Infertility Insurance Mandates and Multiple Births

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Abstract

In 2002, 15.4% of women of childbearing age in the United States reported struggles with infertility. Over the past three decades, drugs and assisted reproductive technologies have been developed to treat infertility, but treatment is costly. Since 1985, several states have adopted insurance mandates that require providers to cover or offer infertility treatments. In this paper, I examine the impact of strong mandate-to-cover laws on multiple births, which are associated with infertility treatment use. I also investigate whether the laws had heterogeneous treatment effects.

Using birth certificate data from 1980-2002, I show that the laws had a small and statistically insignificant impact on multiple birth rates. However, I find that there were over 5,300 mandate-induced triplet and higher-order births over the period, for which the delivery costs alone are estimated to be over $900 million**.** Increases in multiple birth rates are only observed for women over 30, and are greater for women who are married, white, or have a college degree. This is consistent with previous work by Bitler and Schmidt (2006) which finds that the mandates did not reduce disparities in treatment use.

Keywords: Insurance Mandates, Infertility, Multiple Births, Twins, Triplets

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1. Introduction

In 2002, 15.4% of women age 15 to 44 in the United States reported struggling with infertility; among married women the figure was 23% (Chandra 2005).[1] Over the past few decades, technologies have been developed to treat infertility, beginning with FDA approval of the ovulation-inducing drug Clomid in 1967. In vitro fertilization (IVF) was first successfully performed in England in 1978, with the first successful procedure in the U.S. in 1981. By 2002, 12% of all women 15 to 44 reported having received infertility services (Chandra 2005), and in 2004 nearly 50,000 babies were born in the U.S. as a result of assisted reproductive technologies (ARTs) (CDC et al. 2008).[2]

Between 1985 and 2001, fifteen states passed legislation either requiring many employer-provided insurance plans to cover infertility treatments or requiring insurers to offer plans that include them. Evidence of the effects of these insurance mandates is important given that other legislative bodies have considered similar policies. In 2009, legislation was introduced in both the U.S. House and Senate that would have mandated infertility insurance coverage nationwide (Resolve 2010), and there is currently debate over whether infertility treatments should be considered an "essential health benefit" under the Affordable Care Act (Resolve 2012). In this paper, I investigate the impact of state infertility insurance mandates on one important outcome: multiple birth rates.

Because ovulation-inducing drugs and ARTs often result in the fertilization of multiple eggs, infertility treatment is strongly associated with multiple births. The CDC reports that in 2002, 53.3% of infants conceived using ART were part of a multiple birth, compared to 3.3% for

[1] Surgically sterile women are omitted from the sample.
[2] ARTs are procedures in which both eggs and sperm are handled, and include IVF, gamete intrafallopian transfer (GIFT), and zygote intrafallopian transfer (ZIFT) (CDC et al. 2008).

the general population (CDC 2005). Infertility treatments have contributed to dramatic increases in multiple birth rates in developed countries since the early 1980s (Bortolus et al. 1999; Kiely and Kiely 2001; Hoekstra et al. 2008). In the Unites States, twin births rose 52% between 1980 and 1997 while triplet and higher order births increased 404%; about two-thirds of this increase is attributed to infertility treatments (Martin and Park 1999).[3] Over 40% of triplet and higher-order births in the U.S. in 1997 were a result of ARTs, and another 40% were due to fertility drugs (CDC 2000).

I choose to study multiple births for two reasons. First, multiple births can be seen as a (usually) unintended side effect of treatment, and one that bears significant costs and risks. One study concluded that multiple births due to ARTs cost one Boston hospital alone over $3 million a year between 1986 and 1991 (Callahan et al., 1994). Further, multiple births are associated with greater risks to both the mother and child, including low birth weight and prematurity (Martin and Park 1999; Reynolds et al. 2003). Importantly, the expected effect of a mandate on population-level multiple birth rates is ambiguous—on the one hand, mandates have been shown to increase the use of infertility services (Bundorf et al. 2007; Bitler and Schmidt 2006 and 2012). However, among treated patients, fewer eggs are transferred per cycle in mandate states resulting in lower multiple birth rates among IVF patients (Hamilton and McManus *forthcoming*; Reynolds et al. 2003; Jain et al. 2002; Henne and Bundorf 2008).[4]

Second, because live births due to infertility treatments are much more likely to involve multiples, multiple births can serve as a measure of the laws' success in increasing fertility. This

[3] Increasing maternal age is responsible for the remainder, since older women are naturally more likely to have multiple births (Martin and Park 1999).
[4] The number of embryo transfers is lower in mandate states because patients facing a lower out-of-pocket cost per cycle are willing to accept the lower success rates that come with fewer transfers (Reynolds et al. 2003).

is valuable given that data and measurement issues make it difficult to observe the effects of mandates on fertility directly. In particular, evidence on the mandates' effect on fertility by socio-economic status (SES) would shed light on whether the laws affected disparities across SES groups.

To estimate the effects of the mandates, I use birth certificate data from the Center for Disease Control (CDC) to document the rise in multiple births in the U.S. from 1980 to 2002. I then examine whether this increase has been greater in states with infertility insurance mandates, using fixed-effects specifications that account for policy endogeneity and time-invariant omitted variables. Finally, I estimate the model separately by the mother's SES to explore the mandates' effects on disparities in health outcomes.

2. Background

2.1 Fertility Therapies: Development and Use

The use of infertility treatments has increased dramatically since the early 1980s when the first successful IVF procedure was performed in the United States. In 2002 (the last year used in the data analysis below), 115,392 ART cycles were performed in 391 clinics in the U.S., resulting in 33,141 live births and 45,751 babies (CDC 2005). As for success rates, ARTs had a 43% success rate for women under 35 in 2002, where success is defined as a live birth.[5] Success rates decline rapidly with age, and for women over 42 the rate was 6.6%.

The 2002 National Survey of Family Growth provides insight into the type of woman who uses infertility treatments. Among women age 15 to 44, 11.9% had received any infertility

[5] This figure is for cycles using fresh embryos from nondonor eggs, which includes 74.4% of ART procedures in 2002 (CDC 2005). Also, note that for healthy 30-year old women, the chance of conceiving each cycle is about 20% (American Society of Reproductive Medicine 2006).

service; the rate was 18.3% among women 35 to 44 and 23.8% among married women (Chandra et al. 2005). Of those, the majority received advice, tests, or fertility drugs. Only 0.3% of all women received ARTs, though for married women with no children this figure is 1.4%. Maternal age is an important risk factor for infertility (Menken et al. 1986), and older women are much more likely to have sought all types of infertility treatments—particularly those who are married, those who have a college degree, and those with high incomes. Among women with only a high school degree, 0.1% had used ARTs, but this figure is 0.6% for women with a bachelor's degree. More educated women tend to be older when trying to conceive, contributing to their greater need for infertility treatments. But as I discuss next, infertility treatments are costly and more educated women may also be more able to afford them.

2.2 Infertility Insurance Mandates

The monetary costs of conceiving using infertility treatments can be prohibitively high for many women. Treatments are generally conducted as monthly cycles, with several cycles often being necessary to produce a live birth. In 1996, a typical cycle of ovulation-inducing drugs ranged between $200 and $3,000 (Davis 1996). ART is much more costly at approximately $12,000 per cycle (Hewlett 2002). In 1993, the cost per live delivery from an IVF cycle in Massachusetts was estimated to be almost $70,000, and over $100,000 for women age 40 or over (Griffin and Panak 1998).[6]

Insurance plans typically cover small portions of these costs or none at all. A 1998 survey of employer-provided health plans indicated that about one-fourth of all firms nationwide provide some form of infertility insurance, and most of those do not cover IVF (Sonfield 1999).

6 Cost per live delivery is the total cost of all IVF procedures done in the sample, divided by the number of live deliveries resulting from those procedures (Griffin and Panak, 1998).

A study by the Alan Guttmacher Institute (1994) also suggests that coverage for in vitro fertilization is not common—ranging between 14 and 17% of policies depending on the type of coverage. Many policies explicitly exclude IVF and other fertility services. Individual policies covering infertility insurance are not available due to adverse selection issues.

However, between 1985 and 2001, fifteen states passed legislation requiring at least some coverage of infertility treatments (see Table I).[7] I classify seven of these states—Maryland, Arkansas, Hawaii, Massachusetts, Rhode Island, Illinois, and New Jersey—as having strong "mandate-to-cover" laws, which require all purchased insurance that is not part of a self-insured employer-sponsored plan to provide some infertility treatment coverage. To be classified as having a strong mandate-to-cover law, states must have at least 35% of women covered by the law, and in vitro fertilization must be covered. Montana, Ohio, and West Virginia have laws that are described as "mandate-to-cover," but only HMOs are required to comply. In 2004, these three states exhibited HMO penetration rates of only 8.8%, 15.5%, and 10% respectively (Kaiser Family Foundation 2004). Furthermore, the Montana and Ohio mandates exclude IVF. In New York and Louisiana, the law merely states that insurance companies cannot deny treatment of a covered condition only because that condition results in infertility. When applied, these laws are quite weak; New York strengthened its law in 2002 (beyond the period covered in this study). The remaining three states only require that a policy including infertility treatment coverage be offered to employers. However, the employer may still choose a plan with no infertility insurance provision. Thus, in practice, a mandate-to-offer law still leaves the choice of infertility coverage up to the purchaser—much like the case in states with no law at all.

[Table I about here.]

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7 Insurance law information was obtained from Resolve (2010) and from the National Conference of State Legislatures (2010).

2.3 Mandates and Multiple Births

A small literature has examined the impact of infertility insurance mandates on fertility outcomes. Studies using clinic data generally show small decreases in multiple births among clinic patients in mandate states (Jain et al. 2002; Reynolds et al, 2003; Henne and Bundorf 2008). Other studies have used birth certificate or Census data to document population-level fertility effects. Schmidt (2005) considers the effect of the mandates on birth rates and finds that mandates increase first birth rates for women over 35 by about 32%; in a later paper she shows that the effect is concentrated among white women (Schmidt 2007). Bitler (2008) examines the effect of the mandates on infant health, and finds that insurance mandates are associated with slightly less healthy twins as measured by gestation, weight, and 5-minute APGAR scores.

In this paper, I investigate the effects of the mandates on multiple births. Two papers have developed models that provide testable theoretical predictions. First, Hamilton and McManus (*forthcoming*) explore the effects of insurance mandates and competition on the ART market. In their model, childless couples desire a single child (which yields utility B) and choose between attempting to conceive naturally or to use an ART clinic. Individual patients know their probability of conceiving naturally (t_i). The probability of conception at a clinic is greater than or equal to t_i, but clinics charge a price for their services. Hamilton and McManus define a range $[t_1, t_3]$ of patients that will find it optimal to use ARTs. Patients also choose whether to implant one or two embryos for the same price; implanting two increases the probability of a birth but also increases the probability of twins, which yield utility equal to $(1-\delta)B$, where $\delta \in (0,1)$. Thus there is also a value $t_2 \in [t_1, t_3]$, such that ART patients with fertility less than t_2 will implant two embryos while patients with fertility above t_2 will implant one.

In the model, insurance covers the cost of ARTs for a small number of cycles (assumed to be one for simplicity). The first effect of a mandate will be to expand the thresholds t_1 and t_3, so that more patients use ART. This would increase multiple birth rates, as more low-fertility patients enter the market and choose two embryos. However, they argue that a mandate would also allow some couples (with t close to t_2) to choose the less aggressive treatment (i.e. fewer embryos) through an intertemporal income effect, since they will be able to afford further treatment if the first attempt is unsuccessful. Thus, the effect of a mandate on multiple birth rates is ambiguous. Empirically, Hamilton and McManus find that multiple birth rates among clinic patients do decline after a mandate, but they do not estimate the effect at the population level.

Note that in the Hamilton and McManus model, mandates only affect the range (t_1, t_3) by reducing the price of treatment. However, there may be indirect effects, if mandates increase the supply of fertility clinics or doctors, so that services are more readily available for all women (including those not covered by the mandate).[8] Further, both covered and uncovered women in mandate states might be more aware of the availability of infertility treatments if more women around them are using them. This "information" channel may have been important since ARTs had only recently been developed when the mandates were first enacted.

Bundorf, Henne, and Baker (2007) (hereafter referred to as BHB) develop a similar model to discuss the theoretical effects of mandates on multiple births. As in Hamilton and McManus, the fertility thresholds for seeking treatment are expanded under a mandate. However in the BHB model, patients do not choose the number of embryos, but the probability of a multiple birth is increased for all women who choose treatment. Thus, insurance mandates unambiguously increase multiple birth rates. But the effect of mandates on the probability of a

[8] However, Hamilton and McManus do not find a significant effect of mandates on clinic entry.

multiple birth rather than a singleton birth is greater for high fertility patients, who would likely have had a singleton in the absence of treatment. BHB interpret increases in multiple birth rates among high-fertility women (where they use age as a proxy for fertility) as a form of moral hazard, since the benefit of treatment for these women was low.[9]

Thus, in the Hamilton and McManus model the effect of mandates on multiple birth rates is ambiguous, while in the BHB model the effect is positive but heterogeneous by age. In this paper, I investigate empirically the effects of strong mandate-to-cover laws on population-level multiple birth rates—defined as the fraction of births that involve multiples. Knowing the effect empirically is important given the aforementioned costs and risks associated with multiple births (though it is worth noting that some patients may view a multiple birth as a desirable outcome). Triplet and higher order births are especially costly and risky.

Also, an investigation into the effects of mandates on multiple births is useful because they can serve as a proxy for successful ART treatment at the population level, given their strong association with ART use. If successful treatment is defined as a live birth, the ideal measure of success at the population level would be the birth rate (# births/women in the relevant population). Unfortunately, ART use is still very low for the period I consider relative to the total number of births in the U.S. From 1996-2002 (the only years of this study for which the data is available), fewer than 1% of births nationwide were a result of ARTs (CDC et al. 2008).

[9] BHB investigage the effects of the mandates on multiple birth rates for women of different ages, and find that strong mandates significantly increased twin birth rates for women age 30-39, and triplet and higher order births for women 25-39. An important note is that BHB define a comprehensive mandate as a law requiring insurance companies to cover the costs of diagnosis and treatment of infertility and at least four cycles of ART (thus excluding Maryland, Arkansas, and Hawaii). This is a restrictive definition relative to other studies in the literature, where states are classified according to whether they cover any IVF (Schmidt 2007, Bitler 2008, Bitler and Schmidt 2012). I follow this convention when defining states as having a strong mandate-to-cover.

For earlier years, the fraction is much lower. Thus, even if mandates caused ART use to increase by 50% (roughly what Hamilton and McManus (*forthcoming*) find), birth rates would only increase in those states by less than half a percent.

A further complication is that the calculation of birth rates requires population counts, which are estimated for intercensal years. It is even more difficult to obtain accurate population counts when calculating rates by SES—the necessary counts are not available by either education or marital status. I am interested in comparing the effects of the mandates across SES groups as that will help us understand how they affect disparities in health outcomes.[10] This work complements that of Bitler and Schmidt (2006), who use data from the National Survey of Family Growth and find no significant differences in the mandates' effects on rates of infertility treatment *use* across age, race, or education categories. In a subsequent paper, (Bitler and Schmidt 2012) they find that mandates increased treatment use only among highly-educated, older women. However, if treatment success rates vary across groups, disparities in outcomes (in this case, fertility) could be made larger or smaller even though disparities in use are unaffected.[11] Disparities in outcomes could also be affected if the mandates affect selection into treatment differently across groups.

So, while an investigation of the effects of the mandates on birth rates would be ideal, given data and measurement issues I use multiple births as a proxy for successful treatment. One weakness to this approach is that some women who have multiple births as a result of ART would have had singleton births in the absence of treatment; it is not clear that this should be

[10] Bitler and Schmidt (2006) point out that "the rhetoric surrounding the push for mandated coverage of infertility treatment . . . often involves expanding access to those groups who have been traditionally less likely to receive treatment."
[11] Fujimoto et al. (2010) find that nonwhite women had lower odds of having a live birth after ART. Success rates also vary with smoking and obesity (Lintsen et al. 2005), which are correlated with SES.

counted as an improvement in health. Also, if IVF-induced multiple birth rates vary across groups, the mandates' impact on outcomes might be over- or understated. But taken together with the work of Bitler and Schmidt on treatment *use*, the results can provide some insight into whether the mandates affected disparities in health outcomes.

3. Data

3.1 Natality Detail Files

The data used in this study are from the National Center for Health Statistics' Natality Detail Files from 1980 to 2002. The data provide records for all births in 51 U.S. states for every year (including the District of Columbia), with the exception of a few states that report 50% of births prior to 1985.[12] Each record contains detailed information on the mother, father, and baby. Data used in this study include the mother's age, race, marital status, and state of residence, as well as mother's education (included on 90% of certificates). I will also use data on the birth order of the child.

Additionally, I observe the plurality of each birth—whether the baby was a singleton or part of a multiple birth. Twins are identified for all years; higher-order births are top-coded at 3 prior to 1989 and at 5 thereafter. For consistent comparison across years, I top-code the variable at 3 for all years. Because multiple births have more than one record in the data—one for each baby—multiple births would be over-represented in analysis at the level of the infant. Therefore, I match observations for multiple births according to characteristics of the mother and the birth, and keep only the first-born infant. Thus the unit of analysis for all results is a birth; there are 88,391,205 births in the full sample.

[12] For 50% sampling states, each observation is doubled.

3.2 Multiple Births, 1980-2002

Figures 1 and 2 report the number of infants born per 1,000 births in the U.S. between 1980 and 2002 (so that a singleton birth is recorded as 1, twins as 2, and triplets or more as 3). In Figure 1, results are shown by mother's age. We might expect multiple births to differ by age for two reasons. One, older women are naturally more likely to have multiple births. Two, older women are also more likely to experience infertility and therefore seek infertility treatments. Note that in the early 1980s, before the widespread use of infertility treatments, rates of multiple births were stable and relatively low, with older women slightly more likely to experience multiples. However, by 2002, the number of "extra" infants per 1,000 births has doubled for women over 35, from about 15 to nearly 30. Multiple births for younger women have also increased but less dramatically so; the number of children per 1,000 births for women under 25 has remained almost constant.

[Figures 1 and 2 about here.]

In Figure 2, we see that the number of multiple births also varies by education level. For most of the 1980s the three groups were similar in the number of children per birth, with more educated women (who are older on average) slightly more likely to have multiple births. The rate of growth in the number of infants per 1,000 births over the period is increasing in education, and by 2002 the number of "extra" infants has doubled for women with at least sixteen years of education. Thus rates of multiple births rose most dramatically among more educated women, who have higher rates of infertility treatment use.

4. Methods

4.1 Identification Strategy

I begin by providing some graphical evidence of the impact of mandates on multiple birth rates. In Figures 3a and 3b, I graph the fraction of births that involve twins or triplets and higher-order births, respectively. As with all main results in the paper, I compare states with a strong mandate-to-cover law to those with no mandate, omitting states with a mandate-to-offer or weak mandate-to-cover law. The solid line plots the trend for six states that are "treated" with a strong mandate by 1991.[13] The figures are centered at the year the mandate was passed in each state. The dotted line represents a "control" group of 36 states that did not have a mandate at any time between 1980 and 2002. For this group, the fraction of births involving multiples t years from the mandate year is calculated using the average in years in which a strong law was passed in another state, following Ayers and Levitt (1998).[14]

[Figure 3 about here.]

There are four important results in Figures 3a and 3b. First, the fraction of births involving multiples is similar in mandate and no-mandate states in the pre-law period. In the differences-in-differences framework used in the empirical work below, it is important that the trends for the treatment and control groups be the same in the absence of any policy changes, and this appears to be the case. Second, the fraction multiple appears to increase more in mandate states than in no-mandate states, and (particularly for triplet and higher-order births) the trends appear to diverge immediately after treated states adopt a mandate. Five years after the passage of a mandate, the fraction of births involving triplets or more has increased 169% in mandate states, compared to only 58% in control states. Third, the control states show no break in the trend in fraction of births

[13] New Jersey, which passed its mandate in 2001, is not included in this figure because only one year of post-mandate data is available.

[14] For example, for t = 0, I take the average for no-law states in 1985, 1987, 1987, 1987, 1989, and 1991 (when strong law mandates were passed in MD, AS, HI, MA, RI, and IL). These six values are then averaged.

involving multiples. And fourth, while there is some evidence that trends in twin births diverge for treatment and control states, the effect for triplet and higher-order births is more striking. Thus, studies focused exclusively on twin births may miss much of the laws' impacts on multiple births.[15]

Figure 3 provides some prima facie evidence that strong mandate-to-cover laws increase rates of multiple births. However, as with any policy-intervention analysis, there is a concern that the states that passed mandate-to-cover laws are systematically different from those that did not. The fact that pre-treatment trends are similar in Figure 3 offers some reassurance, as does the comparison of pre-mandate characteristics in Table II. Prior to 1984, strong law states and no-mandate states are similar along the four measures of multiple births in the table (the same measures used in the analysis below). Strong law states have slightly higher rates of multiple births—mandate states have 0.18 "extra" infants per 1,000 births, though the difference is not statistically significant at the 5% level. There are no systematic differences in maternal SES across treatment and control states—mothers in mandate states are slightly older and more educated but are less likely to be married or white. [16]

[Table II about here.]

While these results suggest that treatment and control states are similar before the mandates, I will add controls for demographic characteristics in the specifications below. Additionally, all specifications will include state fixed effects to account for policy endogeneity and time-invariant omitted variables.

[15] For example, Bitler (2008) finds an increase in twin births and in mixed-sex twinning among women over 30 in mandate states, but she does not examine higher order multiples. This choice reflects the fact that Bitler's primary interest is in the mandates' effects on infant health.
16. Hamilton and McManus (2005) perform a similar comparison of the ten states with any form of mandated insurance coverage for IVF by 2000 to those without such a law. Using 1990 Census data, they find no significant differences in means for demographic categories such as education, labor force participation, income, and family size. They do find that law states were more likely to have had other similar insurance mandates.

4.2 Empirical Model

I will estimate the effects of strong mandate-to-cover laws on multiple births using a differences-in-differences estimation strategy. The key independent variable in all regressions is a dummy variable indicating the presence of a strong mandate-to-cover law. The variable is equal to one beginning the year after a mandate is passed—given that conception using infertility treatments often takes multiple cycles, and there is generally a nine-month lag between conception and birth, we would not expect to see much of an effect from the mandates in the year that they are enacted.[17]

For tractability, individual observations are collapsed to cells according to demographic characteristics and regressions are weighted by cell size. The equation estimated is:

(1) $$Y_{cst} = \alpha + law_{cst} *\beta + X_{cst} *\theta + \gamma_s + \delta_t + \varepsilon_{cst}$$

where c indexes the cell, s indexes state of residence, and t indexes the year. Y_{cst} is one of four measures of multiple births: 1) number of infants per 1,000 births in the cell; 2) percent of births in the cell that are multiples; 3) percent of twin births in the cell; or 4) percent of births in the cell that are triplet or higher-order. "Law_{cst}" is a dummy indicating the presence of a strong mandate-to-cover law as defined above. X_{cst} is a vector of cell characteristics, and includes mother's age, education in years, marital status, race, and the birth order. The term γ_s represents state fixed effects, δ_t represents year dummies, α is the intercept, and ε_{ist} is error. Standard errors are clustered at the state level.

For the main results, the sample omits states with a mandate-to-offer or weak mandate-to-cover law, though results including these states are reported in the specification checks below.

[17] An alternative specification that allows for the effect of the law to vary over time is discussed below.

As discussed in Section 2, I also estimate the above equation for subsamples of the population. First, I divide the sample by age (<30; ≥30). This specification is common in the literature, and also allows a test of the BHB prediction that the effect of mandates on multiple birth rates will be larger for high-fertility (young) patients. The remaining subpopulations are defined by measures of maternal SES: education (< 16 years; ≥ 16 years), marital status (married; unmarried), and race (white; nonwhite).

5. Results

5.1 Mandates and Multiple Births

I first estimate the effects of a mandate-to-cover law on the number of infants per 1,000 births. Results are in Table III. The first row shows the estimate of the coefficient on the law dummy from equation [1] above, for the full sample and for selected subpopulations. For the full sample, mandates have a small and statistically insignificant positive effect on multiple births (p=0.189). The results by age do not support the prediction of the BHB model, as the estimated effect is much larger for older (low fertility) women, indicating an increase over the mean of 3.3% for this group. The coefficient for women under 30 is actually negative, though statistically insignificant. The mandates appear to increase multiple birth rates for married women, white women, and for women with a college degree (defined as 16 years of education or more). The estimated effect for women with a college degree is 0.52, for a 3.0% increase in "extra" infants per 1,000 births (and is marginally significant, with p=0.108). For married women and white women, the estimated effects are statistically significant and represent an increase over the mean of 4.7% and 3.3% respectively. Among women with less than 16 years of education, or who are unmarried, or nonwhite, there is no statistically significant effect of the law on multiple births.

[Table III about here.]

In the second row of Table III, I also present results from a specification that does not control for demographic characteristics. While the main results include these controls to ensure that changes in multiple births are not driven by changes in mothers' characteristics (mother's age in particular), there is a sense in which I might be "over-controlling" in this regression. Infertility insurance mandates could affect selection into motherhood which could in turn affect multiple births. Controlling for maternal characteristics eliminates this indirect channel by which mandates might affect multiple births.

In most cases, the estimated effects of the mandates are larger (or more positive) when demographic controls are excluded. This is what we would expect if, for example, mandates increase births to older women (as Schmidt (2007) shows) and older mothers are more likely to have multiple births. But qualitatively, the results are the same across specifications—I find that infertility insurance mandates increase multiple births for women who are older and who are married or white. There is also a marginally significant increase in multiple births for women with at least 16 years of education.

In Table IV, I present results for alternative measures of multiple births. All specifications include demographic controls. In the first row, the dependent variable is the percent of births in the cell that are multiple. Again, I find that mandates increase multiple births for married women, with marginally significant results for women over 30 and for white women. In rows 2 and 3 the dependent variable is the percent of twin or triplet and higher-order births, respectively. The biggest effects of the mandates (relative to the mean of the dependent variable) are seen for triplet and higher-order births. For all mothers, mandates increase the percent of births involving triplets or more by 0.0099 percentage points—a 26% increase relative to the mean. Again, the effects are positive and statistically significant for older women but not for younger women. By SES, we see that the percent increase in triplet-plus births is greatest for married women (33%), but there are also statistically significant and economically meaningful increases in high-order multiples for both whites and nonwhites, and for women in both education categories. The magnitude of the increase for the high-SES subsample is at least double that of the low-SES group in all cases.

[Table IV about here.]

In a few cases, the results in Table IV can be compared to those of Bitler (2008) and BHB (2007). Like Bitler, I find a positive but statistically insignificant increase in twin births for women over 30 in states with mandates that include IVF coverage. BHB, using their more restrictive definition of mandates and aggregating the data to five-year age cells, find an increase in both twin and triplet births for women 30-34 and 35-39. They estimate an increase of around 50%—twice as large as the effect I find for women over 30. If I use their more restrictive definition of a strong mandate and also restrict the sample to pre-2000 (matching their sample), I estimate an increase in triplet births of 32%. This suggests that most of the discrepancy in the two sets of results is due to differences in the level of aggregation.[18] Bitler and BHB do not estimate results by education, race, or marital status.

5.2 Specification Checks

In the above analysis, women living in the eight states with weak mandate-to-cover or

[18] Estimating results at the individual level offers two advantages: I am able to obtain more precise measures of multiple births, improving the precision of the estimates, and I can control for demographic characteristics.

with mandate-to-offer laws were omitted from the sample. I have also replicated the results in Tables III and IV but with specifications that include these women and a dummy variable indicating the presence of either type of weak law.[19] For the replications of Table III, the effect of a weak law is statistically insignificant at the 10% level in all but two cases: I find that weak laws increase multiple birth rates for married women (coefficient=0.78; p=0.097) and for women with more than 16 years of education (coefficient=1.08, p=0.093) . For replications of Table IV, the effect of a weak law on the percent triplet births among married women is 0.0093 (p=0.093); all other estimates of the effect of the weak law are statistically insignificant at 10%. In all cases, the null hypothesis that the effect of a strong law is greater than the effect of a weak law could not be rejected at the 10% level.[20]

Figure 3 suggests that the mandates take a few years to realize their full effect (perhaps because of lags induced by the infertility treatment and pregnancy process). Therefore, I also considered specifications in which the policy measure is a series of dummy variables indicating years since the mandate has passed, with dummies for one to two, three to five, six to eight, nine to eleven, and twelve to fourteen years since passage. For the subsamples that saw increases in multiple births using the initial specification, the general pattern is that the effects are statistically insignificant in years 1 and 2, but become significant and greater in magnitude by years 6 to 8.[21]

6. Discussion

[19] All results discussed in this section are available from the author.

[20] Similarly, I have produced results where a mandate is defined to include any mandate-to-offer or –cover. Results are as expected given the findings for weak laws discussed here. The null hypothesis that the estimated effects are the same using the two definitions cannot be rejected.

[21] For example, for the number of infants per 1,000 births to married women, the coefficient for years 1-2 is 0.32 (p=0.645); for years 3-5 is 0.31 (p=0.047); for years 6-8 is 0.84 (p=0.000); for years 9-11 is 1.75 (p=0.1410); and for years 12-14 is 1.26 (p=0.206).

This paper explores the effects that strong laws mandating the provision of infertility insurance have on multiple births. There are two motivations for this: first, multiple births are costly and risky, so it is important to know how their incidence is affected by the mandates. Second, multiple births are one measure of successful treatment, and therefore shed light on how the mandates affect health outcomes by SES.

I find that for the full sample of women, the laws have small and statistically insignificant effects on the number of infants per 1,000 births and on the percent of births that are multiple. However, triplet and higher-order births (which are particularly costly and risky) are increased by 26%. This translates to over 5,300 infertility mandate-induced triplet and higher-order births over the sample period (or 16,000 infants). Estimates of the health care costs associated with mandates should include the costs of these additional births. An intermediate estimate of the average delivery cost alone for a triplet birth in 2000 is $170,282 (the ESHRE Capri Workshop Group 2000), which would mean over 900 million dollars in additional costs.[22] This figure is likely an underestimate of the total health costs from mandate-induced higher-order births, as it does not include costs associated with triplet pregnancies, with treating the immediate and later-life complications associated with triplet births, or costs from quadruplet and higher-order births.

The effects of the mandates are heterogeneous across age and SES. The laws increased multiple births among older women but not younger women; this result is inconsistent with the prediction in the BHB model that mandates will have a greater impact on multiple birth rates of high fertility women. The mandates had the largest effect on married women, for whom the percent of births that are multiple increased by about 4% ($p<.05$). There is also evidence that the number of infants per birth increased among white women, and women with more education. In

[22] This is a projection of an estimate of the costs in 1991 (from Callahan et al. 1994) and includes the costs of delivery and hospital stays of the mother and infants.

contrast, the mandates did not increase the number of infants per birth among young, nonwhite, or unmarried mothers. Taken together with Bitler and Schmidt (2006 and 2012), who found no evidence that the mandates reduced differences in treatment use across SES groups, these results suggest that the mandates had little effect on disparities in health outcomes and in fact may have increased them.

Differences by SES in multiple births induced by the mandates could also point to significant welfare transfers. Wages and other forms of compensation may be reduced to pay for mandated benefits and may cause employers to drop health insurance benefits entirely (Jensen and Morrisey 1999; Gruber 1994).[23] Therefore, these policies may benefit those who value the mandated benefits at the expense of those who do not. Estimates of the rise in premiums from mandated coverage of IVF are typically low—for example, Collins et al. (1995) estimated that a mandate would increase premiums by about $3 per year, or $15.69 per year if the mandate were to increase utilization by 500%. However, this estimate does not include the costs of providing other infertility treatments, or the additional costs associated with multiple pregnancies and deliveries and with post-natal medical care for babies born as multiples.[24] The evidence in this paper suggests that the mandates may disproportionately benefit high SES women, which is a concern if the costs of the mandates are not borne accordingly. Thus, the question of who bears the cost of the mandates is an important area for future research.

[23] Jensen and Morrisey (1999) cite evidence that mandates reduce wages and coverage rates for workers, while Gruber (1994) finds little effect of mandates on insurance coverage (though he points out that the benefits he considers were widely offered already, which is not the case with infertility treatment insurance).

[24] Chelmow et al. (1995) found that in one Massachusetts hospital in 1993, the average triplet birth involved 16.7 inpatient hospital days for the mother and 13.7 days for each baby. Also, over 90% of triplets are low birth weight. Lewit et al. (1995) estimated that in 1988, low birth weight children incurred $1,100 annually in incremental costs between the ages of 1 and 15.

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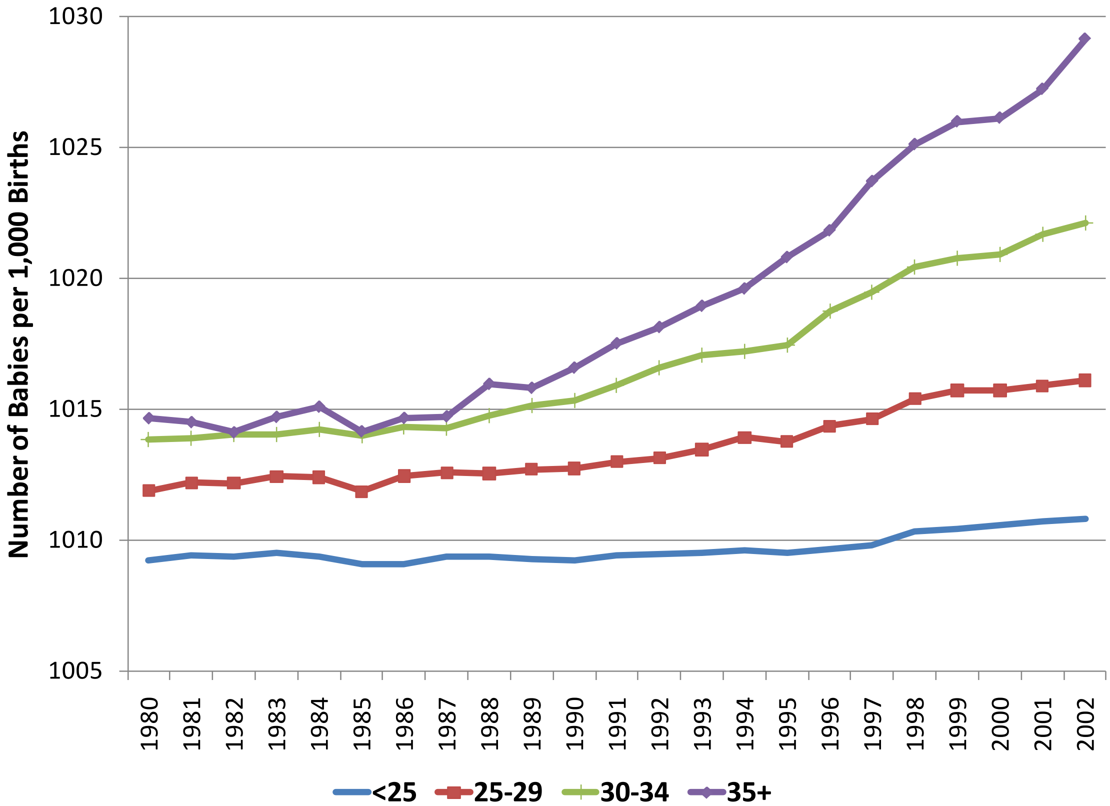
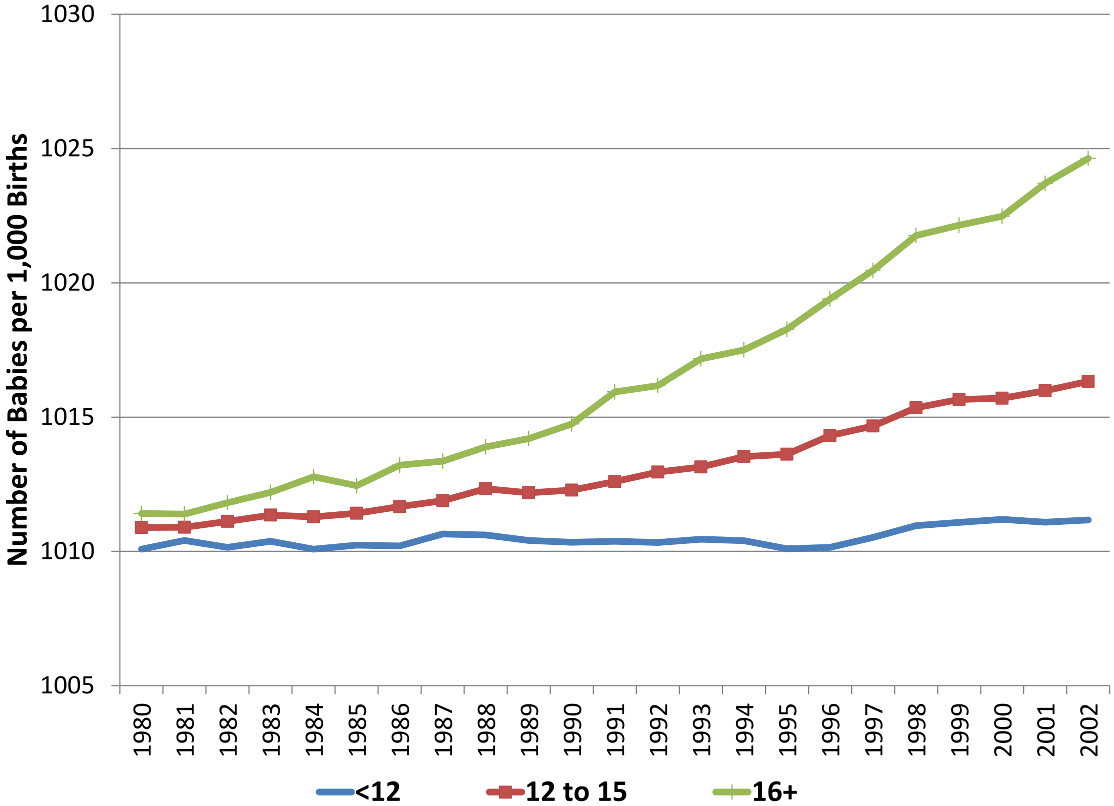
Figure 1: Number of Infants per 1,000 Births, by Mother's Age



Source: CDC Natality Detail Files 1980-2002. The unit of observation is a birth, where the number of infants per birth is equal to one for singletons, two for twins, etc. There are 88,391,205 births in the figure.

Figure 2: Number of Infants per 1,000 Births, by Mother's Years of Education



Source: CDC Natality Detail Files 1980-2002. The unit of observation is a birth, where the number of infants per birth is equal to one for singletons, two for twins, etc. Women with missing education information are omitted; there are 79,122,754 births in the figure.

Figure 3a: Effect of a Strong Mandate-to-Cover on Fraction of Births Involving Twins

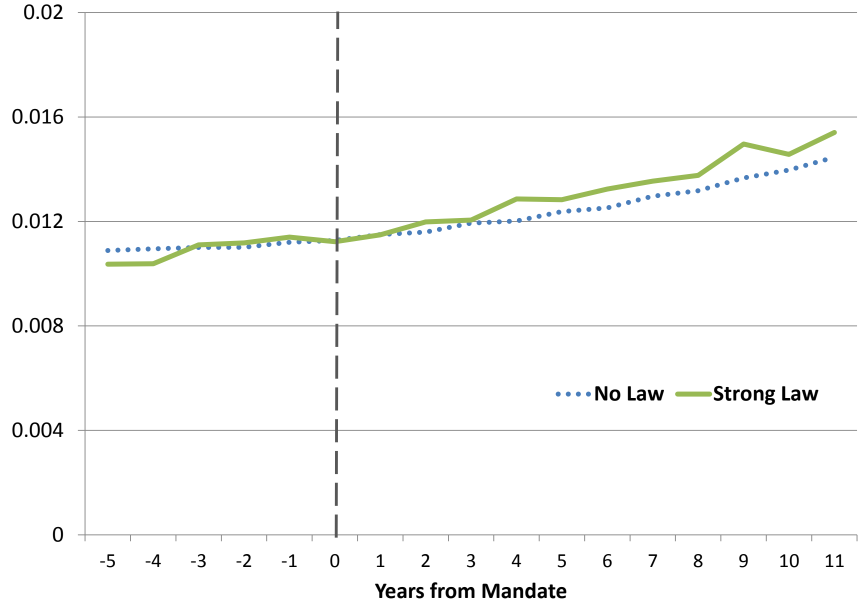
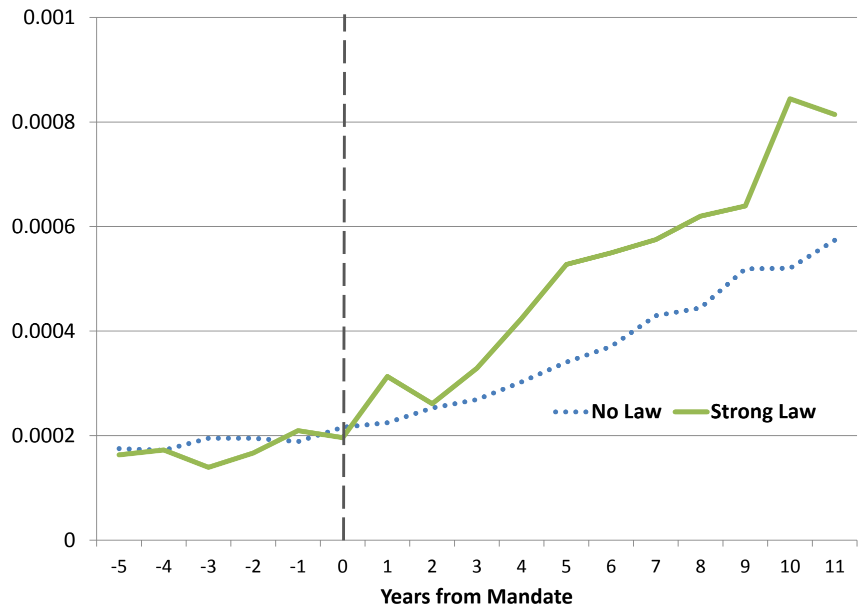


Figure 3b: Effect of a Strong Mandate-to-Cover on Fraction of Births Involving Triplets or More



Source: CDC Natality Detail Files 1980-2002. The unit of observation is a birth. The solid line is the average for 6 states that passed a strong mandate-to-cover law by 1991 (New Jersey is omitted because only one year of post-mandate data is available). The data for each state is centered at the year the law was repealed. The dotted line corresponds to the 36 states that did not pass any mandate by 2001, where fraction of births that are multiple t years from repeal is calculated using an average in years in which a law was passed in another state, following Ayers and Levitt (1998). States with a weak law are omitted. There are 53,704,690 births in the figure.

Table I: Infertility Insurance Coverage by State and Strength of Law, 1985-2001

State	Year Passed	Mandate to Cover--Strong	Mandate to Cover--Weak	Mandate to Offer
Maryland	1985	X		
Arkansas	1987	X		
Hawaii	1987	X		
Massachusetts	1987	X		
Montana	1987		X	
Texas	1987			X
California	1989			X
Connecticut	1989			X
Rhode Island	1989	X		
New York	1990		X	
Illinois	1991	X		
Ohio	1991		X	
West Virginia	1995		X	
Louisiana	2001		X	
New Jersey	2001	X		

States with a strong mandate-to-cover law have laws that cover at least 35% of insured women and must cover in vitro fertilization. Weak mandate-to-cover laws either cover less than 20% of insured women or had significant loopholes and also excluded IVF coverage. Mandate to offer laws require that insurance companies offer a policy to employers, but employers may choose not to purchase these plans. A few states adopted laws and New York and Connecticut strengthened their laws after 2001, which is beyond the period studied here. Source: Resolve (2010), National Conference of State Legislatures (2010).

Table II: Characteristics of Mothers in Natality Detail Files, By Future Legal Environment

	1980-1983			1980-2002		
	Pass a Strong Law (7 States)	Pass a Weak Law (8 States)	Do Not Pass Any Law (36 States)	Pass a Strong Law (7 States)	Pass a Weak Law (8 States)	Do Not Pass Any Law (36 States)
Babies per 1,000 Births	1011.12	1011.79	1010.94	1014.68	1013.12	1013.19
	(30.74)	(20.62)	(32.05)	(33.66)	(24.04)	(33.92)
% Births with Multiples	1.0948	1.1621	1.0790	1.4166	1.2777	1.2836
	(2.9946)	(2.0049)	(3.1405)	(3.2330)	(2.3136)	(3.2842)
% Births with Twins	1.0777	1.1452	1.0645	1.3651	1.2437	1.2486
	(2.9684)	(1.9835)	(3.1189)	(3.1785)	(2.2759)	(3.2442)
% Births with Triplets or More	0.0170	0.0169	0.0145	0.0515	0.0340	0.0351
	(0.4029)	(0.2702)	(0.3702)	(0.5138)	(0.3563)	(0.4805)
Mother's Age	25.66	25.38	25.01	27.08	26.51	26.10
	(5.37)	(5.37)	(5.21)	(5.90)	(5.92)	(5.76)
Mother's Education	12.53	12.42	12.40	12.94	12.31	12.69
	(2.49)	(2.28)	(2.25)	(2.60)	(2.95)	(2.42)
Birth Order	1.95	2.01	1.98	1.98	2.05	2.01
	(1.19)	(1.28)	(1.22)	(1.18)	(1.27)	(1.21)
Fraction Married	0.78	0.80	0.82	0.72	0.71	0.73
	(0.41)	(0.40)	(0.38)	(0.45)	(0.45)	(0.45)
Fraction White	0.77	0.81	0.82	0.75	0.80	0.80
	(0.42)	(0.39)	(0.39)	(0.43)	(0.40)	(0.40)
# Observations	1,924,971	5,092,917	7,415,259	11,758,899	32,146,209	44,486,094

Source: CDC Natality Detail Files 1980-2002. Standard errors are in parenthesis. See Table I for details on how states' legal status is defined. For multiple births, only the birth certificate of the first baby is kept, so that each observation represents a birth.

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Table III: Effect of a Strong Mandate-to-Cover on the Number of Infants per 1,000 Births

		Age		Education		Marital Status		Race	
	All Women	<30	≥30	<College	College+	Unmarried	Married	Nonwhite	White
Demographic Controls:									
Yes	0.2766	-0.1344	0.6045**	0.0828	0.5246	-0.4307	0.6686**	0.0041	0.4412*
	(0.2070)	(0.2022)	(0.2856)	(0.2369)	(0.3193)	(0.2675)	(0.2321)	(0.2391)	(0.2253)
No	0.3488	-0.0842	0.5889*	0.1314	0.5499	-0.3670	0.7453**	0.0255	0.5458*
	(0.2539)	(0.2322)	(0.3075)	(0.2959)	(0.3495)	(0.2939)	(0.2848)	(0.2249)	(0.2713)
Mean Babies per 1,000 Births	1,013.50	1,011.40	1,018.48	1,012.51	1,017.49	1,011.95	1,014.09	1,014.09	1,013.34
Observations	56,244,991	39,578,784	16,666,207	43,612,447	11,022,816	15,406,688	40,817,681	11,736,608	44,508,383

** Significant at 5% level, * significant at 10%. Results are the coefficients from an OLS regression where the dependent variable is the number of infants per 1,000 births (where a singleton=1, twins=2, etc). Standard errors are clustered at the state level and are in parenthesis. All regressions include state fixed effects and year dummies. Demographic controls include mother's age, education in years, race, marital status, and the birth order. The sample excludes women in states with weak laws; the unit of observation is a birth. Data are collapsed to cells according to demographic characteristics and results are weighted by cell size. Data are from the CDC Natality Detail Files 1980-2002.

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Table IV: Effect of a Strong Mandate-to-Cover on Percent of Births Involving Multiples

		Age		Education		Marital Status		Race	
	All Women	<30	≥30	<College	College+	Unmarried	Married	Nonwhite	White
% Multiple	0.0177	-0.0153	0.0413	0.0015	0.0378	-0.0421	0.0510**	-0.0054	0.0321
	(0.0194)	(0.0192)	(0.0272)	(0.0214)	(0.0302)	(0.0252)	(0.0215)	0.0224	0.0213
Mean	1.3138	1.1194	1.7749	1.2247	1.6661	1.1813	1.3637	1.3888	1.2940
% Twin	0.0078	-0.0171	0.0221	-0.0052	0.0231	-0.0411*	0.0352*	-0.0111	0.0200
	(0.0183)	(0.0183)	(0.0267)	(0.0194)	(0.0292)	(0.0238)	(0.0201)	0.0212	0.0202
Mean	1.2751	1.0975	1.6964	1.1975	1.5822	1.1675	1.3156	1.3680	1.2506
% Triplet or	0.0099**	0.0018	0.0192**	0.0068**	0.0147**	-0.0010	0.0158**	0.0058**	0.0120**
More	(0.0022)	(0.0015)	(0.0049)	(0.0029)	(0.0046)	(0.0021)	(0.0031)	0.0027	(0.0024)
Mean	0.0387	0.0219	0.0785	0.0272	0.0839	0.0138	0.0480	0.0208	0.0434
Observations	54,466,820	38,317,078	16,149,742	43,477,979	10,988,841	14,907,388	39,559,432	11,357,275	43,109,545

** Significant at 5% level, * significant at 10%. Results are the coefficients from OLS regressions where the dependent variable is the percent of births involving 1) multiples, 2) twins, or 3) triplets and higher-order births. Standard errors are clustered at the state level and are in parenthesis. All regressions include state fixed effects, year dummies, and controls for mother's age, education in years, race, marital status, and the birth order. The sample excludes women in states with weak laws; the unit of observation is a birth. Data are collapsed to cells according to demographic characteristics and results are weighted by cell size. Data are from the CDC Natality Detail Files 1980-2002.