairments appear more common for twins born in states without mandates in place at conception.[18]

Next we turn to a discussion of our empirical strategy.

[16]Subfamily information is only available for related subfamilies (married couples with or without never-married minor children or single parents with never-married minor children), where some subfamily member is related to the householder. For subfamily units where no member is related to the householder, no relationship information is available. Thus we cannot match children to their parents in such cases.

[17]There will be some miscoding of state of conception here as with the birth certificate data, but only if families move between conception and birth. This is likely not very common.

[18]Also note the rate of twinning in the PUMS/ACS data is slightly higher than that found in the Natality data. For example, the pre-mandate average rate of twinning was approximately 0.02 versus the 0.03 reported here. This likely is partially due to our miscoding some siblings as twins but could also be due to compositional differences between twins still living with their parents in the PUMS/ACS and all twins.

5 Empirical Model

This paper analyzes the impact of infertility treatment on fertility behavior and health outcomes. One naive approach would be to directly regress birth outcomes on indicators for use of infertility treatment. In fact, as discussed above, there are several papers in the medical literature that compare birth outcomes of women using ART to those of other women giving birth. An issue with these case-control studies is that couples using ART are likely to be a selected sample. These couples are the parents who most want to have children, thus they may invest more in their children. Obviously, these couples are also at the lower end of the fecundity distribution, which may suggest that their infants have worse health endowments. A further issue is that, in addition to being potentially endogenous, use of infertility treatment is rarely recorded in public-use data sets. If it were, we could use the mandates as candidate instruments.

In this paper, we compare women who are likely to have easy access to infertility treatment to women who do not. Infants born via use of ART or other infertility treatment, while growing in number over the 1980s and 1990s, still represent a small share of total births. We focus on a population where they are likely to be a larger share of overall births, namely twins. We further focus on older women as the group most likely to be using these treatments. Society for Assisted Reproductive Technology, American Society for Reproductive Medicine (2002) reports that 52% of IVF cycles in 1998 were for women 35 or older. A joint report by National Center for Chronic Disease Prevention and Health Promotion, ASRM, SART, RESOLVE (2002) notes that 70% of cycles in 1998 were for women 30–39. Putting these two sets of numbers together suggests that about 81% of IVF cycles in 1998 were undergone by women 30 and older.

Our econometric approach is to run least squares regressions of outcome measures on demographic covariates, state-level controls, state and year fixed effects, state-specific time trends, policy variables related to infertility mandates, and interactions of the policy variables with maternal age indicators.[19] The regressions have the following form:

$$y_{ist} = X_{ist}\delta + S_{st}\alpha + IT_{st}\beta_1 + A_{ist}ITst\beta_2 + \theta_s t + \gamma_s + \nu_t + \epsilon_{ist}. \quad (1)$$

Here, y_{ist} is any of a series of outcomes for an infant or child. For the fertility regressions, y_{ist} is simply an indicator for being a twin in a pooled sample of twins and singletons from the Natality data or from the PUMS. Health outcomes from the Detailed Natality data include birth weight; indicators

[19] Results for birth outcomes that are binary variables are robust to running the regressions as probits.

for the birth weight being low (< 2500 grams), very low (< 1500 grams), or being extremely low birth weight (< 1000 grams); length of gestation; indicators for the birth being premature (< 37 weeks) or very premature (< 32 weeks); and the 5-minute Apgar score. For each birth outcome in the Natality data, we only use the balanced panel of states and years where the outcome was reported by the state for every year. The disadvantage of this sample selection is that regressions for different outcomes may use different samples but the advantage is that it maximizes the sample for each outcome. We investigate the sensitivity of the results to this sample restriction in Section 6.5 below.[20] These outcomes are ones the literature associates with infant mortality and later worse infant outcomes. By presenting a variety of birth outcomes, we can test whether our findings are robust. We present birth weight first, as it is the most reliably measured (gestation is dated from the last menstrual period in much of the data).

In the PUMS/ACS data, y_{ist} is any of the four disability measures: (1) being blind or deaf or having a severe vision/hearing impairment; (2) having a long-lasting condition that substantially limits physical activity; (3) having a condition lasting at least 6 months that causes difficulty learning, remembering, or concentrating; and (4) having a condition lasting at least 6 months that causes difficulty dressing, bathing, or getting around inside the house. These are also measures the medical literature finds more prevalent among infants born very prematurely or of extremely low birth weight.

X_{ist} is a vector of demographic characteristics, including controls for the mother's age group (20–24, 25–29, 30–34, 35–39, 40–44, and 45 and older), race (black, Asian or Pacific Islander, American Indian, and other non-white), Hispanic ethnicity (or an indicator for Hispanic ethnicity not being reported), and education (high-school graduate, some college, four-year college degree, or missing). Regressions using the Detailed Natality data also control for the number of previous live births (1, 2, 3, 4, 5 or more, or missing).[21] We also control for the infant's or child's sex. Specifications run on the pooled, matched-twin data also contain indicators for the twins being mixed-sex or for both being girls. Mother's educational attainment is included as a proxy for permanent income or resources. The other variables are included because of the evidence that birth outcomes vary by race, ethnicity, age of the mother, gender of the infant, and type of multiple birth (identical or not).

S_{st} is a vector of state-level demographic, labor market, public assistance, and, in some specifications, health care access variables. These variables include the unemployment and aggregate employ-

[20]These restrictions are more onerous for some outcomes than others. New Mexico is the only state excluded from the gestation regressions. California, Delaware, and Oklahoma are excluded from the Apgar score regressions.

[21]We do not include number of siblings in the PUMS/ACS regressions because we only know about their existence if they are still living at home. This would be more of a problem for the older children and possibly for the children of older mothers, who may have had other children while young.

ment growth rates, real median income for a family of four in the state, real annual AFDC/TANF benefits for a family of 4, the cutoff for Medicaid eligibility for a pregnant woman in the state as a share of the federal poverty level, the share of the state population that is under the poverty level, the share of births to unmarried mothers in the state, and the percent of the total state population that is black or Hispanic. These control for state characteristics that may be associated with fertility or the level of health care available to women. In some specifications discussed in Section 6.5, S_{st} also includes variables that control for the level of neonatal care technology available in the state. Means for these state-level variables for the sample of twins from the Natality data are presented in Appendix Table 1. [22]

The γ_s and ν_t terms represent state and year fixed effects. The state (year) fixed effects control for unobserved factors that differ across states and not over time (over time and not across states). Unobservable determinants are captured by ϵ_{ist}. The main specifications also include state-specific linear time-trends, $\theta_s t$. In the fertility regressions, these trends may capture changes in social norms. In the infant health regressions, the trends help capture dissemination of advanced technologies to prolong the life of high risk infants.[23] All regressions and summary statistics are weighted. For the birth certificate data, weighting is necessary because in the early 1980s, some states only provided a 50% sample of birth certificates. For the PUMS/ACS data, use of weights accounts for varying sampling probabilities and non-response adjustments.

All standard errors are clustered at the state-by-year level. This accounts for the fact that the key policy—infertility mandates—only varies at the state-by-year level. Bertrand, Duflo & Mullainathan (2004) and Kezdi (2002) raise concerns about serial correlation with differences-in-differences methodology using state policy reforms, particularly when the reforms stay on once implemented. The statistical significance level of key coefficients of interest was substantively the same with state-level clustering as with state-by-year level clustering.

In order to interpret the coefficients on the age by infertility mandate interactions as estimates of the impact of being older in mandate states on infant health outcomes, we must rule out one alternative. All of the mandates occur in the later part of the sample and no mandate states have subsequently lifted their mandates. If older women in the mandate states are disproportionately receiving care at

[22] Sources for all state-level variables are discussed in a Data Appendix, available upon request.

[23] One concern with this strategy is that trends may not adequately capture dissemination of these technologies. However, these advanced technologies may themselves spread because they are demanded by women who are delaying childbearing. Section 6.5 investigates the sensitivity of the estimates to including controls for neonatal intensive care and intermediate care availability within the state.

hospitals with more advanced technologies for saving babies as compared to younger women and older women in the earlier periods, then the older women's more sickly fetuses may be more likely to survive, leading to a spurious association between being an older mother in a mandate state and adverse infant health outcomes. However, the younger women in the mandate states will also presumably have access to these technologies. As noted above, all infant and child health regressions include state-specific time trends as a imperfect proxy for dissemination of these baby-saving technologies. For the alternative hypothesis to bias the results, these new technologies would also have to be more easily available to older women than to younger women in mandate states post-mandate as compared to time periods with no mandates. Simple cross-sectional differences in access will be captured by the main age effects.

Our main focus is on the coefficients of IT_{st}, a vector of dummy variables for state-level laws mandating insurance coverage of infertility treatment, and interactions of IT_{st} with a dummy for the mother being 30 and older or 35 and older. We interact insurance status with age because older women are those most likely to be suffering from infertility or impaired fecundity, and thus the interaction allows the possibility of a larger impact for older women. Alternatively, one could view the younger women as a control group for the older women (our preferred interpretation for the twin results).

If a state has passed a law mandating that health insurers cover or offer to cover infertility treatment, then the state is forcing insurers to subsidize infertility treatment. In themselves, these mandates do not automatically represent a subsidy. If the insurance market is working perfectly and there are no information problems or other inefficiencies, absence of such coverage would merely imply people were unwilling to pay for such coverage. However, even in an efficient market, if such mandates forced insurers to pool infertility treatment with other treatments, it could result in infertility treatment being subsidized. In the case of adverse selection where insurers cannot identify who likely users of infertility treatment are, mandates may also have real effects.

Many of the states with mandates in effect also cover state employee's infertility treatment. We cannot include a control for state employee coverage of infertility treatment because historical data is unavailable. However, if states with mandates also cover state employees for equity reasons, we might also be picking up the effect of the state employee coverage via the mandate variables.

The coefficients on the insurance variables represent the impact of these subsidies on infant and child outcomes. There are three sets of insurance variables. The first set includes an indicator for whether the state has any mandates concerning infertility treatment and its interaction with maternal age. The second set splits this law indicator into two variables, an indicator for whether the state has a law mandating that health insurers cover or offer to cover infertility treatment specifically excluding

IVF and an indicator for whether the state has passed a law mandating that insurers cover or offer to cover such treatment including IVF. The third set splits the "any law" indicator by whether the mandate forces insurance companies to cover treatment or merely offer coverage to employers purchasing insurance policies.

Table 5 contains a list of states with mandates and indicates the year the state passed the law, whether the mandate specifically excludes IVF or does not, whether the law mandates coverage or that the insurer offer coverage, and how the mandate applies to HMOs.[24] The indicator variables are set to one for every year after the year the law passed (treatment and a successful pregnancy usually take at least 9 months). [25]

There is considerable cross-state over-time variation in when and where the laws were passed during 1981–99 (statistics not in tables). 3% of the twins in the Natality data were born to mothers living in states where a mandate did not exclude IVF from 1981–88, while 17% of twins born in 1989–94 and 20% of the twins born in 1995–99 were born to mothers living in such states. A similar proportion of mothers of twins lived in states with laws mandating insurance coverage but excluding IVF.

The age-by-insurance status variables represent the differences-in-differences impact on birth outcomes for older women in mandate states periods versus older women in non-mandate states as compared to younger women in both sets of states.

We now turn to the results.

6 Results

Section 6.1 discusses the results of regressions predicting the probability of having a twin versus a singleton in the Detailed Natality and PUMS/ACS data. Section 6.2 then discusses the results for regressions predicting health outcomes for twins in the Natality data, Section 6.3 the results for health outcomes for singletons in the Natality data, and Section 6.4 the results for twins in the PUMS. Finally, Section 6.5 discusses various robustness tests.

[24]Information about the state laws was taken from National Conference of State Legislatures (2002) and cross-checked with law information available at `http://www.asrm.org/Patients/insur.html`. These laws do not cover self-insured companies' health insurance plans; as this is preempted by ERISA.

[25]Robustness regressions also include two-year lags of the laws.

6.1 Mandates and the probability of twinning

Table 8 reports coefficients on our key mandate variables and their interactions with the mother being at least 30 for regressions using a one in fifty random sample of singleton and twin births from the 1981–1999 Detailed Natality data. Each column presents coefficients from a different regression including a different set of mandate variables and all of the controls discussed above. The first column suggests that twin births are more likely for women 30 and older in mandate states. The coefficient of 0.003 represents about a 10 percent increase in the probability of having a twin birth, compared to the pre-mandate mean of 0.0295 for women 30 and older.[26]

Turning to column 2, we see that whether or not the state includes IVF in the mandate, women 30 and older are more likely to have twins, and the effects are similar in size for the two types of mandates. The effects range from about a 10 percent to about an 11 percent increase relative to the pre-reform mean. Finally, column 3 presents results with the mandate variable allowed to vary by whether it is a mandate to cover or offer to cover treatment. As one might expect, the age-interaction with a mandate to cover has a large, statistically significant coefficient.

Table 9 presents results from regressions similar to those reported in Table 8 but with the mandate variables interacted with the mother's age being at least 35. Again, as expected, the effect for these older women is larger in magnitude, although the signs and pattern of significance are similar to those in Table 8. One exception is that for women 35 or older, even mandates that only require insurers to offer infertility treatment are associated with a statistically significant increase in the probability of twinning.

Table 10 presents results from regressions similar to those reported in the previous two tables, but the dependent variable is the probability that an infant is a mixed-sex twin. Again the effects for mandates and older mothers are statistically significant and large. Being born to a mother 30 or older in a mandate state is associated with about an 18 percent increase in the probability of being a mixed sex twin. The analogous impact of being born to a mother 30 or older in a mandate state on the probability of being a same-sex boy twin is about 10 percent and for being a same-sex girl twin about 7 percent (not shown).

Finally, Table 11 shows results from regressions predicting twin births among children 5–17 using PUMS data. Here, the mandate variables are interacted with mother's age being at least 30. The

[26]Running this regression as a probit and estimating the marginal effect for the interaction accounting for the main effects leads to a predicted probability of 0.0022 for the marginal effect of the mandates for women 30 and older with a standard error of 0.00075 and a p-value of 0.004 (calculated using the delta method).

"any law" variable interacted with mother's age being at least 30 is positive but no longer significant (although it is a statistically significant 0.0028 (p-value of 0.036) if the sample is expanded to include children aged 0–4). Column 2 shows that for the children 5–17 in the PUMS, the coefficients are similarly sized but insignificant for the IVF and no IVF variables (the "IVF covered and mother 30 or older" variable is a larger 0.0038 (p-value of 0.019) if the sample also includes children 0–4). Finally, column 3 presents the result for the mandates split by whether they mandate coverage or offering to cover treatment. Here, we see being born to an older mother in a cover-mandate state is associated with a statistically significant increase of about 16 percent in the probability of being a twin.

These coefficients are slightly smaller in magnitude than we obtained with the birth certificate data, as one might expect given likely attenuation bias resulting from measurement error in identifying the twins. Appendix Table 7 contains the analogous results with interactions with the mother being 35 or older. Here, the age interaction for "any law" is 0.0049 and is statistically significant at the 5 percent level.

We next turn to the results for impacts of the mandates on infant health.

6.2 Mandates and infant health outcomes for twins: Detailed Natality data

The infant-health results for twins are reported in Tables 12–19 for the Detailed Natality data. Each table has a similar format and contains selected coefficients from three separate regressions predicting each outcome.[27] The only coefficients shown are those on the main insurance variables and the interaction of the insurance variables with being 30 and older. The first column presents results from regressions with a dummy variable for the state having any mandate and its interaction with the mother being 30 and older. The second column presents results from regressions with two separate dummy variables for the type of insurance mandate the state has (including or excluding IVF) and their interactions with the mother being at least 30. The third column regression instead splits the law according to whether the mandate is to cover or offer to cover treatment and includes age interactions of those variables.

Tables 12–15 present results for regressions explaining birth weight, low birth weight, very low birth weight, and "extremely low" birth weight (being under 1000 grams). We focus on the main birth weight results, but present the others because they examine points in the birth weight distribution other than the mean. Column 1 of Table 12 shows that living in a state with any infertility mandate is associated

[27] Coefficients on the other control variables are presented for the regressions predicting length of gestation in Appendix Table 2.

with having a 15 gram lighter infant.

Column 1 of Table 12 shows that living in a state with any infertility mandate is associated with a statistically significant but small decrease in birth weight of around 15 grams, and that this effect is 17 grams larger in magnitude for women 30 and older (the mean at baseline is 2394 grams). This is not a large effect. However, the only women who should be impacted by this law are those using infertility treatment, thus a zero impact on other women is being averaged with a larger effect on these women, leading to a small overall effect.

A simple back of the envelope calculation gives a sense of the possible overall magnitude of these results for the "treated" group. Society for Assisted Reproductive Technology, American Society for Reproductive Medicine (1999) suggests that around 6360 twins were born after use of IVF, ZIFT, GIFT, frozen embryos, or a host uterus from pregnancies initiated during 1996. Suppose twice as many women had twins due to any use of infertility treatment as did due to these treatments and that two thirds of the ART using women are at least 30 (as opposed to about 46% of all twin mothers). Suppose further that all twin births to women 30 and older were evenly split between insurance-mandate states and other states. Then, if we treat the younger women as a control group for the older women, the effect on gestation of the state mandate in states with mandates for women 30 and older using ART would be around $-(17 * 104,000 * 0.461 * 0.5)/(6360 * 2 * 0.67 * 0.5) = 95$ grams, if all the twins were born in 1997 (104,000 twins were born in 1997). This assumes the mandates had no effect on women not using ART and no effect on women under 30. This may be an overestimate of the effect as the share of twins born after use of infertility treatment as a fraction of total twins should be larger in states with insurance mandates than in the full twin population. This would reduce the factor inflating the population effect to the effect on the "treated" group.

Column 2 shows that the impact is again significant only for women in mandate-but-no-IVF states, although the point estimate for living in a mandate-and-IVF-covered state is also negative. For women of at least 30, living in a state with a mandate excluding IVF is statistically significantly associated with having a 24 gram lighter baby. Finally, column 3 shows that for older women, cover and offer mandates are associated with having lighter infants.

The pattern of the coefficients is similar for regressions predicting low birth weight, very low birth weight, or extremely low birth weight (Tables 13–15). The mandates are associated with an increase in having lighter infants for older women, and the effects are concentrated in the mandate-but-no-IVF states. Both cover and offer mandates are associated with a higher probability of having low birth weight infants for older mothers.

Column 1 of Table 16 shows that twins born to older mothers in mandate states are shorter gestation infants. Column 2 of Table 16 shows that forcing insurers to cover infertility treatment but not IVF is also negatively associated with length of gestation. The coefficient suggests a decrease of around 26 grams on a baseline of 2394, and is larger in magnitude for the older women who have a 24 gram lighter pregnancy than other older women. Finally, column 3 suggests that for older mothers, both cover and offer mandates are associated with having a lighter infant.

Table 16 shows that the negative impacts of mandates for older mothers are also present for gestation. The patterns of significance are quite similar to those for birth weight. Tables 17 and 18 contain results from regressions predicting being a premature birth and being a very premature birth. Results in Table 17 and 18 for regressions predicting premature and very premature births suggest that the impact of the health insurance mandate variables is larger for older women in states with mandates that exclude IVF and in offer states.

Table 19 presents results for regressions predicting the 5-minute Apgar score. Here the story is similar, namely living in a state whose mandates excludes IVF is associated with having an infant with a lower Apgar score. However, women 30 and older in states with mandates that include IVF also have infants with lower Apgar scores (and the coefficient of -0.034 is larger in magnitude (more negative) for the mandate-with-IVF interaction than the coefficient of -0.022 for the mandate-but-no-IVF interaction). The baseline mean 5-minute Apgar for twins is 8.5. Again, effects are larger (in magnitude) in offer than cover states for older women but negative and statistically significant in both.

Results for regressions interacting the mandate variables with the mother's age being at least 35 are generally similar to those discussed here (not shown). Effects of the interactions tend to be larger in magnitude when significant, and the significant results are still mainly for the mandate-but-no-IVF variables, and larger in offer than in cover states.

In sum, the results for the Detailed Natality data suggest a statistically significant but small negative association between important health outcomes—birth weight, gestation, and the 5-minute Apgar score—and being an older mother living in a state that mandates insurance coverage of infertility treatment but excludes IVF. They also suggest that all women giving birth in states with any mandate had somewhat worse birth outcomes, although this could merely be picking up changing trends. If one interprets the younger women as a control group for the older women, the age-interactions are differences-in-differences-in-differences estimates of the impacts of mandates.

One might expect the effects of insurance mandates to be larger in states with mandates covering IVF than in states with mandates excluding IVF. However, there are alternate hypotheses that are consistent with both our findings and with the findings from the medical literature. If women in mandate-but-no-IVF states substitute away from IVF and toward intrauterine insemination or other procedures that increase the multiple birth rate, then there may be more infertility treatment related twins born in the mandate-but-no-IVF states than in the mandate-and-IVF-covered states.[28] Alternatively, Jain et al. (2002) suggest that women in mandate-but-no-IVF states may be transferring more embryos since they may be able to afford fewer cycles of IVF than women in mandate-and-IVF-covered states. Regardless, these findings suggest that insurance coverage of infertility treatments may have unexpected consequences.

We anticipated finding impacts of the mandates among twins if there indeed were any impacts of the mandates. Still, one might expect the twins results to reflect predominately use of ART. It is possible that findings for singletons would instead pick up use of less aggressive infertility treatment. The magnitude of the estimates should also be smaller for singletons, given the smaller share of women in mandate states actually using infertility treatment, so looking at singletons should provide a specification check for our twin results. We present results for the one in fifty sample of singleton births in the next section.

6.3 Mandates and infant health outcomes for singletons: Detailed Natality data

Table 20–22 present results for the one in fifty sample of singletons from 1981–1999 for regressions predicting birth weight, gestation, and Apgar score. Summary statistics for the one in fifty sample of singletons are in Appendix Table 3. The signs of the mandate-age interactions are similar to those from the twin regressions, and many are still statistically significant. Further, the coefficients are considerably smaller in magnitude. Here the negative effects for women 30 and older for gestation and Apgar score are concentrated in the mandate-and-IVF-covered states. The negative effects for birth weight are only statistically significant for older mothers in the mandate-but-no-IVF states.

Next, we examine the longer-term health impacts of these mandates.

6.4 Mandates and child health outcomes for twins: PUMS/ACS data

Tables 23–26 present results from regressions predicting longer-term health impacts for twins born from 1982–1997. Here the mandates are interacted with an indicator for the mother being at least 30. Most of the point estimates for the mandate-age interactions are positive (being born in a mandate state

[28]We thank Vivian Ho for suggesting this hypothesis.

to an older mother is associated with a higher probability of having the disabilities), and a number are statistically significant. The most consistent results are those for the determinants of physical impairment (Table 24). Here, being born to an older mother in a mandate state is associated with an increase in the probability of having a physical disability and the association holds across all the mandate variables. The magnitude of the results is rather large. There is some evidence of an increase in the probability of having a sensory impairment (Table 23) or a condition limiting the ability to dress or get around the house (Table 26).[29]

There is no evidence that mandates are associated with a condition limiting memory, learning, or the ability to concentrate. Results from regressions estimated with mandate age interactions for the mother being at least 35 are similar in sign and more of the coefficients approach significance.

6.5 Robustness

We experimented with a number of subsamples and specifications to test the robustness of the Natality results. Below, we discuss the impact of these changes on the main results for gestation, birth weight, and the 5-minute Apgar score. We have begun to conduct robustness tests in the PUMS/ACS data, and touch on those.

In general, restricting the Detailed Natality samples to women more likely to have used infertility treatment—women with no previous live deliveries before this pregnancy or college graduates with no previous live deliveries before this pregnancy lead to larger estimated coefficients and similar patterns of significance. Restricting the sample to twins who could be matched, and to more homogeneous samples of matched twins did not substantively change key coefficients. Including single year of age dummy variables did not change key coefficients of interest nor did estimating regressions with the unbalanced panel of all observations available for each outcome.[30]

One possible concern with the identification strategy is that without detailed information about where these women gave birth and what neonatal-care technologies their health care providers had access to, the negative mandate impacts may merely reflect the fact that older women are wealthier and give birth at hospitals that have better doctors and more advanced equipment in the later periods. Thus, very sickly fetuses may be more likely to be born alive for these women than for younger,

[29] Running the first sensory impairment regression as a probit and estimating the marginal effect for the interaction accounting for the main effects leads to a predicted probability of 0.0064 for the marginal effect of the mandates for women 30 and older with a standard error of 0.0040 and a p-value of 0.147 (calculated using the delta method). Other marginal effects will be calculated.

[30] Results discussed in this section are not shown. All are available from the author on request.

less wealthy women (although this concern may be more appropriate for outcomes such as neonatal mortality). One way to test this is to include measures of neonatal care technology dissemination in the regressions. Dissemination of advanced neonatal care technology may reflect demand for these technologies from women seeking infertility treatment. While it is interesting to see how inclusion of measures of these technologies affect the results, because they may be demand-induced, their coefficients may be biased. Nonetheless, we pooled information from the American Hospital Association surveys for 1982, 1984, 1991, 1992, 1994, 1995, and 1997 on the number of obstetric beds, neonatal intensive care beds, and neonatal intermediate care beds in each state. We created variables measuring the total number of available hospital beds of each type per 1000 women aged 15–44 in each state. For years with missing data, we used the values for the previous year, and for 1981, we used values from 1982. Including these measures in the regressions hardly changed the key coefficients. Results for the regressions controlling for neonatal care were substantively similar to the main results.

Another concern may be how we coded the mandate variables. The mandates do not affect all the women in a given state. Ideally, we would have information for each woman on whether she had private insurance that was not exempt from state mandates through ERISA. But no such information is available in the birth certificate data. Instead we use the March CPS from 1980–2000 to calculate the share of women aged 15–44 who are covered by private insurance. We replace the mandate dummies with the share of women at risk of being affected by the mandates—the share of women 14–55 covered by private insurance in mandate states. We also include its interaction with the mother being 30 and older, the share of women covered by private insurance, and the interaction of the privately insured share with the mother's age being 30 and older. The results are quite robust to this. The coefficient on the interaction of "share of women with private insurance in mandate states" with the mother being 30 and older in the birth weight regressions is -17 grams and is significant at the 1 percent level. The coefficient on the interaction is also negative for gestation but no longer statistically significant. The coefficient on the interaction is -0.040 and again significant at the 1 percent level in the regression predicting Apgar score. Not surprisingly, the interaction of the share with private insurance and mother's age being 30 and older is itself positive and statistically significant.

A second robustness test considers whether the mandate only applies to HMOs, excludes HMOS, or covers all private insurers. Here, our measure of the share of women likely affected by the mandate is one if the mandate applies to all private insurers, the HMO penetration rate in the state if the mandate is only for HMOs, and one minus the HMO penetration rate if the mandate excludes HMOs. Again, the regressions include the level of HMO penetration and its interaction with mother's age. The results here are also robust. The interaction of this mandate variable and the woman being 30 and older is negative and statistically significant at the 1 percent level for birth weight (-25 grams), the 5 percent level for gestation (-0.081 weeks), and the 1 percent level for Apgar score (-0.052 points).

Given the incentives firms face to self-insure when facing mandates due to ERISA and the fact that self-insurance is cheapest for the largest firms, one might expect different effects according to the size of firm offering private insurance to women. To investigate this possibility, we constructed from the 1988–2000 March CPS and the 1979 May CPS the share of women who worked or whose husbands worked at firms with $\leq$ 24 employees, 25–99 employees, and $\geq$ 100 employees, using a linear interpolation of the 1979 and 1987 numbers for years in between. We interact these employment size variables with mandate, age of mother, and mandate times age of mother, and include the main employment size variables as well. These models have a large number of interactions and are rather hard to interpret. Only one of the employment size by mandate by age interactions is significant, that of the share of women with an attachment to a firm with $\geq$ 100 employees interacted with the mandate and mother being at least 30. This is negatively associated with the Apgar score (coefficient is -0.257, significant at the 5 percent level). The rest are imprecisely estimated and about two-thirds negative and one-third positive.

The final exercise for the Detailed Natality data involved dropping the state-specific trends. Generally, this had little effect on the signs of the age interactions; in some cases they became slightly larger in the no-trends specification. The insurance measures generally had more negative signs in this specification. This is consistent with the hypothesis that these state-specific linear trends are indeed a proxy for technology improvements in neonatal treatments over the period.

Overall, these various exercises suggest that the results for gestation, birth weight, and the 5-minute Apgar score are quite robust.

We plan to conduct numerous robustness tests with the PUMS/ACS data in future drafts, including many of those conducted with the Detailed Natality data.

7 Conclusion

Reproductive technologies have improved radically since the introduction of the first fertility drugs in the late 1960s. These technologies make conception possible for many couples who otherwise would be unable to reproduce. Many of these technologies increase the probability of having a multiple birth, typically a more risky pregnancy. These technologies also provide women considering delaying reproduction with insurance against later infertility.

This study examines the effect of subsidies for use of advanced reproductive technologies on fertility outcomes (twin births), birth outcomes (for twins and singletons), and longer term child health (for twins). The subsidies are state mandates that health insurers cover or offer to cover infertility treatment. Living in a mandate state leads to about a 10 percent increase in the twin birth rate for mothers 30 and older in the birth certificate data, and also to a 18 percent increase in the mixed-sex twin birth rate. The mandates lead to a slightly smaller increase in the twin birth rate in the PUMS/ACS data. This suggests that the infertility mandates are having real and substantive effects. With existing data, we are unable to determine what share of the increase in twin deliveries is due to women waiting because of the availability of new technology and what share is women having children who otherwise could not.

Subsidized infertility treatment and increased use of this treatment by older women (as proxied by interactions between age indicators and the insurance mandates) are each associated with small, statistically significant, negative effects on birth outcomes such as gestation, birth weight, and the 5-minute Apgar score. However, preliminary findings looking at the longer-term impacts of being born in a mandate state for twins are mixed.

This paper contributes to the ongoing debate about birth selection in health economics. In previous work that examines birth selection, heterogeneity or selection among mothers and the impact of maternal investment on birth outcomes are expected to affect birth outcomes in the same direction. Here, the taxing nature of infertility treatments suggests that women who give birth due to use of ART or other infertility treatment may invest more in their pregnancies than do other women. Thus, these negative impacts of insurance mandates suggest that infertility treatment itself may be associated with adverse birth outcomes or that selection into childbearing of previously infertile women may lead to worse birth outcomes. These findings for birth outcomes and preliminary findings for child health suggest further investigation of longer-term impacts of mandates on child health is warranted.

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Table 1: Mean of Twin Variables, by Presence of Infertility Treatment Mandate, Sample of Twins and Singletons, Natality Data

	No mandate for Infertility treatment	Mandate for Infertility treatment
Twin	0.0227	0.0251
Mixed-sex twin	0.0058	0.0070
Same-sex female twin	0.0067	0.0078
Same-sex male twin	0.0067	0.0077
N	1070832	370323

Summary statistics for singleton and twin births from Detailed Natality files for 1981–1999. Sample for first row is one in fifty random subsample of twins and singletons and sample for other rows is one in fifty random subsample of singletons and of twins where twins could be matched to one another. N is N for row 1 statistics. Column 1 contains means for variables during years when no infertility treatment mandate was in place during the year before birth and column 2 contains means for variables during years when any infertility treatment mandate was in place during the year before birth. Statistics weighted to account for 50% sampling in some states before 1985.

Table 2: Means of Birth Outcomes, Infant, and Mother Characteristics by Presence of Infertility Treatment Mandate, Sample of Twins, Natality Data

	No mandate for Infertility treatment	Mandate for Infertility treatment
Gestation (wks.)	35.91	35.74
Premat. (< 37 wks.)	0.48	0.51
Very premat. (< 32 wks.)	0.11	0.11
Birth weight (gms.)	2394	2395
Low BW (< 2500 gms.)	0.52	0.52
Very low BW (< 1500 gms.)	0.10	0.10
Extremely low BW (< 1000 gms.)	0.05	0.05
Five minute Apgar score (0–10)	8.49	8.57
Mother has 4 yr. degree	0.19	0.26
Mother black	0.19	0.16
Mother Hispanic	0.08	0.21
Mother Hispanic not reported or missing	0.19	0.02
Age of mother	27.40	28.68
HI for infert., state law	0.00	1.00
HI for infert., may incl. IVF , state law	0.00	0.47
HI for infert., excl. IVF, state law	0.00	0.53
N	1221629	462468

Summary statistics for twin births from Detailed Natality files for 1981–1999. Column 1 contains means for all twins during years when no infertility treatment mandate was in place during the year before birth and column 2 contains means for all twins during years when any infertility treatment mandate was in place during the year before birth. Statistics weighted to account for 50% sampling in some states before 1985.

Table 3: Mother's Age and Share of Twin Births to Women in Specific Age Groups by Presence of Infertility Treatment Mandate, Sample of Twins, Natality Data

	No mandate for Infertility treatment	Mandate for Infertility treatment
Age of mother	27.40	28.68
Mother aged $\leq$ 19	0.082	0.070
Mother aged 20–24	0.242	0.192
Mother aged 25–29	0.316	0.277
Mother aged 30–34	0.247	0.285
Mother aged 35–39	0.098	0.146
Mother aged 40–44	0.013	0.026
Mother aged 45 or older	0.001	0.004
N	1221629	462468

Mother's age and share of births born to women of various ages by time period for all twin births in sample from Detailed Natality files. Column 1 contains means for all twins during years when no infertility treatment mandate was in place during the year before birth and column 2 contains means for all twins during years when any infertility treatment mandate was in place during the year before birth. Statistics weighted to account for 50% sampling in some states before 1985.

Table 4: Means of Educational Attainment by Age and Presence of Infertility Mandate, Sample of Twins, Natality Data

	No mandate for Infertility treatment	Mandate for Infertility treatment
Mother ≤ 29		
Mother's educ. < 4 yr. degree	0.87	0.87
Mother has 4 yr. degree	0.13	0.13
N, mother's education reported	686829	240229
N, mother's education missing	94075	9044
Mother 30–34		
Mother's educ. < 4 yr. degree	0.63	0.60
Mother has 4 yr. degree	0.37	0.40
N, mother's education reported	269636	128061
N, mother's education missing	33406	3620
Mother 35–39		
Mother's educ. < 4 yr. degree	0.58	0.54
Mother has 4 yr. degree	0.42	0.46
N, mother's education reported	107738	65999
N, mother's education missing	12509	1671
Mother ≥ 40		
Mother's educ. < 4 yr. degree	0.54	0.43
Mother has 4 yr. degree	0.46	0.57
N, mother's education reported	15684	13517
N, mother's education missing	1752	327

Mother's education and total number of twins for twin births by mother's age group and presence of state level infertility mandates from Detailed Natality files. Each panel presents means and number of observations for a specific age group for educational attainment for all records reporting mother's education as well as the number of observations that did not report mother's education. Column 1 contains means for all twins during years when no infertility treatment mandate was in place during the year before birth and column 2 contains means for all twins during years when any infertility treatment mandate was in place during the year before birth. Statistics weighted to account for 50% sampling in some states before 1985.

Table 5: States Enacting Laws Mandating Health Insurance Offer or Cover Infertility Treatment, 1981–2003

State	Year law	*IVF is*		*Mandate to insurers to*		*Law applies to*		
	Passed	Not excluded	Excluded	Cover	Offer	All firms	Non-HMOs	Only HMOS
Arkansas	1987	1	0	1	0	0	1	0
California	1989	0	1	0	1	1	0	0
Connecticut	1989	1	0	0	1	0	1	0
Hawaii	1987	1	0	1	0	1	0	0
Illinois	1991	1	0	1	0	1	0	0
Louisiania	2001	0	1	1	0	1	0	0
Maryland	1985	1	0	1	0	1	0	0
Massachusetts	1987	1	0	1	0	1	0	0
Montana	1987	0	1	1	0	0	0	1
New York	1990	0	1	1	0	0	1	0
New Jersey	2001	1	0	1	0	1	0	0
Ohio	1991	0	1	1	0	0	0	1
Rhode Island	1989	1	0	1	0	1	0	0
Texas	1987	1	0	0	1	1	0	0
West Virginia	1977	0	1	1	0	0	0	1

Shown are the date each state passed a law related to health insurance coverage of infertility (column 1), whether the coverage mandate includes IVF or does not specify (column 2), and whether the coverage mandate excludes IVF (column 3), whether the coverage is mandated (column 4), and whether the insurer is required to offer it to the customer (column 5), whether all firms are covered (column 6), whether HMOs are excluded from the law (column 7), and whether the law applies only to HMOs (column 8).

Table 6: Means, Twin Indicator and Mother's Completed Education by Presence of Infertility Treatment Mandate, Sample of Twins and Singletons, PUMS and ACS

	No mandate for Infertility treatment	Mandate for Infertility treatment
Child is twin	0.030	0.032
N	2168833	522299

Summary statistics for singletons and twins from PUMS and ACS. Column 1 contains means for all singletons and twins in years with no mandate for infertility treatment the year before birth and and column 2 contains means for all singletons and twins in years with a mandate for infertility treatment the year before birth. Sample is all children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are either the only child or one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Statistics weighted.

Table 7: Means, Child Outcomes, and Mandate Variables, Sample of Twins, PUMS and ACS

	No mandate for Infertility treatment	Mandate for Infertility treatment
Long-lasting condition		
Blindness/deafness/vision or hearing impairment	0.012	0.010
Limited in basic physical activities	0.013	0.013
Physical, mental, or emot. cond. lasting ≥ 6 months causes		
Difficulty learning, remembering, or concentrating	0.057	0.038
Difficulty dressing, bathing, or getting around house	0.011	0.010
N	65742	17171

Summary statistics for twins from PUMS and ACS. Column 1 contains means for all twins in years with no mandate for infertility treatment the year before birth and and column 2 contains means for all twins in years with a mandate for infertility treatment the year before birth. Sample is all children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Statistics weighted.

Table 8: Coefficients on Regressions of Determinants of Being a Twin, Interactions with Mother 30 or Older, Sample of Singletons and Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI for infert.	-0.00183**		
	(0.00082)		
HI for infert. $* \geq 30$	0.00302***		
	(0.00096)		
HI for infert. may incl. IVF		-0.00190*	
		(0.00101)	
HI for infert. may incl. IVF $* \geq 30$		0.00282**	
		(0.00113)	
HI for infert. excl. IVF		-0.00175	
		(0.00130)	
HI for infert. excl. IVF $* \geq 30$		0.00319**	
		(0.00139)	
HI must cover infert.			-0.00393***
			(0.00110)
HI must cover infert. $* \geq 30$			0.00673***
			(0.00109)
HI must offer infert. coverage			0.00029
			(0.00104)
HI must offer infert. $* \geq 30$			-0.00034
			(0.00108)

Coefficients on insurance mandate variables, regressions of determinants of birth being a twin. Sample is one in fifty random subsample of all singleton and twin births for 1981–1999. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with being 30 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF, and their interactions with being 30 or older, that in column 3 has indicators for mandates for insurers to cover or offer to cover infertility treatment, and their interactions with being 30 or older, Regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Standard errors clustered at the state-by-year level. Regressions are weighted to account for the 50% sampling in some states before 1985. N is 1,439,525. Pre-reform mean of dependent variable is 0.0227, that for women 30 or older is 0.0295, and that for women 35 or older is 0.0308. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 9: Coefficients on Regressions of Determinants of Being a Twin, Interactions with Mother 35 or Older, Sample of Singletons and Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 35	IVF/no IVF and IVF/no IVF $*$ age ≥ 35	Cover/offer and Cover/offer $*$ age ≥ 35
HI for infert.	-0.00142*		
	(0.00080)		
HI for infert. $* \geq 35$	0.00580***		
	(0.00119)		
HI for infert. may incl. IVF		-0.00160	
		(0.00101)	
HI for infert. may incl. IVF $* \geq 35$		0.00672***	
		(0.00173)	
HI for infert. excl. IVF		-0.00123	
		(0.00124)	
HI for infert. excl. IVF $* \geq 35$		0.00509***	
		(0.00139)	
HI must cover infert.			-0.00247**
			(0.00110)
HI must cover infert. $* \geq 35$			0.00797***
			(0.00157)
HI must offer infert. coverage			-0.00016
			(0.00101)
HI must offer infert. $* \geq 35$			0.00381***
			(0.00144)

Coefficients on insurance mandate variables, regressions of determinants of birth being a twin. Sample is one in fifty random subsample of all singleton and twin births for 1981–1999. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with being 35 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF, and their interactions with being 35 or older, that in column 3 has indicators for mandates for insurers to cover or offer to cover infertility treatment, and their interactions with being 35 or older. Regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Standard errors clustered at the state-by-year level. Regressions are weighted to account for the 50% sampling in some states before 1985. N is 1,439,525. Pre-reform mean of dependent variable is 0.0227, that for women 30 or older is 0.0295, and that for women 35 or older is 0.0308. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Table 10: Coefficients on Regressions of Determinants of Being a Mixed-Sex Twin, Interactions with Mother 30 or Older, Sample of Singletons and Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI for infert.	-0.00153***		
	(0.00051)		
HI for infert. $* \geq 30$	0.00153***		
	(0.00044)		
HI for infert. may incl. IVF		-0.00099	
		(0.00063)	
HI for infert. may incl. IVF $* \geq 30$		0.00106**	
		(0.00051)	
HI for infert. excl. IVF		-0.00211***	
		(0.00080)	
HI for infert. excl. IVF $* \geq 30$		0.00194***	
		(0.00064)	
HI must cover infert.			-0.00226***
			(0.00069)
HI must cover infert. $* \geq 30$			0.00299***
			(0.00057)
HI must offer infert. coverage			-0.00080
			(0.00062)
HI must offer infert. $* \geq 30$			0.00021
			(0.00047)

Coefficients on insurance mandate variables, regressions of determinants of birth being a mixed-sex twin. Sample is one in fifty random subsample of all singleton and matched twin births for 1981–1999. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with being 30 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF, and their interactions with being 30 or older, that in column 3 has indicators for mandates for insurers to cover or offer to cover infertility treatment, and their interactions with being 30 or older, Regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Standard errors clustered at the state-by-year level. Regressions are weighted to account for the 50% sampling in some states before 1985. N is 1,435,000. Pre-reform mean of dependent variable is 0.0058, that for women 30 or older is 0.0082, and that for women 35 or older is 0.0088. $^{***}p < .01$, $^{**}p < .05$, $^{*}p < .10$.

Table 11: Selected Coefficients, Determinants of Being a Twin, Interactions with Mother 30 or Older, Sample of Singletons and Twins, PUMS and ACS

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI for infert.	-0.00388**		
	(0.00172)		
HI for infert. $* \geq 30$	0.00191		
	(0.00167)		
HI for infert. may incl. IVF		-0.00541**	
		(0.00244)	
HI for infert. may incl. IVF $* \geq 30$		0.00114	
		(0.00209)	
HI for infert. excl. IVF		-0.00225	
		(0.00226)	
HI for infert. excl. IVF $* \geq 30$		0.00261	
		(0.00245)	
HI must cover infert.			-0.00459**
			(0.00221)
HI must cover infert. $* \geq 30$			0.00530***
			(0.00197)
HI must offer to cover infert.			-0.00358
			(0.00246)
HI must offer infert. $* \geq 30$			-0.00099
			(0.00242)

Coefficients on insurance mandate variables, regressions of determinants of birth being a twin. Sample is all children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are either the only child or one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with being 30 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF and their interactions with being 30 or older. that in column 3 has indicators for mandates for insurers to cover or offer to cover infertility treatment and their interactions with being 30 or older. All regressions include state of birth fixed effects for the child, year fixed-effects, and state of birth linear time trends. Regressions also include indicators for the mother's education being high school, some college, a four-year degree; for the mother's age in 5 year groupings; for the child being black, Asian, American Indian, or other non-white; for the child being Hispanic; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted. N is 2,690,368. Pre-reform mean of dependent variable is 0.0305, that for women 30 or older is 0.0322, and that for women 35 or older is 0.0339. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 12: Selected Coefficients, Regressions of Determinants of Birth Weight (grams), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age $\geq$ 30	IVF/no IVF and IVF/no IVF $*$ age $\geq$ 30	Cover/offer and Cover/offer $*$ age $\geq$ 30
HI mandate for infert.	-15.453*		
	(8.290)		
HI for infert. $* \geq 30$	-16.673***		
	(3.620)		
HI for infert., may incl. IVF		-5.903	
		(7.927)	
HI for infert., may incl. IVF $* \geq 30$		-7.849	
		(4.996)	
HI for infert., excl. IVF		-26.240**	
		(12.609)	
HI for infert., excl. IVF $*$ mother ≥ 30		-24.145***	
		(3.926)	
HI must cover infert.			-9.66202
			(8.88789)
HI must cover infert. $* \geq 30$			-12.81674***
			(4.40568)
HI must offer infert. coverage			-24.32111
			(17.60663)
HI must offer infert. $* \geq 30$			-20.71728***
			(4.81513)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,676,147. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Table 13: Selected Coefficients, Regressions of Determinants of Low Birth Weight (< 2500 grams), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.000		
	(0.004)		
HI for infert. $* \geq 30$	0.010***		
	(0.002)		
HI for infert., may incl. IVF		-0.001	
		(0.004)	
HI for infert., may incl. IVF $* \geq 30$		0.005	
		(0.003)	
HI for infert., excl. IVF		0.001	
		(0.006)	
HI for infert., excl. IVF $*$ mother ≥ 30		0.014***	
		(0.003)	
HI must cover infert.			-0.00045
			(0.00470)
HI must cover infert. $* \geq 30$			0.00897***
			(0.00281)
HI must offer infert. coverage			0.00071
			(0.00761)
HI must offer infert. $* \geq 30$			0.01123***
			(0.00314)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,676,147. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Table 14: Selected Coefficients, Regressions of Determinants of Very Low Birth Weight (< 1500 grams), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	0.011***		
	(0.003)		
HI for infert. $* \geq 30$	0.004**		
	(0.001)		
HI for infert., may incl. IVF		0.008**	
		(0.004)	
HI for infert., may incl. IVF $* \geq 30$		0.001	
		(0.002)	
HI for infert., excl. IVF		0.016***	
		(0.005)	
HI for infert., excl. IVF $*$ mother ≥ 30		0.006***	
		(0.002)	
HI must cover infert.			0.00725**
			(0.00338)
HI must cover infert. $* \geq 30$			0.00177
			(0.00188)
HI must offer infert. coverage			0.01779**
			(0.00759)
HI must offer infert. $* \geq 30$			0.00551***
			(0.00182)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,676,147. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 15: Selected Coefficients, Regressions of Determinants of Extremely Low Birth Weight (< 1000 grams), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate ∗ age ≥ 30	IVF/no IVF and IVF/no IVF ∗ age ≥ 30	Cover/offer and Cover/offer ∗ age ≥ 30
HI mandate for infert.	0.010***		
	(0.003)		
HI for infert. ∗ ≥ 30	0.002		
	(0.001)		
HI for infert., may incl. IVF		0.005	
		(0.003)	
HI for infert., may incl. IVF ∗ ≥ 30		-0.000	
		(0.001)	
HI for infert., excl. IVF		0.016***	
		(0.005)	
HI for infert., excl. IVF ∗ mother ≥ 30		0.003***	
		(0.001)	
HI must cover infert.			0.00532*
			(0.00285)
HI must cover infert. ∗ ≥ 30			0.00031
			(0.00130)
HI must offer infert. coverage			0.01732**
			(0.00739)
HI must offer infert. ∗ ≥ 30			0.00310**
			(0.00137)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,676,147. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 16: Selected Coefficients, Regressions of Determinants of Gestation (Weeks), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age $\geq$ 30	IVF/no IVF and IVF/no IVF $*$ age $\geq$ 30	Cover/offer and Cover/offer $*$ age $\geq$ 30
HI mandate for infert.	-0.128***		
	(0.050)		
HI for infert. $* \geq 30$	-0.046**		
	(0.021)		
HI for infert., may incl. IVF		-0.089*	
		(0.054)	
HI for infert., may incl. IVF $* \geq 30$		-0.000	
		(0.028)	
HI for infert., excl. IVF		-0.172**	
		(0.073)	
HI for infert., excl. IVF $*$ mother ≥ 30		-0.085***	
		(0.023)	
HI must cover infert.			-0.06472
			(0.05560)
HI must cover infert. $* \geq 30$			-0.00019
			(0.02744)
HI must offer infert. coverage			-0.22967**
			(0.10657)
HI must offer infert. $* \geq 30$			-0.09503***
			(0.02287)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,636,418. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 17: Selected Coefficients, Regressions of Determinants of Premature Birth (Gest. < 37 weeks), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.000		
	(0.004)		
HI for infert. $* \geq 30$	0.009***		
	(0.003)		
HI for infert., may incl. IVF		0.003	
		(0.006)	
HI for infert., may incl. IVF $* \geq 30$		0.005*	
		(0.003)	
HI for infert., excl. IVF		-0.003	
		(0.006)	
HI for infert., excl. IVF $*$ mother ≥ 30		0.012***	
		(0.003)	
HI must cover infert.			0.00100
			(0.00553)
HI must cover infert. $* \geq 30$			0.00415
			(0.00324)
HI must offer infert. coverage			-0.00052
			(0.00640)
HI must offer infert. $* \geq 30$			0.01425***
			(0.00306)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,636,418. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 18: Selected Coefficients, Regressions of Determinants of Very Premature Birth (Gest. < 32 weeks), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	0.010***		
	(0.003)		
HI for infert. $* \geq 30$	0.003**		
	(0.002)		
HI for infert., may incl. IVF		0.009**	
		(0.004)	
HI for infert., may incl. IVF $* \geq 30$		-0.000	
		(0.002)	
HI for infert., excl. IVF		0.011**	
		(0.005)	
HI for infert., excl. IVF $*$ mother ≥ 30		0.007***	
		(0.002)	
HI must cover infert.			0.00458
			(0.00412)
HI must cover infert. $* \geq 30$			0.00068
			(0.00202)
HI must offer infert. coverage			0.01795**
			(0.00703)
HI must offer infert. $* \geq 30$			0.00625***
			(0.00199)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,636,418. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 19: Selected Coefficients, Regressions of Determinants of 5-Minute Apgar Score, Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.038*		
	(0.020)		
HI for infert. $* \geq 30$	-0.029***		
	(0.008)		
HI for infert., may incl. IVF		-0.008	
		(0.017)	
HI for infert., may incl. IVF $* \geq 30$		-0.034***	
		(0.010)	
HI for infert., excl. IVF		-0.073**	
		(0.034)	
HI for infert., excl. IVF $*$ mother ≥ 30		-0.022**	
		(0.010)	
HI must cover infert.			-0.03953*
			(0.02044)
HI must cover infert. $* \geq 30$			-0.02688***
			(0.00786)
HI must offer infert. coverage			-0.00056
			(0.05412)
HI must offer infert. $* \geq 30$			-0.06287*
			(0.03498)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,313,105. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Table 20: Selected Coefficients, Regressions of Determinants of Birth Weight (grams), Sample of Singletons, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-10.120**		
	(4.305)		
HI for infert. $* \geq 30$	-8.204***		
	(2.936)		
HI for infert., may incl. IVF		-7.171	
		(5.531)	
HI for infert., may incl. IVF $* \geq 30$		-1.488	
		(3.580)	
HI for infert., excl. IVF		-13.688**	
		(5.705)	
HI for infert., excl. IVF $*$ mother ≥ 30		-13.792***	
		(3.556)	
HI must cover infert.			-9.02929*
			(4.65483)
HI must cover infert. $* \geq 30$			-7.05353*
			(3.64444)
HI must offer infert. coverage			-11.69124
			(8.25392)
HI must offer infert. $* \geq 30$			-9.27988**
			(3.80859)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is 1 in 50 random sample of singleton births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,404,233. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 21: Selected Coefficients, Regressions of Determinants of Gestation (Weeks), Sample of Singletons, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.020		
	(0.018)		
HI for infert. $* \geq 30$	-0.019*		
	(0.010)		
HI for infert., may incl. IVF		-0.004	
		(0.023)	
HI for infert., may incl. IVF $* \geq 30$		-0.031***	
		(0.012)	
HI for infert., excl. IVF		-0.037	
		(0.023)	
HI for infert., excl. IVF $*$ mother ≥ 30		-0.009	
		(0.014)	
HI must cover infert.			0.00697
			(0.02027)
HI must cover infert. $* \geq 30$			-0.02353
			(0.01476)
HI must offer infert. coverage			-0.05468*
			(0.03226)
HI must offer infert. $* \geq 30$			-0.01574
			(0.01191)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is 1 in 50 random sample of singleton births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,366,019. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Table 22: Selected Coefficients, Regressions of Determinants of 5-Minute Apgar Score, Sample of Singletons, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.001		
	(0.009)		
HI for infert. $* \geq 30$	0.000		
	(0.006)		
HI for infert., may incl. IVF		0.019***	
		(0.007)	
HI for infert., may incl. IVF $* \geq 30$		-0.012**	
		(0.006)	
HI for infert., excl. IVF		-0.026*	
		(0.014)	
HI for infert., excl. IVF $*$ mother ≥ 30		0.014	
		(0.010)	
HI must cover infert.			0.00006
			(0.00889)
HI must cover infert. $* \geq 30$			-0.00059
			(0.00668)
HI must offer infert. coverage			-0.03314
			(0.02311)
HI must offer infert. $* \geq 30$			0.01599
			(0.01127)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is 1 in 50 random sample of singleton births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 30, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 30, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 30. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,080,284. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 23: Selected Coefficients, Regresssions of Determinants of Sensory Impairment, Sample of Twins, PUMS and ACS

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.00963**		
	(0.00489)		
HI for infert. $* \geq 30$	0.00703**		
	(0.00338)		
HI for infert. may incl. IVF		-0.00392	
		(0.00509)	
HI for infert. may incl. IVF. $* \geq 30$		0.00587	
		(0.00361)	
HI for infert. excl. IVF		-0.01540**	
		(0.00767)	
HI for infert. excl. IVF $* \geq 30$		0.00814	
		(0.00504)	
HI must cover infert.			-0.01201*
			(0.00700)
HI must cover infert. $* \geq 30$			0.00796
			(0.00563)
HI must offer to cover infert.			-0.00709
			(0.00542)
HI must offer infert. $* \geq 30$			0.00634*
			(0.00345)

Each panel represents one regression. Coefficients on insurance mandate variables, regressions of determinants of having long-lasting blindness, deafness, or a long-lasting severe vision or hearing impairment. Sample is twin children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are either the only child or one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with the mother being 30 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF and their interactions with the mother being 30 or older, that in column 3 has indicators for mandates to cover or offer to cover infertility treatment and their interactions with the mother being 30 or older. All regressions include state of birth fixed effects for the child, year fixed-effects, and state of birth linear time trends. Regressions also include indicators for the mother's education being high school, some college, a four-year degree; for the mother's age in 5 year groupings; for the child being black, Asian, American Indian, or other non-white; for the child being Hispanic; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted. N is 82,875. Pre-reform mean of dependent variable is 0.0122 and that for women 30 or older is 0.0092. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Table 24: Selected Coefficients, Regresssions of Determinants of Physical Impairment, Sample of Twins, PUMS and ACS

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.00486		
	(0.00610)		
HI for infert. $* \geq 30$	0.00944**		
	(0.00383)		
HI for infert. may incl. IVF		0.00286	
		(0.00739)	
HI for infert. may incl. IVF. $* \geq 30$		0.01220**	
		(0.00536)	
HI for infert. excl. IVF		-0.01268	
		(0.00841)	
HI for infert. excl. IVF $* \geq 30$		0.00697	
		(0.00493)	
HI must cover infert.			-0.00054
			(0.00850)
HI must cover infert. $* \geq 30$			0.01232*
			(0.00699)
HI must offer to cover infert.			-0.01056
			(0.00753)
HI must offer infert. $* \geq 30$			0.00665**
			(0.00334)

Each panel represents one regression. Coefficients on insurance mandate variables, regressions of determinants of having a long-lasting condition that severely limits one or more basic physical activities such as walking, climbing stairs, reaching, lifting, or carrying. Sample is twin children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are either the only child or one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with the mother being 30 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF and their interactions with the mother being 30 or older, that in column 3 has indicators for mandates to cover or offer to cover infertility treatment and their interactions with the mother being 30 or older. All regressions include state of birth fixed effects for the child, year fixed-effects, and state of birth linear time trends. Regressions also include indicators for the mother's education being high school, some college, a four-year degree; for the mother's age in 5 year groupings; for the child being black, Asian, American Indian, or other non-white; for the child being Hispanic; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted. N is 82,875. Pre-reform mean of dependent variable is 0.0132 and that for women 30 or older is 0.0104. $^{***}p < .01$, $^{**}p < .05$, $^{*}p < .10$.

Table 25: Selected Coefficients, Regresssions of Determinants of Condition Limiting Mental Activities, Sample of Twins, PUMS and ACS

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.01138		
	(0.01139)		
HI for infert. $* \geq 30$	0.00204		
	(0.00697)		
HI for infert. may incl. IVF		-0.01564	
		(0.01436)	
HI for infert. may incl. IVF. $* \geq 30$		0.01057	
		(0.00914)	
HI for infert. excl. IVF		-0.00707	
		(0.01613)	
HI for infert. excl. IVF $* \geq 30$		-0.00581	
		(0.00879)	
HI must cover infert.			-0.01186
			(0.01733)
HI must cover infert. $* \geq 30$			0.00363
			(0.01162)
HI must offer to cover infert.			-0.01120
			(0.01297)
HI must offer infert. $* \geq 30$			0.00065
			(0.00632)

Each panel represents one regression. Coefficients on insurance mandate variables, regressions of determinants of having a physical, mental or emotional contion lasting at least 6 months that causes difficulty learning, remembering, or concentrating. Sample is twin children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are either the only child or one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with the mother being 30 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF and their interactions with the mother being 30 or older, that in column 3 has indicators for mandates to cover or offer to cover infertility treatment and their interactions with the mother being 30 or older. All regressions include state of birth fixed effects for the child, year fixed-effects, and state of birth linear time trends. Regressions also include indicators for the mother's education being high school, some college, a four-year degree; for the mother's age in 5 year groupings; for the child being black, Asian, American Indian, or other non-white; for the child being Hispanic; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted. N is 82,875. Pre-reform mean of dependent variable is 0.0569 and that for women 30 or older is 0.0576. $^{***}p < .01,^{**} p < .05,^{*} p < .10$.

Table 26: Selected Coefficients, Regresssions of Determinants of Condition Limiting Physical Activities, Sample of Twins, PUMS and ACS

Controls for	Any mandate and Any mandate $*$ age ≥ 30	IVF/no IVF and IVF/no IVF $*$ age ≥ 30	Cover/offer and Cover/offer $*$ age ≥ 30
HI mandate for infert.	-0.00128		
	(0.00367)		
HI for infert. $* \geq 30$	0.00678**		
	(0.00312)		
HI for infert. may incl. IVF		-0.00139	
		(0.00580)	
HI for infert. may incl. IVF. $* \geq 30$		0.00883**	
		(0.00448)	
HI for infert. excl. IVF		-0.00117	
		(0.00423)	
HI for infert. excl. IVF $* \geq 30$		0.00491	
		(0.00362)	
HI must cover infert.			-0.00023
			(0.00583)
HI must cover infert. $* \geq 30$			0.00758*
			(0.00454)
HI must offer to cover infert.			-0.00270
			(0.00381)
HI must offer infert. $* \geq 30$			0.00601*
			(0.00365)

Each panel represents one regression. Coefficients on insurance mandate variables, regressions of determinants of having a physical, mental or emotional contion lasting at least 6 months that causes difficulty dressing, bathing, or getting around inside the house. Sample is twin children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are either the only child or one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with the mother being 30 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF and their interactions with the mother being 30 or older, that in column 3 has indicators for mandates to cover or offer to cover infertility treatment and their interactions with the mother being 30 or older. All regressions include state of birth fixed effects for the child, year fixed-effects, and state of birth linear time trends. Regressions also include indicators for the mother's education being high school, some college, a four-year degree; for the mother's age in 5 year groupings; for the child being black, Asian, American Indian, or other non-white; for the child being Hispanic; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted. N is 82,875. Pre-reform mean of dependent variable is 0.0106 and that for women 30 or older is 0.0096. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Appendix Table 1: Means, State Controls, Sample of Twins, Natality Data

	All, 81–99	Twin matched, 81–99
% Hispanic	9.50	9.49
% black	12.51	12.53
Medicaid eligibility threshold as share of FPL	108.56	111.81
Real annual max. AFDC/TANF ben., family of 4 (97 $1000s)	6.46	6.40
Real median income, family of 4 (97 $1000s)	50.66	50.73
Overall unemployment rate (as share)	0.06	0.06
Employment growth rate (as share of employment)	0.02	0.02
Share under the poverty level	0.14	0.14
Share of births to unmarried women	0.28	0.28
Obstetric beds/1000 wom. 15–44	1.03	1.03
Neonatal intens. care beds/1000 wom. 15–44	0.19	0.19
Neonatal interm. care beds/1000 wom. 15–44	0.08	0.08
N	1684097	1456610

Summary statistics for all state level controls for sample of all twin births. Column 1 contains means for sample of all twins during 1981–99 and column 2 contains means for sample of all twins whose other twin was matched to them during 1981–99. Statistics weighted to account for 50% sampling in some states before 1985.

Appendix Table 2: Coefficients on Controls, Regressions of Determinants of Gestation (Weeks), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate ∗ age ≥ 30	IVF/no IVF and IVF/no IVF ∗ age ≥ 30	Cover/offer and Cover/offer ∗ age ≥ 30
One previous live birth	0.366***	0.365***	0.366***
	(0.008)	(0.008)	(0.008)
Two previous live births	0.703***	0.703***	0.703***
	(0.011)	(0.011)	(0.011)
Three previous live births	0.732***	0.731***	0.732***
	(0.014)	(0.014)	(0.014)
Four previous live births	0.672***	0.672***	0.672***
	(0.019)	(0.019)	(0.019)
Five or more previous live births	0.681***	0.682***	0.682***
	(0.026)	(0.026)	(0.026)
Birth order missing	-0.129	-0.127	-0.126
	(0.125)	(0.125)	(0.125)
Mother high school grad., no college	0.102***	0.102***	0.101***
	(0.016)	(0.016)	(0.016)
Mother some college, no 4 yr. deg.	0.166***	0.166***	0.166***
	(0.017)	(0.017)	(0.017)
Mother has 4 yr. degree	0.243***	0.243***	0.242***
	(0.018)	(0.018)	(0.018)
Mother's education missing	-0.448***	-0.457***	-0.468***
	(0.069)	(0.069)	(0.081)
Mother black	-0.970***	-0.970***	-0.970***
	(0.016)	(0.016)	(0.016)
Mother Asian or Pacific islander	0.139***	0.139***	0.140***
	(0.027)	(0.027)	(0.027)
Mother American Indian	0.114**	0.113**	0.113**
	(0.056)	(0.056)	(0.056)
Mother Hispanic	0.060***	0.060***	0.059***
	(0.019)	(0.019)	(0.019)
No Hispanic indicator	-0.004	-0.000	0.010
	(0.040)	(0.040)	(0.041)

Coefficients on other controls, regressions of determinants of gestation. Sample is all twin births for 1981–1999. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with an indicator for the mother being ≥ 30, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF, and their interactions with an indicator for the mother being ≥ 30, and that in column 3 has indicators for mandates to cover or offer to cover infertility treatment and their interactions with an indicator for the mother being ≥ 30. Regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,636,418. $^{***}p < .01$, $^{**}p < .05$, $^{*}p < .10$.

Appendix Table 3: Means of Birth Outcomes, Infant, and Mother Characteristics by Presence of Infertility Treatment Mandate, Sample of Singletons, Natality Data

	No mandate for Infertility treatment	Mandate for Infertility treatment
Gestation (wks.)	39.25	39.07
Premat. (< 37 wks.)	0.09	0.10
Very premat. (< 32 wks.)	0.02	0.02
Birth weight (gms.)	3361	3360
Low BW (< 2500 gms.)	0.06	0.06
Very low BW (< 1500 gms.)	0.01	0.01
Extremely low BW (< 1000 gms.)	0.01	0.01
Five minute Apgar score (0–10)	8.98	8.98
Mother has 4 yr. degree	0.16	0.20
Mother black	0.17	0.14
Mother Hispanic	0.10	0.27
Mother Hispanic not reported or missing	0.21	0.03
Age of mother	26.08	26.93
HI for infert., state law	0.00	1.00
HI for infert., may incl. IVF , state law	0.00	0.47
HI for infert., excl. IVF, state law	0.00	0.53
N	1046429	361023

Summary statistics for singleton births from Detailed Natality files for 1981–1999. Column 1 contains means for all singletons during years when no infertility treatment mandate was in place during the year before birth and column 2 contains means for all singletons during years when any infertility treatment mandate was in place during the year before birth. Statistics weighted to account for 50% sampling in some states before 1985.

Appendix Table 4: Selected Coefficients, Regressions of Determinants of Birth Weight (grams), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 35	IVF/no IVF and IVF/no IVF $*$ age ≥ 35	Cover/offer and Cover/offer $*$ age ≥ 35
HI mandate for infert.	-20.568**		
	(8.537)		
HI for infert. $* \geq 35$	-11.521**		
	(4.798)		
HI for infert., may incl. IVF		-8.560	
		(8.340)	
HI for infert., may incl. IVF $* \geq 35$		-2.351	
		(6.100)	
HI for infert., excl. IVF		-33.747***	
		(12.656)	
HI for infert., excl. IVF $*$ mother ≥ 35		-18.541***	
		(5.865)	
HI must cover infert.			-13.99855
			(8.81366)
HI must cover infert. $* \geq 35$			-6.18503
			(6.14716)
HI must offer infert. coverage			-30.11414*
			(18.16491)
HI must offer infert. $* \geq 35$			-17.30659***
			(5.84478)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 35, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 35, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 35. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,676,147. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Appendix Table 5: Selected Coefficients, Regressions of Determinants of Gestation (Weeks), Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age $\geq$ 35	IVF/no IVF and IVF/no IVF $*$ age $\geq$ 35	Cover/offer and Cover/offer $*$ age $\geq$ 35
HI mandate for infert.	-0.150***		
	(0.050)		
HI for infert. $* \geq 35$	0.034		
	(0.028)		
HI for infert., may incl. IVF		-0.098*	
		(0.054)	
HI for infert., may incl. IVF $* \geq 35$		0.089**	
		(0.039)	
HI for infert., excl. IVF		-0.206***	
		(0.073)	
HI for infert., excl. IVF $*$ mother ≥ 35		-0.009	
		(0.032)	
HI must cover infert.			-0.07681
			(0.05520)
HI must cover infert. $* \geq 35$			0.10312***
			(0.03704)
HI must offer infert. coverage			-0.26070**
			(0.10818)
HI must offer infert. $* \geq 35$			-0.04237
			(0.02879)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 35, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 35, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 35. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,636,418. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Appendix Table 6: Selected Coefficients, Regressions of Determinants of 5-Minute Apgar Score, Sample of Twins, Natality Data

Controls for	Any mandate and Any mandate $*$ age ≥ 35	IVF/no IVF and IVF/no IVF $*$ age ≥ 35	Cover/offer and Cover/offer $*$ age ≥ 35
HI mandate for infert.	-0.048**		
	(0.020)		
HI for infert. $* \geq 35$	-0.007		
	(0.010)		
HI for infert., may incl. IVF		-0.019	
		(0.017)	
HI for infert., may incl. IVF $* \geq 35$		-0.016	
		(0.012)	
HI for infert., excl. IVF		-0.082**	
		(0.033)	
HI for infert., excl. IVF $*$ mother ≥ 35		0.004	
		(0.014)	
HI must cover infert.			-0.04936**
			(0.02024)
HI must cover infert. $* \geq 35$			-0.00781
			(0.01005)
HI must offer infert. coverage			-0.03047
			(0.05258)
HI must offer infert. $* \geq 35$			0.00750
			(0.02597)

Coefficients on indicators for a state's mandating health insurers cover/offer to cover infertility treatments and interactions of age indicators with those variables. Sample is twin births in states reporting outcome for 1981–99. Column 1 regression includes an indicator for any mandate on infertility treatment and its interaction with the mother being ≥ 35, column 2 regression includes an indicator for insurers to cover/offer infertility treatment including and excluding IVF and their interactions with an indicator for being ≥ 35, and column 3 regression includes an indicator for insurers to cover or offer to cover treatment and their interactions with the mother being ≥ 35. All regressions include state of residence fixed-effects, year fixed-effects, month of birth fixed-effects, and state of residence linear time trends. Regressions also include indicators for the mother having had 1, 2, 3, 4, 5 or more prior live births, or for this being unknown; for her education being high school, some college, a four-year degree, or being unknown/not reported; for the mother being black, Asian, American Indian, or other non-white; for the mother being Hispanic, or for that not being reported; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted to account for 50% sampling in some states before 1985. N is 1,313,105. $^{***}p < .01, ^{**}p < .05, ^{*}p < .10$.

Appendix Table 7: Selected Coefficients, Determinants of Being a Twin, Interactions with Mother 35 or Older, Sample of Singletons and Twins, PUMS and ACS

Controls for	Any mandate and Any mandate $*$ age ≥ 35	IVF/no IVF and IVF/no IVF $*$ age ≥ 35	Cover/offer and Cover/offer $*$ age ≥ 35
HI for infert.	-0.00367**		
	(0.00167)		
HI for infert. $* \geq 35$	0.00408*		
	(0.00246)		
HI for infert. may incl. IVF		-0.00513**	
		(0.00236)	
HI for infert. may incl. IVF $* \geq 35$		0.00119	
		(0.00287)	
HI for infert. excl. IVF		-0.00213	
		(0.00223)	
HI for infert. excl. IVF $* \geq 35$		0.00655*	
		(0.00369)	
HI must cover infert.			-0.00363*
			(0.00208)
HI must cover infert. $* \geq 35$			0.00866***
			(0.00290)
HI must offer to cover infert.			-0.00395
			(0.00248)
HI must offer infert. $* \geq 35$			0.00008
			(0.00355)

Coefficients on insurance mandate variables, regressions of determinants of birth being a twin. Sample is all children aged 5–17 in combined 2000 5% and 1% PUMS and 2001–2002 ACS whose mother is in the household, who are either the only child or one of two children their age, both of whom are a child or grandchild of the householder and share the same mother, and whose age and sex and relationship to the head are not allocated. Twins are identified as children of the same age, whose mother lives in the household, who share the same mother, and for whom the householder is their parent or grandparent. Each column represents one regression. The regression in column 1 has an indicator for any mandate that insurers covering/offering to cover infertility treatment and its interaction with being 35 or older, that in column 2 has indicators for mandates for insurers on infertility treatment that exclude IVF treatment or that may include IVF and their interactions with being 35 or older. that in column 3 has indicators for mandates for insurers to cover or offer to cover infertility treatment and their interactions with being 35 or older. All regressions include state of birth fixed effects for the child, year fixed-effects, and state of birth linear time trends. Regressions also include indicators for the mother's education being high school, some college, a four-year degree; for the mother's age in 5 year groupings; for the child being black, Asian, American Indian, or other non-white; for the child being Hispanic; for the child's gender; and for state-level economic, demographic, and public assistance variables. Standard errors clustered at the state-by-year level. Regressions are weighted. N is 2,690,368. Pre-reform mean of dependent variable is 0.0305, that for women 30 or older is 0.0322, and that for women 35 or older is 0.0339. $^{***}p < .01$, $^{**}p < .05$, $^{*}p < .10$.

Figure 1: Share of births that are multiples by state and year, Detailed Natality Data

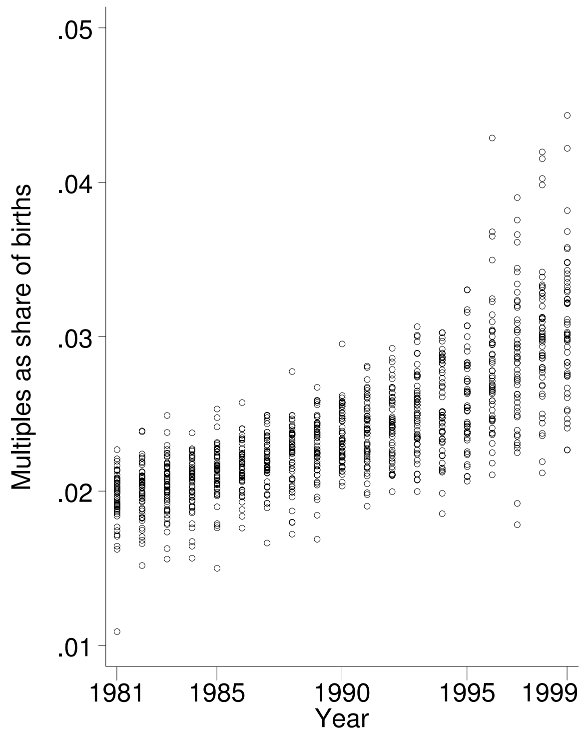

Figure 2: Average age of twin mothers by state and year, Detailed Natality Data

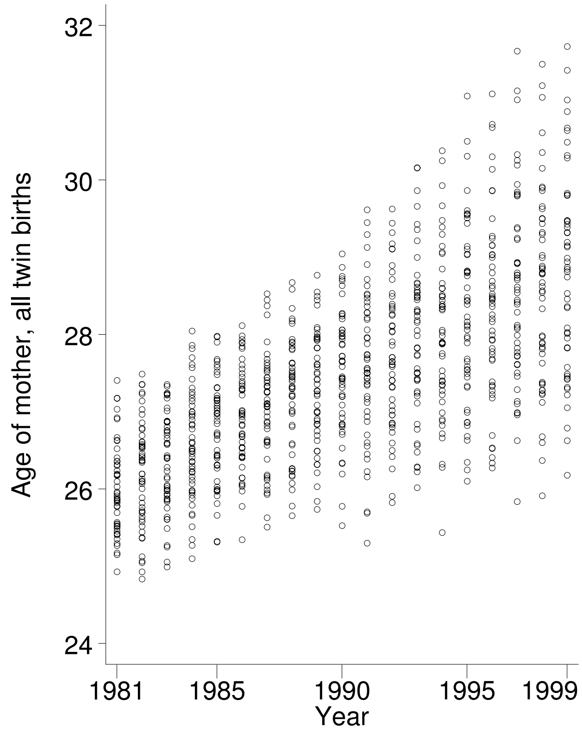

Figure 3: Pregnancies, deliveries, and live infants from ART, SART registry

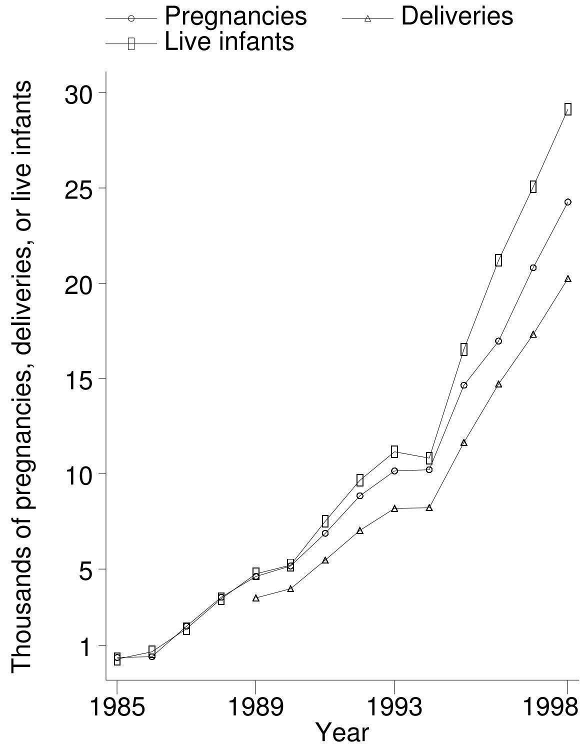

Figure 4: Number of pregnancies per delivery and infants per delivery, SART registry