The Effects of Insurance Mandates on Choices and Outcomes in Infertility Treatment Markets

Barton H. Hamilton and Brian McManus*

May 27, 2011

Abstract

For the 10%-15% of American married couples who experience reproductive problems, *in vitro* fertilization (IVF) is the leading technologically advanced treatment procedure. IVF's expense, however, may prevent many couples from receiving treatment, and those who are treated may take an overly aggressive approach in order to reduce the probability of failure. Aggressive treatment, which occurs through an increase in the number of embryos transferred during IVF, can lead to medically dangerous multiple births. We evaluate the principle policy proposal – insurance mandates – for improving IVF access and outcomes. We use data from US markets during 1995-2003 to show that broad insurance mandates for IVF result in large increases in treatment access and also significantly less aggressive treatment. More limited insurance mandates, which may apply to a subset of insurers or provide weaker guidelines for insurer behavior, generally have little effect on IVF markets.

Keywords: Infertility; in vitro fertilization (IVF); multiple births; insurance mandates.

*Earlier versions of this paper circulated under the titles "Competition, Insurance, and Quality in the Market for Advanced Infertility Treatment" and "Infertility Treatment Markets: The Effects of Competition and Policy." We thank Lyda Bigelow, Gautam Gowrisankaran, Glenn MacDonald, Randall Odem, Sam Peltzman, Marc Rysman and seminar participants at Harvard, Northwestern-Kellogg, Stanford GSB, Washington University, and the UBC summer IO conference for many helpful comments. Thomas Piper, Director of the Missouri Certificate of Need (CON) program, provided us with information on state CON laws. Peter Laakman, Jason Liauw, and Mindy Marks provided excellent research assistance. Contact information: Barton Hamilton: HamiltonB@wustl.edu; Brian McManus: mcmanusb@email.unc.edu.

1 Introduction

An estimated $10\% - 15\%$ of American married couples with a wife of reproductive age are infertile, where infertility is defined as the the inability to become pregnant after 12 months of trying to conceive without contraception (Stephen and Chandra, 2000). For these 5 million couples, infertility treatment can include simple medical advice, ovulation drugs, or the use of an assisted reproductive technology (ART) procedure such as *in vitro* fertilization (IVF). Currently, virtually all ART treatments are IVF, and in 2003 IVF accounted for 1% of all births in the US. Despite being the most technologically advanced infertility treatment, IVF is often unsuccessful and also may be quite expensive. Each attempted treatment typically entails an out-of-pocket cost of $10,000-$15,000 to the patient, with only a 25%-30% chance of success (a birth). Patients often attempt multiple cycles of treatment; Malizia et al. (2009) study one infertility clinic and find that over half of the patients continue treatment until a birth. An additional feature of infertility treatment is the chance of multiple births, which may be viewed as a characteristic of both the medical procedure and the incentives faced by treated patients. ART multiple birth rates are currently around 30% per delivery, while the natural rate is 2%. This is seen as an important deficiency of ART, as multiple births can be medically dangerous and socially expensive.

In this paper we study the primary policy intervention – insurance mandates – that US states have used to address ART access and treatment outcomes. Private insurance coverage of ART is rare, but some states have mandated that insurers provide coverage for infertility treatment. The mandates vary in their scope, with some requiring that all insurers cover ART, while others mandate coverage for lower-technology treatments or require that insurers merely offer plans that include ART coverage. The more generous mandates are designed to affect treatment patterns in several ways. First, they have the goal of expanding access to ART for patients who cannot afford to pay out-of-pocket for treatment. Advocacy groups and some lawmakers have argued that infertility is a medical condition, and couples with unfavorable fertility characteristics should not bear extraordinary costs to receive medical care (Fidler and Bernstein, 1999). Second, by reducing financial pressure on patients to obtain success during their first attempt at IVF, the mandates may reduce multiple births risks. Patients and their doctors choose the number of embryos to implant during a treatment, with a greater number of embryos providing both a higher birth probability and a higher chance of a multiple birth.

We perform our main analysis on annual clinic- and market-level data during the years 1995-

2003. For each market (i.e. metropolitan area), we compute the population share under each of three observed insurance regulations. These mandates include: a "Universal" mandate that *all* insurers must *cover* ART, a "Restricted" mandate that *some* specified types of insurers must *cover* ART, and "Other" laws that involve insurance for infertility treatment but do not require ART coverage. For example, an Other mandate law may require that insurers *offer* coverage for ART treatment. In addition to insurance regulations, a market's IVF activity and outcomes are likely affected by characteristics of the local population and the structure and attributes of local IVF clinics. In our analysis we employ an extensive set of variables to control for these characteristics. In addition, we address directly whether a state's insurance mandates can be treated as exogenous with respect to unobserved factors that may also affect IVF activity. We use data on state demographics and pre-mandate infertility treatments to show that variation in states' insurance regulations are largely due to governing tastes and not unobserved preferences for ART.

We find that Universal insurance mandates lead to a substantial increase in IVF usage in a market. The other types of insurance mandates do not have as large an impact. We use data on birthrates, controlling for treatment technology and aggressiveness, to conclude that the new patients drawn to IVF by Universal mandates are generally less fertile than patients in markets without insurance mandates. This suggests that the policies are successful in opening treatment to couples with severe medical needs. Despite the reduction in selected innate fertility, patients in Universal mandate markets reduce the number of embryos they receive during treatment. This is significant because less fertile patients require additional embryos to achieve a given birth probability, so the observed reduction in embryos implies that the mandates have shifted patients' incentives to pursue aggressive treatment. The reduction in embryos yields a significant reduction in the frequency of triplet pregnancies in Universal mandate markets, although twin pregnancies are unchanged. The other demographic variables have some intuitive relationships with IVF outcomes – for example, treatment is more common in markets with a greater percentage of women with graduate degrees – but in general no market characteristics have the consistently strong impact of Universal insurance mandates. One result of particular interest is that markets with more clinics are not associated with more aggressive embryo transfers or greater risks of multiple births, which could occur if competition among clinics drove doctors to attempt to inflate their birthrates with the goal of attracting more patients (Kolata, 2002; Bergh et al., 1999; Wells, 1999).

Our analysis of IVF and insurance mandates extends the literature in several ways. This is due to two features of our analysis: our consideration of insurance mandates' exogeneity, and our market-level panel data. The former allows us to go beyond studies that use difference-in-differences approaches to examine state-level reproductive trends before and after the passage of insurance mandates, which generally pre-date the availability of IVF clinic data. Using this state-level approach, Schmidt (2007) and Bitler (2008) use Vital Statistics and Detailed Natality data to investigate the impact of insurance mandates for ART on population-level birthrates and infant health outcomes, respectively. Schmidt (2005) and Bitler and Schmidt (2006) further consider how mandates have differentially impacted women by race and age. Bundorf, Henne, and Baker (2007) use a similar analytical approach to study insurance mandates' effects on overall fertility and multiple birth rates. These studies that use state-level panel data generally find that insurance mandates have their strongest effects on women who are over 30 or 35 years old. Outside of the state-level difference-in-differences approach, Jain et al. (2002) use a single year of clinic data, aggregated to the state level, to compare the number of IVF treatment cycles and outcomes in insurance mandate states to those in non-mandate states, while Henne and Bundorf (2008) take a similar approach with clinic data from 1990-2001 to examine trends across states (by insurance mandates) in IVF access, birthrates, and multiple births. These papers report that Universal mandates have large effects on clinic activity. Our paper is closely related to Henne and Bundorf (2008), but we extend the analysis by offering a discussion of policy exogeneity, market- (rather than state-) level analysis, and the more incentive-oriented measures of embryos and multiple gestations. The length and detail of our market-level panel also allow us to extend the results of Steiner et al. (2005) and Henne and Bundorf (2010), who find that competition in IVF markets is not associated with higher multiple birthrates.

The remainder of the paper has the following structure. In Section 2 we provide background information on the medical aspects of IVF procedures, and we also sketch a model of patient treatment and selection to provide intuition for our empirical analysis. Section 3 contains a description of our data, plus evidence on whether insurance mandates can be treated as exogenous. In Section 4 we describe our empirical models and present our main results. Section 5 concludes.

2 ART and IVF

2.1 What happens during an IVF cycle?

An individual or couple seeking infertility treatment generally begins with medical tests and advice on how to get pregnant without additional medical intervention. The next step is usually infertility drugs to stimulate egg production, for which the couple pays several hundred dollars out-of-pocket. If these simple and relatively inexpensive treatment methods are unsuccessful or if the woman's reproductive window is closing due to her age, an ART procedure may be recommended by the doctor or demanded by the patient.[1] ART is the only type of infertility treatment that includes the deliberate creation of an embryo outside of a woman's body. During most forms of ART including IVF, eggs are surgically removed from a woman's ovaries, combined with sperm in the laboratory, and embryos (fertilized eggs) are returned to the woman's body or donated to another recipient. The dominant type of ART used in the US is IVF. Some clinics also use less advanced forms of ART, which include gamete intrafallopian transfer (GIFT) and zygote intrafallopian transfer (ZIFT). GIFT and ZIFT are both more invasive than IVF and less frequently successful. The use of these alternatives to IVF peaked around 1990, and they are now almost completely absent from ART markets.

Events within a typical cycle of IVF treatment are illustrated in Figure 1. A woman first receives drugs that stimulate egg production. While there are broad guidelines for recommended drug dosages to yield the optimal quantity and quality of eggs, the dosage received may vary by physician and patient. During this period, the woman visits the fertility clinic frequently to monitor egg development. If the ovarian response is deemed to be insufficient, the physician and patient may choose to cancel the cycle. If the cycle is not terminated, the patient then undergoes surgery to retrieve the eggs for insemination in the laboratory. While the sperm and egg simply may be placed together to achieve fertilization, a more advanced technique known as intracytoplasmic sperm injection (ICSI) may be used.[2] With ICSI, a single sperm is injected directly into the egg, and the procedure is associated with an increased probability of successful fertilization, particularly for couples with male factor infertility. The use of ICSI generally adds $\$900 - \$1200$ to the $\$10,000 - \$15,000$ in expenses from the other steps of an IVF cycle. The drugs that are required during IVF account for approximately $\$3,000$ of this expense, and these drugs are an out-of-pocket cost to the patients even if insurance coverage is present.

The embryos are then cultured in the lab for 2 to 6 days as the cells begin to divide. A lab

[1] Infertility drugs alone are lower-quality treatment than IVF in two ways. First, per-egg success probabilities are lower because fertilization is not assisted. Second, the variance in the multiplicity of embryos is higher because the drugs may generate a large number of eggs available for fertilization. The relatively low price of drug treatment combined with the high variance in multiple birth risk leads to the unfortunate coincidence of low income families and dangerously high-order pregnancies.

[2] Hamilton and McManus (2005) provide evidence that ICSI diffused first to competitive markets.

technician grades the quality of the embryos, and a decision is made as to when embryos should be transferred into the patient's uterus. Additionally, the patient and her doctor must decide how many embryos will be transferred, based on embryo quality. This is perhaps the most important decision made by the doctor and patient during the IVF treatment cycle. Increasing the number of embryos to transfer increases the likelihood of pregnancy. However, it also raises the likelihood of multiple gestation, which is associated with higher miscarriage rates and lower birthweights. If the patient has a large number of high-quality embryos and the lab is adept at culturing the embryos, the physician may delay the transfer until day 5 or 6. At this point there is more information as to which embryos are the most viable; this allows the physician to transfer fewer embryos and minimize the multiple pregnancy risk for a given birthrate. Otherwise, the transfer is made more quickly following fertilization. A high-quality ART clinic will transfer fewer embryos and have a lower rate of multiple births while still maintaining a high pregnancy and birthrate. A low-quality clinic might transfer more embryos and have more multiple births in order to raise its birthrate. Of course, differences in patients' innate fertility characteristics and their effect on sorting across clinics will complicate cross-clinic comparisons in practice.

The possibility of multiple births is a central issue in the social benefits and costs of IVF. Hidlebaugh et al. (1997) calculate the mean medical cost of delivering a singleton baby to be \$9,329, while a set of twins costs \$20,318, and triplets have a delivery expense of \$153,335. Doctors typically describe a healthy singleton pregnancy and birth as the best possible outcome of an IVF treatment, while many patients do not consider twins to be worse than a singleton birth in terms of medical risk, family responsibilities, or overall goals for family size. In fact, some may prefer twins to a singleton (Pinborg et al., 2003). Many of the immediate health costs of high-order births are paid by insurers, so moral hazard could influence patients' and clinics' choices on treatment intensity.

2.2 Treatment choices and patient selection

Many factors simultaneously affect the choices of ART clinics and their potential patients. In order to fix ideas about patient characteristics and their choices within treatment, we describe innate patient fertility as ranging from a lower limit, $\underline{F}$, to an upper limit, $\overline{F}$. All couples have a personal value of $F \in [\underline{F}, \overline{F}]$, with couples near $\overline{F}$ having little trouble bearing children, while couples near $\underline{F}$ experience extreme difficulty with reproduction. Let N denote attempted natural conception and A denote the use of ART. A couple's natural probability of conception is $\phi(F, N)$, with $\phi_F > 0$, while the probability of conception with ART is $\phi(F, A) > \phi(F, N)$. For prospective patients at the bottom of the fertility distribution we conjecture $\phi(\underline{F}, A) \approx \phi(\underline{F}, N) \approx 0$, while highly fertile couples have $\phi(\overline{F}, A) \approx \phi(\overline{F}, N) \approx 1$. Suppose that couples attempting conception maximize the simple objective function $U(t|F) = \phi(F, t) - p_t$ by choosing the reproductive "technology" $t \in \{A, N\}$. The price of ART, p_A, is large relative to the price of natural conception, p_N. Given these relative prices and our assumptions about ϕ, couples with very high or very low natural fertility will opt out of treatment. Let F^L represent the lowest value of F such that ART is the preferred option, and likewise let F^U be the highest value of F such that a couple uses ART. If the difference between the success probabilities, $\phi(F, A) - \phi(F, N)$, is single-peaked in F, then all couples with values of F in $[F^L, F^U]$ receive IVF, with $\underline{F} < F^L < F^U < \overline{F}$. This sorting pattern is illustrated in Figure 2. In a related working paper (Hamilton and McManus, 2003), we provide a more rigorous analysis of patients and clinics' decisions under parametric assumptions of couples' utility functions and clinics' treatment technologies. The discussion here is an overview of the main results from the working paper.

The values of the thresholds F^L and F^U are affected by the effectiveness of the treatment technology and its price. For a fixed ART technology $\phi(\cdot, A)$, as price decreases we expect F^L to decrease as more low-fertility patients are willing to risk failure within ART, while F^U increases as more couples with relatively high fertility feel less pressure to wait for natural conception to be successful. The price reductions that draw more patients into the market can be due to an expansion in insurance benefits or increased competition among clinics.[3] Changes to the fertility mix of patients participating in the market will affect success rates, holding fixed the treatment technology. For example, if a price reduction substantially decreases F^L while F^U remains relatively constant, this expansion of treatment will result in an apparent decline in IVF success rates as the patients drawn into the market pull down the average. In our empirical analysis, we confirm that insurance mandates can have the predicted "price effect" of expanding treatment in a market. Further, we interpret estimated changes in IVF success probabilities (i.e. birth rates), controlling for treatment technology and choices, as an indication of the changing average fertility characteristics of the treated population.

Now consider how different couples may make different choices about the number of embryos to transfer during treatment. Additional embryos are typically available for transfer at zero marginal

[3] Schmittlein and Morrison (2003) provide a theoretical analysis of the marketing and pricing strategies of IVF clinics.

cost (and price). Couples who take treatment with low natural fertility (near F^L) are likely to have the most to gain from transferring additional embryos. These couples have both the lowest chance of a birth from an individual embryo and the lowest multiple birth risk from any fixed number of embryos. Holding fixed the trade-offs couples are willing to make between the chance of any birth success versus the chance of multiple births, we expect that when the treated population expands through a reduction in F^L, the average number of embryos transferred would also increase. Similarly, an expansion in treatment primarily through an increase in F^U would reduce embryo transfers, ceteris paribus. In practice, treated couples with relatively high fertility often receive two embryos during treatment. While this entails some multiple birth risk, the probability of a dangerously high-order birth is rare. In contrast, low fertility couples (near F^L) have received, historically, four or five embryos. In most cases these embryos yield zero births, but triplets or quadruplets are also possible.

The simple intuition above on embryo transfers is likely to be incomplete, however, because ART prices have important dynamic implications that affect choices within treatment. One reason why an infertile couple will take a high number of embryos is because it is costly to fail treatment and pay for another round of IVF. When the price of treatment is substantially reduced, perhaps through insurance coverage, even low fertility patients who are drawn into the market can "afford" a relatively small number of embryos. The impact of prices on dynamic treatment strategies may also provide an additional benefit of competition among IVF clinics. Through reducing prices, competition may reduce multiple birth rates because patients do not feel as much pressure to maximize the success probability of their first treatment.

Overall, the theoretical effects of a reduction in treatment prices on embryo transfers and multiple birth risk are ambiguous since the effects depend on both the fertility characteristics of new patients drawn into the market and how prices affect decisions on embryo choice. Once we have estimated changes to patients' fertility using the approach described above, however, we can empirically resolve some of this ambiguity. We empirically investigate whether embryo transfer rates rise or fall for less-fertile women who come into the IVF market due to insurance mandates. Evidence confirming the latter effect – a negative correlation between fertility and embryo transfers – supports the intuition above on dynamic treatment incentives and also confirms a primary goal of IVF insurance regulations. In addition, we measure the overall effect of shifted embryo transfer choices and patient fertility on multiple birth probabilities.

3 Data on ART Markets and Clinics

Our data on ART clinics cover two distinct periods and come from two sources. The primary data, which cover the years 1995-2003, are clinic-level treatment statistics that are available from the Centers for Disease Control and Prevention (CDC). These data contain treatment and outcome information within several patient age categories, and we use these data for our main analysis. We focus entirely on treatments that use fresh, non-donor eggs, which account for 90% of all IVF cycles during 1995-2003

We supplement the primary data with additional information on clinic activity during 1987. These secondary data are the result of a congressional subcommittee hearing led by US Representative Ron Wyden in 1989 and were provided to us by the Society for Advanced Reproductive Technology (SART). While the 1987 sample does not contain information on embryo transfer or multiple gestation rates, we show below that the data provide useful evidence that insurance mandate laws may be treated as exogenous. During both periods clinic reporting was required by federal law, so we treat the data as exhaustive for all US clinics during 1987 and 1995-2003.

We supplement each clinic data set with contemporary data on market characteristics. We use demographic data from the US Census Bureau. Many demographic variables are observed annually, but in some cases we have data from 2000 only or both 1990 and 2000. When data are available from both decennial censuses but not during the years between them, we use linear interpolation to fill in the data for the missing years. Our information on ART mandates are from Schmidt (2007) and Resolve: The National Infertility Association. Finally, we use medical wage data from the Centers for Medicare and Medicaid Studies (CMS), and information on states' Certificate of Need (CON) laws from the Missouri CON Program.

3.1 Markets

We assume that the US's Metropolitan Statistical Areas (MSAs) comprise the markets for ART services. When multiple US counties or MSAs together form a Combined Statistical Area (CSA), we use the CSA's boundaries to define the market. For example, Washington D.C. and Baltimore each have their own MSAs, but the Census Bureau has identified a CSA that includes both of these MSAs. Two aspects of ART treatment support our assumption about market boundaries. First, during the main sample period only 7 clinics (with 34 clinic-year combinations) operated outside of an MSA. Second, while ART treatment may be expensive and important enough to compel a couple to travel across a metropolitan area to receive the treatment they think is best, the repeated clinic visits required for an ART cycle are likely to restrict a couple from seeking treatment outside of their home city. The number of MSAs with at least one clinic grew from 99 in 1995 to 112 in 2003. Most of the entry by new clinics occurred in markets where other clinics were already present.

3.1.1 Insurance mandates for ART

Fifteen states currently have mandates regarding insurance for infertility treatment, summarized on Table 1. See Schmidt (2007) for additional information on individual states' mandates. There are four important differences among these regulations. First and most simple is the year that the mandate was enacted. Infertility treatment mandates were introduced as early as 1977 and as recently as 2001. There is typically a lag between when a regulation is passed and when it becomes effective, so we assume that a mandate becomes effective in the year after its passage.[4] Second, the regulations vary in whether they include ART procedures. Some states (e.g. New York) explicitly exclude IVF from their mandates. Third, the laws that include IVF vary in whether they are mandates for insurance to *cover* treatment or simply *offer* coverage. The former is more generous; the latter can be completely toothless if an insurance provider chooses to offer ART coverage at a very high price. Finally, the coverage mandates vary in whether they require all firms and insurers to provide coverage (i.e., coverage is Universal), or the mandates apply only to certain organizations (i.e., the coverage mandate is Restricted). For example, Arkansas excludes HMOs from its regulation, while the Ohio and West Virginia mandates apply to HMOs only.

Most states' coverage mandates include lifetime caps on the dollar value of covered treatment or the number of cycles. While mandates often specify that treatment must occur in facilities that comply with guidelines from the American College of Obstetricians and Gynecologists (ACOG) and the American Society of Reproductive Medicine (ASRM), the regulations generally do not provide guidelines on specific treatment choices within IVF, e.g. the number of embryos. One exception is that most of the Restricted mandate states do not cover IVF with donor sperm or donor eggs; Universal mandate states do cover such IVF cycles. To our knowledge, the ACOG, the ASRM, and individual insurers do not provide firm limits on treatment practices. Variation in patients'

[4] Assuming an implementation lag is common in studies of infertility mandates (see Schmidt 2005 for an example), and our results are robust to this assumption. We assume that mandates that were repealed (Ohio and West Virginia) cease being effective immediately after the ending year provided on Table 1.

health characteristics leads to variation in what treatment choices are prudent, and this prevents the creation of "one size fits all" guidelines on treatment details.

We use these differences across insurance mandates to classify each state into one of four categories. First, there are three states under Universal mandates to cover IVF treatment. Second, seven states have Restricted mandates to cover treatment. Third, we classify five states as having Other laws regarding infertility, including mandates to offer insurance for IVF or mandates to cover non-IVF infertility treatments. Fourth, the remaining 35 states plus the District of Columbia have no infertility mandates. Due to the timing of insurance regulations relative to the available data, we primarily exploit cross-sectional variation in states' mandates to identify our empirical model, although some longitudinal variation exists in the data due to changing regulations and the relative population shares of markets that straddle state borders. In Section 3.3 below we discuss whether insurance laws can be regarded as exogenous.

We incorporate insurance mandates into our market-level data by calculating the share of each market's female population ages 25-44 who live under each mandate. This treatment of insurance coverage accounts for MSA boundaries that cross state lines. For example, the St. Louis MSA includes women who live in Illinois (with a Universal mandate) and Missouri (with no mandate). Similarly, after 2001 the New York City MSA includes women living in states with two distinct types of insurance law – a Restricted mandate in New Jersey and an Other law in New York and Connecticut. Despite these examples, MSAs that include states in multiple insurance regimes are relatively rare. For example, 8 of 112 markets overlapped regime boundaries in 2003, and in 2 of these cases 95% of the population was under a single regime.

The 1995-2003 data include 954 market-year combinations with at least one clinic. On Table 2 we provide summary statistics for the year 2000, when we observe 108 markets with clinics. The average share of women covered by a Universal mandate is 6%, which comes largely from seven markets where most women reside in a Universal mandate state. Restricted mandates are rarer, accounting for an average of 3% of the population. (Although this share is small, markets with women under Restricted mandates are relatively large.) The average proportion of women affected by an Other law is 15%.

A shortcoming of our data is that we do not know the decisions of insurance companies to offer ART coverage when they are not legally obligated to do so. However, it is reasonable to assume that privately offered insurance for IVF would be more expensive than other insurance options within the same market, and fewer potential patients in unregulated states would receive ART under insurance coverage.

3.1.2 Clinic market structure

There is substantial variation in the number of ART clinics that serve US markets. Only about a third of MSAs have any clinics at all, and about 40% of markets with IVF are served by a single clinic during our panel. Large cities, however, may have many clinics. In 2003, 15 markets had 6 or more clinics, and the New York City region contained 47 clinics (up from 18 clinics in 1995). Across market-year observations in the 1995-2003 data, the median number of clinics is 2. The number of IVF clinics has grown significantly. In 1987, at the time of the Wyden investigation, there were 173 ART clinics in the US; this number increased to 257 in 1995 and to 396 in 2003.

In our main analysis, we characterize market structure with a pair of dummy variables. We construct one variable so that it has a value of 1 when a market-year has 2-5 clinics, and the variable takes the value 0 otherwise. The second dummy variable has a value of 1 when a market-year has 6 or more clinics. The omitted category is monopoly markets. Because our main analysis is at the clinic level, we do not account for markets with zero clinics. In Table 2 we display summary statistics for the market structure indicators during 2000.

Markets vary in their numbers of IVF clinics for many reasons, both observable and unobservable. Clinics may be more likely to form in markets with: a large number of women of child-bearing age, especially if they have delayed fertility due to education or career concerns; relatively high incomes or wealth levels because of IVF's expense; or insurance mandates that might stimulate demand. Local tastes for infertility treatment are also likely to influence clinic formation, although these tastes may be impossible to observe directly, implying that market structure is endogenous. In this paper we do not attempt to estimate the causal impact of additional clinics on the prevalence of IVF in a population or the choices made during treatment. Instead, we use our measures of market structure as controls for the combined effect of additional competition and the unobserved tastes that contributed to clinic entry. Our focus, instead, is on the effect of insurance mandates on infertility treatment.

3.1.3 Market demographics

We employ several additional measures of IVF markets' characteristics, and we display summary statistics for these variables on Table 2. To describe the extent of demand in a market, we use data on: the number of women ages 25-44, the market's per-capita income, the fraction of households with heads aged 25-44 and income of $75,000 or more, the 75th percentile of house value as a measure of wealth, the fraction of women in the labor force, the fraction of women with a bachelor's and (separately) a graduate degree, and the average household size. As a supplementary measure of the local availability of IVF, we create an dummy variable for whether there is a neighboring MSA within 75 miles that also has at least one IVF clinic. To account for variation in the difficulty in travelling across a market to receive treatment, we record each market's total land area.

We use two controls for the characteristics of the local medical market. A medical wage index accounts for variation in the general expense of healthcare in a market. This could reflect restricted supply, but high wages could also indicate above-average quality. We also use data on states' Certificate of Need (CON) laws, which restrict the establishment of new medical facilities. While CON laws do not apply directly to infertility clinics, a market with restrictive CON laws will have fewer potential workers with training or experience in medical offices and labs. In our empirical analysis, we use a "CON score" constructed by the Missouri CON Program which accounts for the number and severity of these laws (a higher value implies stricter laws).

3.2 Treatment data

The treatment data include a clinic's number of cycles, statistics on choices made during treatment, and the cycles' outcomes. The data from 1995-2003 are more detailed than those from 1987. On Table 3 we display summary statistics from the more recent data, with treatment patterns and outcomes divided by insurance mandate. We classify a clinic as operating in a Universal mandate market if more than 50% of the female population lives in a state with a Universal mandate, and we take a similar approach to classify clinics in Restricted mandate and Other law markets. We display statistics at both the market level, summing the activity of all clinics within a market, and at the clinic level. Throughout the discussion and analysis of the more recent treatment data, we separate patients into under-35 and over-35 age groups.[5] The American College of Obstetricians and Gynecologists recommends that women aged 35 or over receive expedited evaluation and treatment if they fail in attempts to conceive (ACOG, 2008). Age 35 is near the median patient age.

The market-level statistics show that the overall rates of IVF (i.e. cycles per 1,000 women ages 25-34 or 35-44) are substantially greater in Universal mandate markets than in other regimes.

[5] The CDC offers IVF statistics that are divided into several categories by patients' ages, but the ages that define the boundaries of these categories vary from year to year. Our definition of under-35 and over-35 age categories allows us to handle patients' ages consistently across 1995-2003.

The markets with Restricted mandates or Other laws, in fact, have IVF rates that are below those in markets that are not covered by an insurance mandate. This could be due to observable demographic characteristics, which we control for in the analysis below, or it could be due to aspects of the laws that direct patients to infertility treatments other than IVF. Despite the high IVF cycle rate under a Universal mandate, these markets do not have substantially different numbers of clinics than other markets.

In the clinic-level portion of Table 3, it is clear that Universal mandates are associated with expanded treatment through an increase in the average size of IVF clinics. Relative to clinics in no-mandate markets, those in Universal mandate markets also differ noticeably in their birthrates, average embryo transfer rates, and the frequency of triplet+ pregnancies. Clinics in Restricted mandate markets also have lower birthrates and triplet pregnancy rates than no-mandate markets. In Universal mandate markets, the differences from no-mandate markets are generally largest among women under age 35. This may occur because the price-reducing nature of a Universal mandate stimulates couples to try IVF relatively early in their attempts to conceive, while in no-mandate markets couples utilize lower-technology (and less expensive) options first.

The 1987 data identify 172 clinics, and of these 141 provided information on their number of treatment cycles. (We assume that the reporting of cycle data is uncorrelated with future insurance regulations.) The clinics were active in 74 markets, although we restrict our analysis to the cycles in the 72 markets that are both within MSAs and outside of West Virginia, which enacted an infertility mandate in 1977. The number of cycles in a market ranged from 3 to 2,326, with an average of 246 and standard deviation of 410.

The use of IVF and its general success rates both expanded greatly during our sample period. On Table 4 we compare treatment during 1995 and 2003. The annual number of cycles in the US doubled between 1995 and 2003, while IVF birthrates increased by about 50% for women both below and above age 35. While the substantial reduction in embryo transfers has not reduced the share of births that are twins or more, fewer women risk dangerously high-order pregnancies of triplets or more. The data on pregnancies, which are available beginning in 1997, show that the twin pregnancy rate increased slightly between 1997 and 2003 (by about 6%, or 2 percentage points). Meanwhile, the frequency of higher-order pregnancies has fallen substantially (by 50%, or almost 6 percentage points). We illustrate these trends, separated by insurance mandate regime, on Figures 3-5. Relative to markets without insurance mandates, Universal mandates are consistently associated with fewer embryo transfers and fewer triplet+ pregnancies. Restricted mandates also compare favorably to treatment in no-mandate markets over time, although these differences are more modest.

3.3 Are insurance mandates exogenous?

An obvious concern in our empirical analysis below is whether observed differences in ART activity are due to regulatory policy or, instead, market- (or state-) specific unobserved preferences for infertility treatment. This is important for policy, since we would like to know whether a mandate actually affects ART usage or simply provides a transfer to treated couples who would have purchased treatment even without a subsidy through insurance. Our identification strategy largely relies on cross-sectional variation across states with different insurance laws, so we perform preliminary analyses to verify that this assumption is reasonable. We investigate the exogeneity of insurance mandates with respect to preferences for IVF treatment in two ways.

First, in Table 5 we compare the *observable* characteristics of states that have or had IVF-specific mandates with the characteristics of states that never had mandates. We compare states with any mandate (column 2) to those with no mandate (column 1), and we also separate the three types of insurance mandates discussed above (columns 3-5). In the top portion of the table we present demographic measures that may be related to families' childbearing decisions or their likelihood to take infertility treatment. The demographic variables we consider include the population share that is female and age 25-44, female educational attainment, female labor force participation rates, average family size, per-capita income, and the share of households with heads aged 25-44 and income above $50,000. We use data from the 1990 decennial census for its relative proximity to when most mandate laws were enacted. Near the bottom of Table 5 we present indicators for whether a state has insurance mandates for colorectal cancer screenings, Medicaid funding of abortions, and mental health parity. The table shows that states with mandates for a variety of health issues also tended to adopt regulations for IVF. The willingness of states to adopt health mandates appears to reflect voters' preferences for government intervention in healthcare markets, as indicated by the significant difference between mandate and non-mandates states in their preference for Bill Clinton in the 1992 presidential election. Laugesen et al. (2006) describes the evolution of state health insurance mandates during the 1980s and 1990s.

The demographic measures show that, in many ways, states with insurance mandates are very similar to those without mandates. Comparing states with no mandates to the pooled group of states with mandates, we find statistically significant differences only in the share of young households with high incomes. Column (3) shows that residents of Universal mandate states also appear to have higher per-capita incomes. The policy and political measures at the bottom of Table 5 reveal greater differences among the states. The presence of IVF mandates is correlated with insurance mandates for other health procedures, and infertility mandates are also correlated with a preference for a Democratic president. In all, the statistics on Table 5 suggest that state residents vary in their governing tastes but not necessarily their preferences for children or other related life-cycle decisions.[6]

Second, we search for evidence of *unobserved* differences between states with and without IVF-specific mandates by analyzing the 1987 data on IVF rates and the number of clinics in each market. As we discussed above, few states had implemented insurance mandates by 1987. Consequently, we estimate a "pre-program" regression (Heckman and Hotz, 1989) in which we regress 1987 measures of ART intensity on <u>future</u> regulatory status along with other contemporary control variables.[7] If a particular state's residents are especially disposed to take infertility treatment independent of the regulatory environment, then the treatment levels in the state's markets will be relatively high even before an insurance mandate is approved. Our results from this analysis are on Table 6. In Table 6's column 1, we define the dependent variable to be the logged number of ART cycles in a market per 10,000 women aged 25-44. We group together all markets affected by any future mandate because of the relatively small number of observations within each type of mandate. We find that there is no significant correlation between a future mandate and the 1987 ART rate. In columns 2 and 3 we report results from an ordered probit analysis of the number of clinics in a market, and we include markets with zero clinics. This allows us to examine a broader set of markets, and in column 3 we include separate variables for the three types of insurance mandate. When we group together

[6]We have estimated probit models for the probability of an infertility insurance mandate, using as explanatory variables the measures on Table 5 that are significantly different between states with and without infertility mandates. We find that the demographic measures of education and income have no explanatory power in models that also include indicators for the presence of other mandates and the 1992 presidential election results.

[7]There are five states (Massachusetts, Arkansas, Hawaii, Montana, and Texas) that enacted infertility mandates in 1987, which we assume become effective in 1988. The Office of Technology Assessment (1988) reports that the official effective dates for the Massachusetts and Arkansas mandates were at the beginning of 1988, while the official effective dates for Hawaii and Texas were in June and September, respectively. There is no information on the Montana law, but we know of no IVF clinic that have ever operated in that state. A delay between the official effective date and the actual impact of a mandate may occur due to gradual information diffusion or institutional constraints in potential patients acquiring new insurance benefits. Our pre-program regression results are robust to the exclusion of clinic and market data from Hawaii, Texas, and Montana.

all mandates, we find no significant correlation between the future regulation and the number of clinics. In column 3 we find that the 1987 number of clinics has a marginally significant negative correlation with future Universal mandates, while the other mandates are uncorrelated with the number of clinics. The result on Universal mandates disappears if we limit the sample to markets with clinics in 2003, or if we cap the number of clinics at 5, which affects only 5 observations. In summary, Tables 5 and 6 appear to show that infertility insurance mandates are primarily due to state-level differences in regulatory and political preferences, and minimally related to unobserved characteristics that drive both insurance policy and ART activity.

4 Empirical analysis

We now test whether different insurance mandate policies have different effects on ART access, treatment, and outcomes. We do this with two empirical models. The first is a simple model of market-level IVF access which describes how a market's number of IVF cycles per 1,000 women varies across insurance policies. The market-level empirical model is:

$$y_{amt} = INSUR_{mt}\alpha_1 + STRUC_{mt}\alpha_2 + DEMOG_{mt}\alpha_3 + YEARS_t\alpha_4 + e_{amt}. \quad (1)$$

The subscripts m and t refer to market and year, respectively, and a is the patent's age group. The variable y is the natural log of the number of IVF cycles per 1,000 women in the corresponding age group (25-34, 35-44, or 25-44). The vector $INSUR$ contains three variables: the fraction of a market's population under a Universal insurance mandate, a Restricted insurance mandate, or one of the Other laws described above. The coefficient on each mandate variable will reflect an average over time and across states in how each class of mandates affects activity. $STRUC$ contains a dummy variable for whether the market has 2-5 firms and a second dummy for whether the market has 6 or more firms. A correlation between $STRUC$ and y could include both the causal effect of a change in market structure and a proxy for unobserved market characteristics (such as strong taste for ART treatment) that encourage both the entry of clinics and the use of IVF. We do not distinguish between the interpretations of $STRUC$ in this paper, and in some versions of the estimation we restrict $\alpha_2 = 0$. The vector $DEMOG$ contains the market-level demographic variables summarized in Table 2, and $YEARS$ contains a dummy variable for each year in the data. The error term e_{amt} accounts for unobserved market characteristics. In estimating α, we cluster the standard errors by market.

The clinic-level analysis extends the regression model in (1) to include some clinic- and treatment-level characteristics. The model is:

$$\begin{aligned} y_{aimt} &= INSUR_{mt}\beta_1 + STRUC_{mt}\beta_2 + CLIN_{it}\beta_3 + TREAT_{iat}\beta_4 \\ &\quad + DEMOG_{mt}\beta_5 + YEARS_t\beta_6 + \varepsilon_{aimt}. \end{aligned} \tag{2}$$

In addition to the notation above, the subscript i indexes individual clinics. Clinic characteristics that are fixed across patients are in $CLIN$; these include whether the clinic is a member of the Society for Assisted Reproductive Technology (SART) and whether the clinic accepts single women as patients. In $TREAT$ we collect clinic-level statistics on treatment attributes that may vary within a clinic, depending on the patients' and doctors' preferences and constraints. This vector contains three variables: the average number of embryos transferred during a treatment (by age group), the share of all ART treatments that are IVF, and the share of all IVF treatments that use ICSI. The error term ε_{aimt} accounts for unobserved clinic and market characteristics. As in the market-level model, we cluster observations by m in estimating (2).

4.1 IVF access

We estimate (1) to describe the overall effect of insurance policy on IVF penetration in a market, and we report our results in Table 7. The variable y_{amt} includes the sum of cycles across all clinics in a market. In specifications 1-3 we exclude $STRUC$ from the model, and thus the estimated values of α_1 account for an insurance mandate's effect on both the number of clinics and the number of cycles at each clinic. In a final specification we include $STRUC$ in the model to separate the direct effect of the insurance policy on patients from its indirect effects through a potential expansion in the number of clinics or the particular local tastes that drive clinics to enter a market.

We find that a Universal mandate leads to an expansion in IVF penetration by about 90% for women in all age groups. The impact is slightly larger for women over 35 years old. A Restricted mandate has a positive but insignificant impact on IVF access. For women under 35 years old in markets with Other mandate laws, IVF penetration is significantly below the rate in markets with no insurance mandates. This may be due to alternative fertility treatments being favored relative to IVF. If this selection occurs and is driven by medical needs, then its effects may appear below in the clinic-level models of treatment outcomes.

Relatively few of the variables in $DEMOG$ have a significant effect on IVF penetration. Given the construction of y as a rate per 1,000 women, the population variables in $DEMOG$ are interpreted as measuring whether women in larger markets are more likely to receive IVF than women in smaller markets. We find no significant effects of population in specifications 1-3. IVF penetration is significantly greater in markets with a large percentage of women with graduate degrees, which may indicate that infertility treatments are relative common among women who have delayed childbearing in favor of additional schooling or career development. To our surprise, neither a market's income measures nor its 75^{th} percentile of house value have a positive impact on y. In fact, IVF penetration is significantly lower in markets with relatively high house values. The market's medical wage index, which may be related to the quality of local medical care or residents' willingness to take medical treatment in general, is positively correlated with the IVF penetration rate. In specification 4 we find that the measures of market structure are positively and significantly correlated with a market's IVF rate. The addition of $STRUC$ has a minimal impact on the coefficients on $INSUR$, suggesting that the primary impacts of infertility regulations do not occur through their effects on clinic formation.

While the results in Table 7 use data from 1995-2003 only, we also find a large effect of Universal mandates in the relevant markets when we compare 1987 IVF rates (before the mandates) to 1995 levels, and then repeat this comparison in markets outside of mandate states. Markets under a Universal mandate in 1995 experienced an eight-fold increase in cycle rates between 1987 and 1995, while IVF rates only doubled between 1987 and 1995 in markets without mandates.

4.2 Birthrates

The introduction of an insurance coverage mandate increases the number of couples in a market who receive fertility treatment, and this effect is significant for Universal mandates. Are insurance mandates associated with higher or lower birthrates for these patients? The model in Section 2 suggests that insurance mandates may be associated with reduced birthrates if lower-fertility patients are disproportionately drawn in to the market. On the other hand, if clinics draw in relatively high-fertility patients or those who are inclined to request especially aggressive treatment, birthrates may increase.

To answer this question we estimate the clinic-level model (2), and we define y_{iamt} as a clinic's birthrate per 100 cycles. We account for variation in clinic size by weighting the observations by a clinic's number of cycles. In specifications 1 and 3 of Table 8 we report results from models that include the variables in $TREAT$. Including these variables controls for shifts in treatment practices that may occur with insurance mandates, and therefore the coefficients on $INSUR$ reveal changes in underlying patient fertility. Specifications 2 and 4, which exclude $TREAT$, provide the full effect of ART regulations on birth outcomes, including both patient selection and changes in choices. In Table 8 and subsequent tables we economize on space by not presenting the coefficient estimates on CON laws, land area, and the presence of nearby clinics; all are consistently insignificant throughout the analysis.

We find that treatment success rates are generally lower in markets with insurance coverage mandates. There is no significant effect of Other laws on birthrates. Specification 1 indicates that under-35 women in Universal mandate markets are significantly less fertile, on average, than women in markets with no infertility treatment regulations. The relevant coefficient increases (but is still significantly negative) when the variables in $TREAT$ are excluded in specification 2. This suggests that the net effect of changes in treatment choices have a positive effect on birthrates, given the selected population drawn into the market by a Universal mandate. For women over age 35, the results in specifications 3 and 4 indicate that Restricted mandates have a larger negative effect on birthrates than Universal mandates. This may be due to differences in the laws' effects on how couples with varying fertility problems sort themselves across types of treatment. In particular, because many Restricted mandate states exclude coverage of IVF cycles with donor sperm or donor eggs, patients in these states may take treatment with their own sperm and eggs when otherwise they might have used a donor for one or both components. For these couples, the reduced success probability of non-donor treatment may be worthwhile because their cycles are covered by insurance. In Universal mandate states, where donor treatments are not excluded from mandated insurance coverage, similar couples might be more likely to use donor eggs or sperm. Cycles using donor eggs are not included in our analysis.

Women in both age categories experience higher birthrates in clinics with high ICSI rates, which is expected given the nature of this technology. Clinics that accept single women typically have lower birthrates, as do clinics in highly competitive markets. The magnitudes of the coefficients on the quadratic population variables imply that IVF success is decreasing in population for all but the very largest markets in the sample. As in our interpretation of the insurance mandate variables, we interpret the population results as indicating a difference in the selection of patients who seek IVF. Finally, we note that the coefficients on the medical wage variable are negative and significantly different from zero. If this wage proxies for quality, then the results are consistent with clinics in higher-quality markets attracting less fertile patients into treatment.

4.3 Embryo transfers

We now investigate the impact of insurance on treatment decisions made by physicians and patients, as given by the choice of the number of embryos to transfer. While previous research (Jain et al., 2002) has shown that insurance mandates are associated with reduced embryo transfer rates, we address the issue with richer data. For this analysis, we define y_{iamt} as a clinic's average number of embryos transferred to a patient. As in the case of birthrates, we weight observations by the clinic's number of cycles. We report our results in Table 9.

We find that women both below and above age 35 take fewer embryos, on average, in markets with Universal mandates. Coupled with the results in Table 8 indicating lower innate fertility, this is strong evidence that the observed difference in embryo transfers is due to a shift in patients' choices. If, instead, patients' perceptions about the value of completing IVF quickly did *not* change with the Universal mandate, then we would expect less fertile women to request *more* embryos during treatment rather than fewer. In contrast to the large and significant effects of a Universal mandate, there is no significant effect of a Restricted mandate or an Other law on embryo choices.

Among the other clinic and market characteristics that may affect embryo choices, clinics with high IVF rates transfer fewer embryos, which is consistent with the more precise nature of this procedure over other forms of ART. Those treating single women are associated with higher embryo rates, but it is unclear whether this is a characteristic of the clinics themselves or the women who seek treatment within them. Single women may take more embryos per treatment because they lack the resources for multiple treatments if the initial attempt fails. Our measures of competition are uncorrelated with the number of embryos, which provides some assurance that intensified competition between clinics does not lead to birthrate races. An important trend across all models is that the number of embryos has fallen steadily and significantly since the beginning of our panel. Between 1995 and 2003 the number of embryos per patient fell by 1.3 (about 40%) for women both below and above age 35. This trend may reflect learning by doing, as well as the diffusion of techniques such as ICSI and assisted hatching (Hamilton and McManus, 2005).

4.4 Multiple gestation and births

We conclude our analysis by examining the potentially dangerous outcomes from IVF treatments: high-order pregnancies and multiple births. It is important to recall that twin and triplet+

pregnancies are substantially different from each other in health hazard, expense, and desirability. In a survey of IVF patients, Pinborg et al. (2003) find that a majority state that twins are their preferred pregnancy outcome. Given their different consequences, we estimate separate models for the frequency of twin versus higher-order outcomes.[8] We define y_{iamt} as a clinic's rate of twin or triplet+ pregnancies per 100 embryo transfers, and we weight observations by clinic size. We exclude the variables in $TREAT$ to account for the full effect of insurance mandates on IVF outcomes.

Our results on twin pregnancies, which we display in specifications 1 and 2 of Table 10, show that twin rates are generally unaffected by insurance mandates. This occurs despite the significant reduction in embryo transfers in markets with Universal insurance mandates. There is a marginally significant positive effect of Other laws on over-35 twin rates, but this may be a spurious correlation. Older women in Other-law states appear otherwise unaffected by these mandates, according to our other measures of IVF outcomes. The other explanatory variables appear to have little effect on twin pregnancy rates, and the dummy variables in $YEAR$ (which are not shown on the table) also show no significant change in twin rates over time.

The impact of Universal mandates on triplet+ pregnancies is substantially stronger. The results in Table 10's specification 3 indicate a reduction in triplet+ pregnancies by about a third for women under age 35. (The average triplet+ pregnancy rate is 7.8% in our sample.) Older women also experience a significant reduction in the triplet+ pregnancy rate in Universal mandate markets, although the reduction is only 40% as large as for women under 35. As in twin pregnancies, the other explanatory variables (including the other insurance mandates and measures of market structure) have no consistent impact on triplet+ pregnancy rates across age groups. The coefficients on $YEAR$, in contrast, indicate a steady decline in triplet+ pregnancies over time.

Finally, we estimate equation (2) while defining y_{iamt} as the clinic's number of multiple births per 100 cycles. These results are in Table 11. In measuring this outcome as a rate over all cycles (rather than pregnancies as in Table 10) and also excluding the variables in $TREAT$, we capture the full impact of an insurance mandate on IVF outcomes. We find that Universal mandates have a negative and significant effect on multiple birth rates for both age groups. Because twin pregnancies are not affected by the mandates, this change is likely due to the underlying fertility of women taking treatment, although some of the effect may be due to partial or full miscarriages

[8] Separate pregnancy rates for twins versus triplets are only available for 1997-2003 due to CDC reporting conventions, which also prevent us from separating multiple birth outcomes between twins and all others.

after a multiple pregnancy is recorded. We also find that Restricted mandates have a negative and significant effect on multiple birth rates for over-35 women. This result may be traced to the reduced fertility of over-35 women under Restricted mandates, revealed through the reduced birth rates on Table 8. Similarly, the relatively low multiple birth rates of older women in highly competitive markets could be due to the relatively low fertility of the treated population.

5 Conclusions

The most important economic issues in contemporary ART markets are: 1) access to treatment and 2) treatment success, as measured through birth rates and multiple birth rates. These issues of access and quality are also the central concerns for US health care markets in general. Across the medical sector of the economy and in IVF markets in particular, it has been suggested that altering the extent of insurance coverage can affect both access to care and quality. See Cutler (2004) or Gruber (1994) for general discussions of these issues. In the market for infertility treatment, mandatory insurance coverage is predicted to bring new patients into the market and to reduce the incentive to transfer a dangerously high number of embryos during treatment, thereby increasing the quality of care. With the present paper we evaluate the impact of mandated insurance coverage on ART access and treatment success rates.

Our empirical analysis confirms the existing intuition that an insurance mandate can increase access to IVF while decreasing the number of embryos that patients transfer during treatment. We find significant differences, however, across types of insurance mandates. Universal mandates, which require coverage by all private insurers, are the only mandates that consistently have significant effects on IVF access and outcomes. By jointly studying changes in birthrates, treatment technology and choices, and outcomes, we are able to separate selection effects from differences in choices. In particular, we find that the effects of Universal insurance mandates on embryo transfer rates are likely due to shifts in incentives rather than variation in the selection of patients. Our results are consistent with the view that a generous (Universal) insurance mandate brings more low-fertility patients into the market who, without adjusted dynamic incentives, would be expected to transfer more embryos. The reduced embryo transfers, combined with changes to underlying fertility, yield a significant reduction in high-order pregnancy rates. We caution readers that our estimates recover average effects across states with a given type of insurance mandate and also across time. Differences in particular state laws are likely to have some effect on outcomes, and we cannot assess how markets' responses to mandates change while the mandate is in effect.

Although our results indicate that high-order pregnancy *rates* from IVF may not change or will fall with expanded insurance coverage, it is important to note that the *number* of triplets may not be reduced. In fact, our results imply that the opposite is likely to occur because of the substantial growth in the number of ART cycles following a Universal insurance mandate. Whether the increase in multiple births observed in these markets will lead to substantially higher health care costs depends on the types of patients induced to attempt IVF. If new IVF patients are drawn entirely from the population of women who are taking no alternative infertility treatment, the number of triplets in the population would increase due to the effects that we identified above and the substantial difference between the natural rate of multiple births and that under ART. However, if new infertility patients take IVF instead of continuing with ovulation drugs, there is again an ambiguous effect of expanding ART on the number of multiple births. Ovulation drugs tend to have higher variation in their outcomes, and may have a higher risk of triplets (or more) than IVF. Further research on individual choices among infertility treatment options would be useful in addressing these questions.

In this paper we have used the available data to estimate shifts in measures of treatment access and quality, but we have not evaluated the extent to which these shifts increase or decrease social welfare. The overall welfare effects of public policy on IVF markets is a rich area for future study, both in the number of questions to be answered and the importance of these issues to choices made by women in the US. Although IVF has been fairly recently introduced, its use is spreading rapidly. The percentage of all births in the US due to IVF procedures using fresh, non-donor eggs grew from 0.3% in 1995 to 0.8% in 2003 to 0.9% in 2007. For women over age 35, the shares of IVF births grew from 0.9% to 2.4% to 2.7% during the same years. We expect the use of IVF to continue to grow, as treatment expenses fall with competition and technological progress, and more women account for the possibility of ART while making related life cycle choices regarding education, career, and marriage. Indeed, the changing economic environment of recent decades is likely to have shifted substantially the demand for infertility treatment services. As women's labor force participation rates and real wages have increased, couples have deferred the decision to have children.[9] However, biological fertility decreases with age (Menken et al., 1986), so women who delay having children are more likely to benefit from medical treatment for infertility. Thus,

[9] Between 1970 and 2000 the average age of the mother at first birth in the United States rose 3.5 years (Mathews and Hamilton, 2002).

infertility treatments such as IVF can permit an important increase in control over the timing of education, career, and family choices. This is similar to the function that Goldin and Katz (2002) ascribe to the birth control pill. Ultimately, public policies that increase the efficiency of ART provision and practices may have a substantial impact on the welfare and productivity of women and their families.

References

[1] American College of Obstetricians and Gynecologists (2008): "Age Related Fertility Decline: A Committee Opinion," *Fertility and Sterility* 90, S154-55.

[2] Bergh, T; A Ericson; T Hillensjo; K-G Nygren; and U-B Wennerholm (1999): "Deliveries and Children Born after *In Vitro* Fertilization in Sweden 1982-95: a Retrospective Cohort Study," *Lancet* 354, 1579-85.

[3] Bitler, Marianne P. (2008): "Effects of Increased Access to Infertility Treatment on Infant Health Outcomes: Evidence from Twin Births," University of California-Irvine working paper.

[4] Bitler, Marianne P. and Lucie Schmidt (2006): "Health Disparities and Infertility: Impacts of State-Level Insurance Mandates," *Fertility and Sterility* 85 (4), 858-865.

[5] Bundorf, M. Kate; Melinda Henne; and Laurence Baker (2007): "Mandated Health Insurance Benefits and the Utilization and Outcomes of Infertility Treatments," NBER working paper #12820.

[6] Cutler, David (2004): *Your Money or Your Life*. New York: Oxford University Press.

[7] Fidler, Anne T. and Judith Bernstein (1999): "Infertility: From a Personal to a Public Health Problem," *Public Health Reports* 114, 494-511.

[8] Goldin, Claudia and Lawrence F. Katz (2002): "The Power of the Pill: Oral Contraceptives and Women's Career and Marriage Decisions," *Journal of Political Economy* 110 (4), 730-770.

[9] Gruber, Jonathan (1994): "State Mandated Benefits and Employer Provided Insurance," *Journal of Public Economics* 55(3), 433-464.

[10] Hamilton, Barton H. and Brian McManus (2003): "A Model of an Assisted Reproductive Technology (ART) Market," Washington University Olin School of Business working paper.

[11] Hamilton, Barton H. and Brian McManus (2005): "Technology Diffusion and Market Structure: Evidence from Infertility Treatment Markets" Washington University Olin School of Business working paper.

[12] Heckman, James J. and V. Joseph Hotz (1989): "Choosing Among Alternative Nonexperimental Methods for Estimating the Impact of Social Programs: The Case of Manpower Training," *Journal of the American Statistical Association* 84, 862-874.

[13] Henne, Melinda B. and M. Kate Bundorf (2008): "Insurance Mandates and Trends in Infertility Treatments," *Fertility and Sterility* 89 (1), 66-73.

[14] Henne, Melinda B. and M. Kate Bundorf (2010): "The Effects of Competition on Assisted Reproductive Technology Outcomes," *Fertility and Sterility* 93 (6), 1820-1830.

[15] Hidlebaugh, Dennis A.; Irwin E. Thompson; and Merle J. Berger (1997): "Cost of Assisted Reproductive Technologies for a Health Maintenance Organization," *Journal of Reproductive Medicine* 42 (9), 570-574.

[16] Jain, Tarun; Bernard L. Harlow; and Mark D. Hornstein (2002): "Insurance Coverage and Outcomes of *In Vitro* Fertilization," *New England Journal of Medicine* 347 (9), 661-666.

[17] Kolata, Gina (2002): "Fertility Inc.: Clinics Race to Lure Clients," *The New York Times*, January 2, 2002.

[18] Laugesen, Miriam J.; Rebecca R. Paul; Harold S. Luft; Wade Aubry; and Theodore G. Ganiats (2006): "A Comparative Analysis of Mandated Benefit Laws, 1949-2002," *Health Services Research* 41 (3), 1081-1103.

[19] Malizia, Beth A.; Michele R. Hacker; and Alan S. Penzias (2009): "Cumulative Live-Birth Rates after In Vitro Fertilization," *New England Journal of Medicine* 360 (3), 236-243.

[20] Mathews, T.J. and Brady E. Hamilton (2002): "Mean age of mother, 1970-2000," *National Vital Statistics Reports* 51 (1).

[21] Menken, Jane; James Trussell; and Ulla Larsen (1986): "Age and Infertility," *Science* 233 (4771), 1389-1394.

[22] Office of Technology Assessment, US Congress (1988): *Infertility: Medical and Social Choices*, OTA-BA-358. Washington, DC: U.S. Government Printing Office.

[23] Pinborg, Anja; Anne Loft; Lone Schmidt; and Anders Nyboe Andersen (2003): "Attitudes of IVF/ICSI-Twin Mothers Towards Twins and Single Embryo Transfer," *Human Reproduction* 18, 621-627.

[24] Schmidt, Lucie (2005): "Infertility Insurance Mandates and Fertility," *American Economic Review, Papers and Proceedings* 95 (2), 204-208.

[25] Schmidt, Lucie (2007): “Effects of Infertility Insurance Mandates on Fertility,” *Journal of Health Economics* 26, 431-463

[26] Schmittlein, David C. and Donald G. Morrison (2003): “A Live Baby or Your Money Back: the Marketing of *In Vitro* Fertilization Procedures,” *Management Science* 49 (12), 1617-1635.

[27] Steiner, Anne Z.; Richard J. Paulson; and Katherine E. Hartmann (2005): “Effects of Competition Among Fertility Centers on Pregnancy and High-Order Multiple Gestation Rates,” *Fertility and Sterility* 83(5), 1429-1434.

[28] Stephen, Elizabeth Hervey and Anjani Chandra (2000): “Use of Infertility Services in the United States: 1995,” *Family Planning Perspectives* 32 (3), 132-137.

[29] Wells, Matt (1999): “Doctors Warn on Test-Tube Births,” *The Guardian*, November 5 1999.

Table 1: ART regulations

	Year[1]		Year[1]	Include ART?	Cover or Offer?
Universal mandate		Other infertility treatment regulation			
Illinois	1991	Connecticut	1989	Yes	Offer
Massachusetts	1987	Texas	1987	Yes	Offer
Rhode Island	1989	California	1989	No	Offer
		Louisiana	2001	No	Cover
Restricted mandate		New York	1990	No	Cover
Arkansas	1987				
Hawaii	1987				
Maryland	1985				
Montana[2]	1987				
New Jersey	2001				
Ohio[3]	1991-1997				
West Virginia[3]	1977-2001				

Notes:
A Universal mandate requires that all insurers must cover ART treatments. A Restricted mandate requires that some specified types of insurers must cover ART treatments. States with Other regulations have insurance regulations on ART or other infertility treatments, but do not require coverage of ART. Other notes: (1) Year that the regulation was passed or repealed. We assume that the regulatory changes become effective during the following year. (2) The extent of Montana's law is untested, as there has never been an ART clinic in the state. (3) Ohio and West Virginia updated their regulations to effectively exclude IVF from coverage.

Table 2: Market characteristics, year 2000

	Mean	Std. Dev.	Min.	Max.
Insurance mandate				
Universal	0.06	0.24	0	1.00
Restricted	0.03	0.17	0	1.00
Other	0.15	0.35	0	1.00
Number of clinics	3.48	5.36	1	39
2-5 clinics in market	0.45	0.50	0	1
6+ clinics in market	0.13	0.34	0	1
Female pop. age 25-44 (000s)	27.98	46.87	1.64	343.25
Pct. women with bachelor's degree	16.10	3.60	9.65	28.06
Pct. women with graduate degree	8.25	2.56	4.72	19.48
Per-capita income (000s)	29.38	4.30	22.21	47.14
Pct. hholds with income $75k+, age 25-44	21.47	5.75	10.50	44.48
Top quartile house value	17.19	6.57	9.59	52.58
Pct. women in labor force	59.60	4.70	46.47	70.95
Average household size	2.51	0.13	2.19	2.97
Land area	5.16	4.98	0.46	35.32
Clinics in neighboring markets?	0.49	0.50	0.00	1.00
Medical wage index	0.98	0.12	0.80	1.47
CON score	8.20	7.88	0.00	30.80
N	108			

Table 3: Treatment statistics, 1995-2003

Insurance mandate:	None		Universal		Restricted		Other	
Patient Age:	Under 35	Over 35	Under 35	Over 35	Under 35	Over 35	Under 35	Over 35
<u>Market-level</u>								
Cycles per 1,000 women	0.227	0.223	0.407	0.365	0.198	0.195	0.171	0.179
	(0.154)	(0.151)	(0.165)	(0.191)	(0.093)	(0.125)	(0.109)	(0.105)
Number of clinics	5.77		4.67		3.87		6.82	
	(8.25)		(5.91)		(4.63)		(9.70)	
N	264		57		53		154	
<u>Clinic-level</u>								
Number of cycles	95.46	134.96	177.23	218.81	99.04	122.97	78.41	116.07
	(137.30)	(202.67)	(224.09)	(322.98)	(121.45)	(162.37)	(98.96)	(160.89)
Birthrate % per cycle [2]	33.00	20.38	28.86	18.08	31.26	18.45	35.81	21.88
	(10.10)	(6.99)	(8.25)	(5.94)	(8.59)	(6.41)	(10.50)	(7.18)
Embryos transferred per cycle [2]	3.07	3.50	2.88	3.26	3.11	3.45	3.17	3.63
	(0.74)	(0.65)	(0.63)	(0.60)	(0.68)	(0.61)	(0.79)	(0.65)
% twin gestation [3]	28.88	24.55	28.55	24.41	27.76	23.34	29.28	24.81
	(12.35)	(7.34)	(11.74)	(5.70)	(13.08)	(7.58)	(12.46)	(7.84)
% triplet gestation [3]	7.76	7.02	5.87	6.19	6.64	5.79	8.88	7.56
	(6.82)	(4.88)	(5.13)	(3.89)	(5.88)	(4.69)	(7.44)	(5.17)
% cycles with multiple births [2]	13.20	6.27	10.77	5.15	12.20	5.40	14.84	6.98
	(5.69)	(3.12)	(3.97)	(2.31)	(4.89)	(2.76)	(6.13)	(3.32)
N	1522		266		205		1051	

<u>Notes:</u> Each cell contains a market- or clinic-level mean, with the standard deviation in parentheses. The superscript '2' indicates that we calculate the mean while weighting by a clinic's number of cycles. The superscript '3' indicates that we calculate the mean while weighting by a clinic's number of pregnancies.

Table 4: ART Outcomes

Year	1995	1995	2003	2003
Patient's age	Under 35	Over 35	Under 35	Over 35
Total cycles in US	19,125	23,022	39,464	46,547
Average number of embryos	3.95 (0.85)	4.02 (0.77)	2.56 (0.45)	3.06 (0.52)
% Cycles with a birth	25.83% (9.98)	15.26% (7.23)	37.35% (9.52)	22.88% (7.20)
% Births with twins+	41.19% (13.5)	30.77% (13.38)	38.38% (9.58)	28.76% (9.83)
N	253	253	389	392

Note: We focus on cycles of fresh, non-donor eggs. We obtain "Total cycles" by summing cycles from all clinics in our data. The remaining cells include a mean and standard deviation (in parentheses). We calculate the means as weighted averages taken across clinics within the appropriate year and age group. *N* is the number of clinics from which we have data within each year and age group.

Table 5: State characteristics and insurance mandates

	(1)	(2)	(3)	(4)	(5)
Insurance mandate:	None	Any	Universal	Restricted	Other
Demographics in 1990					
(Female pop. age 25-44) /	16.11	16.38	16.53	16.16	16.60**
Total pop.	(0.92)	(0.74)	(0.45)	(1.02)	(0.33)
Pct. women with high	76.77	74.56	75.47	74.80	73.68
school degree	(5.99)	(4.93)	(4.25)	(6.26)	(3.95)
Pct. women with	17.04	17.93	20.17	16.04	19.24
bachelor's degree	(2.92)	(4.29)	(3.41)	(4.80)	(3.47)
Pct. women with	5.04	5.93	6.98	4.94	6.69
graduate degree	(1.08)	(1.93)	(1.43)	(1.74)	(2.05)
Per-capita income	28,327.0	30,913.1	33,795.0*	28,980.3	31,889.8
	(4,742.1)	(6,970.3)	(2,734.3)	(7,892.4)	(7,675.5)
Pct. households age 25-44	22.29	27.18*	32.47*	22.78	30.16
with income > $50k	(6.97)	(9.04)	(5.50)	(9.95)	(10.67)
Pct. women in labor force	57.77	56.78	58.77	56.38	56.15
	(3.60)	(5.55)	(1.36)	(7.65)	(3.90)
Average household size	2.69	2.72	2.69	2.70	2.77*
	(0.12)	(0.13)	(0.03)	(0.19)	(0.08)
Insurance mandates					
Medicaid for abortion	37.1%	66.7%*	2/3	4/7	4/5*
Colorectal cancer screening	22.9%	40.0%	2/3*	2/7	2/5
Mental health parity	62.3%	86.7%*	3/3	6/7	4/5
Political leanings					
Plurality voted for Clinton In 1992	51.4%	93.3%***	3/3	7/7**	4/5
N	35	15	3	7	5

Notes: The demographic statistics are means with standard deviations in parentheses below. We conduct t-tests for the equality of the means between columns (2)-(5) and column (1).
*** indicates significance at $p = 0.01$, ** for $p = 0.05$, and * for $p = 0.10$.

Table 6: Pre-mandate ART measures

	(1)	(2)	(3)
Dependent variable:	Cycles/population	Clinic count	Clinic count
Estimation method:	OLS	Ordered probit	Ordered probit
Any future mandate	0.286	-0.119	
	(0.322)	(0.210)	
Future Universal mandate			-1.037*
			(0.591)
Future Restricted mandate			0.194
			(0.338)
Future Other mandate			-0.109
			(0.252)
Pct. women with	0.593	0.195	0.0623
bachelor's degree	(4.418)	(2.505)	(2.542)
Pct. women with	3.532	6.315*	6.857*
graduate degree	(6.539)	(3.785)	(3.854)
Per capita income	-0.873	0.177	0.177
	(2.006)	(0.697)	(0.690)
Pct. households age 25-44	0.0130	0.00982	0.0145
with income $50k+	(0.0685)	(0.0263)	(0.0262)
Pct. women in labor force	2.052	0.131	-0.144
	(4.226)	(2.395)	(2.460)
Avg. household size	0.448	-0.211	-0.243
	(1.709)	(0.792)	(0.811)
Female pop. age 25-44		0.0106***	0.0106***
		(0.00113)	(0.00114)
(Female pop. age 25-44)^2		-0.00201***	-0.00206***
		(0.000424)	(0.000431)
N	72	291	291
R^2	0.054	–	–

Notes: Specification (1) also includes a constant.
*** indicates significance at p = 0.01, ** for p = 0.05, and * for p = 0.10.

Table 7: Changes in access to ART
Dependent variable: log(Cycles in the market/Female population)

	(1)	(2)	(3)	(4)
Age group:	Under 35	Over 35	All ages	All ages
Universal mandate	0.638***	0.691***	0.659***	0.681***
	(0.137)	(0.126)	(0.131)	(0.121)
Restricted mandate	0.259	0.209	0.253	0.261
	(0.166)	(0.209)	(0.176)	(0.192)
Other mandate	-0.226*	-0.107	-0.164	-0.192*
	(0.121)	(0.106)	(0.112)	(0.109)
Female pop. age 25-44	-0.00145	-4.88e-05	-0.000716	-0.00878**
	(0.00353)	(0.00359)	(0.00349)	(0.00366)
$(\text{Female pop. age 25-44})^2$	0.00106	0.000500	0.000796	0.00270***
	(0.000999)	(0.000965)	(0.000966)	(0.00101)
Pct. women with	0.0156	0.0389	0.0249	0.0281
bachelor's degree	(0.0243)	(0.0242)	(0.0237)	(0.0214)
Pct. women with	0.0672**	0.0883***	0.0773**	0.0746**
graduate degree	(0.0335)	(0.0305)	(0.0315)	(0.0315)
Per capita income	0.000230	0.00385	0.00348	0.00298
	(0.0186)	(0.0200)	(0.0187)	(0.0180)
Pct. households age 25-44	0.0139	0.0222	0.0156	0.00634
with income $75k+	(0.0283)	(0.0263)	(0.0270)	(0.0263)
Top quartile house value	-0.0429***	-0.0255*	-0.0320**	-0.0341**
	(0.0161)	(0.0149)	(0.0152)	(0.0159)
Pct. women in labor force	0.0282*	-0.000317	0.0172	0.0224
	(0.0151)	(0.0145)	(0.0145)	(0.0142)
Avg. household size	0.328	0.515	0.454	0.446
	(0.345)	(0.357)	(0.342)	(0.331)
Land area	-0.0152	-0.0110	-0.0139	-0.0139
	(0.00996)	(0.0102)	(0.00974)	(0.00955)
Clinics in neighboring	-0.0364	-0.0500	-0.0479	-0.0379
markets?	(0.126)	(0.113)	(0.118)	(0.111)
CON score	-0.000511	-0.00123	-0.00125	0.000132
	(0.00569)	(0.00506)	(0.00526)	(0.00485)
Medical wage index	1.065*	1.041*	1.012*	1.443**
	(0.624)	(0.603)	(0.602)	(0.594)
2-5 clinics in market				0.340***
				(0.0758)
6+ clinics in market				0.775***
				(0.141)
N	954	953	954	954
R^2	0.376	0.340	0.380	0.426

Notes: Variables included in models but excluded from table: constant, year dummies.
*** indicates significance at $p = 0.01$, ** for $p = 0.05$, and * for $p = 0.10$.

Table 8: IVF success rates
Dependent variable: Births per 100 cycles

	(1)	(2)	(3)	(4)
Age group:	Under 35	Under 35	Over 35	Over 35
Include treatment variables?	Y	N	Y	N
Universal mandate	-3.822***	-2.918**	-1.758	-1.915*
	(1.380)	(1.341)	(1.061)	(0.980)
Restricted mandate	-1.764	-2.578*	-2.995***	-3.355***
	(1.609)	(1.407)	(1.130)	(1.041)
Other mandate	1.192	1.294	0.548	0.829
	(0.995)	(1.102)	(0.808)	(0.762)
2-5 clinics in market	-0.0152	0.0473	-0.939	-0.941
	(0.972)	(1.031)	(0.654)	(0.672)
6+ clinics in market	-2.409	-2.517	-3.718***	-3.806***
	(1.564)	(1.609)	(1.098)	(1.125)
Clinic is SART member	3.101**	3.409**	1.731	1.672
	(1.489)	(1.707)	(1.212)	(1.252)
Clinic accepts single women	-1.201	-1.714*	-1.407**	-1.276*
	(0.923)	(1.008)	(0.659)	(0.707)
Clinic avg. number of embryos	-2.787***		0.392	
	(0.956)		(0.552)	
Clinic IVF rate	-2.475		2.826	
	(2.608)		(2.520)	
Clinic ICSI rate	7.685***		4.019**	
	(1.990)		(1.951)	
Female pop. age 25-44	-0.0963***	-0.0891***	-0.0631***	-0.0502**
	(0.0331)	(0.0329)	(0.0237)	(0.0218)
$(\text{Female pop. age 25-44})^2$	0.0283***	0.0271***	0.0199***	0.0169***
	(0.00788)	(0.00784)	(0.00571)	(0.00534)
Pct. women with	0.353	0.369	0.207	0.220
bachelor's degree	(0.311)	(0.336)	(0.236)	(0.237)
Pct. women with	-0.182	-0.239	-0.115	-0.184
graduate degree	(0.256)	(0.279)	(0.178)	(0.174)
Per capita income	0.0403	0.0234	0.137	0.128
	(0.287)	(0.273)	(0.176)	(0.178)
Pct Households age 25-44	0.411	0.425	0.288*	0.235
with income $75k+	(0.249)	(0.263)	(0.172)	(0.174)
Top quartile house value	0.0410	-0.0193	-0.0111	0.0157
	(0.120)	(0.123)	(0.0806)	(0.0772)
Pct. women in labor force	0.0252	0.118	0.205	0.250*
	(0.187)	(0.204)	(0.141)	(0.133)
Avg. household size	3.189	3.889	-0.512	-0.0666
	(4.298)	(4.563)	(3.135)	(3.137)
Medical wage index	-18.23**	-14.88*	-10.98**	-10.47**
	(7.742)	(8.317)	(4.745)	(4.976)
N	3,119	3,119	3,114	3,117
R^2	0.247	0.217	0.222	0.214

Notes: Variables included in models but excluded from table: constant, year dummies, indicator for clinic in nearby market, land area, CON score. *** indicates significance at $p = 0.01$, ** for $p = 0.05$, and * for $p = 0.10$.

Table 9: Embryo transfers
Dependent variable: Average number of embryos transferred per cycle

	(1)	(2)
Age group:	Under 35	Over 35
Universal mandate	-0.359***	-0.305***
	(0.103)	(0.0753)
Restricted mandate	0.0293	0.134
	(0.106)	(0.110)
Other mandate	0.0534	0.0675
	(0.109)	(0.0987)
2-5 clinics in market	0.0146	-0.0906
	(0.0690)	(0.0683)
6+ clinics in market	0.0640	-0.130
	(0.108)	(0.0974)
Clinic is SART member	-0.133	-0.0615
	(0.0825)	(0.0647)
Clinic accepts single women	0.191***	0.148**
	(0.0596)	(0.0600)
Clinic IVF rate	-1.231***	-1.226***
	(0.215)	(0.202)
Clinic ICSI rate	0.366**	0.317**
	(0.169)	(0.128)
Female pop. age 25-44	0.00259	-0.00129
	(0.00232)	(0.00222)
$(\text{Female pop. age 25-44})^2$	-0.000782	0.000121
	(0.000524)	(0.000521)
Pct. women with	-0.00359	0.00183
bachelor's degree	(0.0204)	(0.0178)
Pct. women with	-0.0122	-0.0107
graduate degree	(0.0209)	(0.0185)
Per capita income	-0.00120	-0.0105
	(0.0201)	(0.0240)
Pct Households age 25-44	-0.0245	0.00565
with income $75k+	(0.0176)	(0.0191)
Top quartile house value	0.0256***	0.0340***
	(0.00780)	(0.00738)
Pct. women in labor force	-0.00947	-0.0196
	(0.0122)	(0.0121)
Avg. household size	0.0450	0.0330
	(0.370)	(0.394)
Medical wage index	-0.589	-0.964**
	(0.385)	(0.478)
N	3,119	3,114
R^2	0.503	0.417

Notes: Variables included in models but excluded from table: constant, year dummies, indicator for clinic in nearby market, land area, CON score. *** indicates significance at $p = 0.01$, ** for $p = 0.05$, and * for $p = 0.10$.

Table 10: Multiple gestations
Dependent variable: Twin and triplet+ gestations per 100 pregnancies

	(1)	(2)	(3)	(4)
Age group:	Under 35	Over 35	Under 35	Over 35
Gestation outcome	Twins	Twins	Triplets+	Triplets+
Universal mandate	1.229	0.634	-2.790***	-1.114**
	(0.762)	(0.915)	(0.904)	(0.559)
Restricted mandate	0.832	-0.405	-0.632	0.507
	(1.385)	(1.469)	(1.105)	(0.766)
Other mandate	0.796	1.851*	-0.0683	0.305
	(1.328)	(0.996)	(0.873)	(0.519)
2-5 clinics in market	-0.712	-0.836	0.954	-0.0243
	(0.811)	(0.782)	(0.652)	(0.580)
6+ clinics in market	-1.845	-1.764	1.888	-0.173
	(1.145)	(1.170)	(1.292)	(0.843)
Clinic is SART member	1.202	0.498	0.199	-0.0274
	(1.356)	(0.927)	(0.687)	(0.569)
Clinic accepts single women	-1.127	-1.088	1.062**	0.142
	(0.769)	(0.814)	(0.424)	-0.0100
Female pop. age 25-44	-0.0184	0.0107	-0.0202	(0.0145)
	(0.0191)	(0.0225)	(0.0197)	0.00298
(Female pop. age 25-44)^2	0.00708	-0.000359	0.00523	(0.00338)
	(0.00441)	(0.00505)	(0.00454)	0.173
Pct. women with	0.329	0.175	0.0983	(0.125)
bachelor's degree	(0.203)	(0.217)	(0.199)	-0.214
Pct. women with	-0.272	-0.197	-0.162	(0.147)
graduate degree	(0.269)	(0.219)	(0.188)	-0.0167
Per capita income	-0.00846	-0.0982	-0.0691	(0.0968)
	(0.156)	(0.143)	(0.130)	-0.0127
Pct Households age 25-44	0.234	0.0297	-0.0823	(0.113)
with income $75k+	(0.151)	(0.150)	(0.150)	0.0549
Top quartile house value	-0.0720	0.00910	0.0769	(0.0439)
	(0.0918)	(0.0777)	(0.0598)	-0.109
Pct. women in labor force	-0.0448	0.0998	-0.103	(0.0929)
	(0.121)	(0.136)	(0.103)	-2.058
Avg. household size	3.419	-2.148	-0.551	(2.893)
	(4.885)	(3.373)	(3.054)	-0.0100
Medical wage index	-7.724	-2.240	-1.106	-1.581
	(4.859)	(4.908)	(3.712)	(2.941)
N	2,567	2,512	2,567	2,512
R^2	0.028	0.015	0.155	0.050

Notes: Variables included in models but excluded from table: constant, year dummies, indicator for clinic in nearby market, land area, CON score. *** indicates significance at p = 0.01, ** for p = 0.05, and * for p = 0.10.

Table 11: Multiple births
Dependent variable: Multiple births per 100 cycles

	(1)	(2)
Age group:	Under 35	Over 35
Universal mandate	-1.741**	-0.977**
	(0.675)	(0.404)
Restricted mandate	-1.240	-1.057**
	(0.906)	(0.425)
Other mandate	0.939	0.473
	(0.603)	(0.322)
2-5 clinics in market	-0.0678	-0.412
	(0.487)	(0.289)
6+ clinics in market	-1.324	-1.824***
	(0.865)	(0.465)
Clinic is SART member	1.566	0.533
	(0.985)	(0.464)
Clinic accepts single women	-0.519	-0.603*
	(0.570)	(0.317)
Female pop. age 25-44	-0.0505***	-0.0137
	(0.0157)	(0.00997)
$(\text{Female pop. age 25-44})^2$	0.0159***	0.00551**
	(0.00390)	(0.00240)
Pct. women with bachelor's degree	0.339**	0.133
	(0.167)	(0.104)
Pct. women with graduate degree	-0.298**	-0.195***
	(0.142)	(0.0660)
Per capita income	-0.0648	0.0155
	(0.137)	(0.0662)
Pct Households age 25-44 with income $75k+	0.299**	0.103
	(0.127)	(0.0724)
Top quartile house value	-0.00450	0.0143
	(0.0540)	(0.0312)
Pct. women in labor force	-0.0288	0.0875
	(0.0964)	(0.0601)
Avg. household size	1.976	-1.201
	(2.564)	(1.212)
Medical wage index	-10.66***	-3.692*
	(3.996)	(2.183)
N	3,119	3,117
R^2	0.142	0.137

Notes: Variables included in models but excluded from table: constant, year dummies, indicator for clinic in nearby market, land area, CON score. *** indicates significance at $p = 0.01$, ** for $p = 0.05$, and * for $p = 0.10$.