

Infertility Treatment Markets: The Effects of Competition and Policy

Barton H. Hamilton and Brian McManus*

July 2007

Abstract

For the 10%-15% of American married couples who experience reproductive problems, *in vitro* fertilization (IVF) is the leading technologically advanced treatment procedure. Two important issues are at the center of policy debates regarding IVF markets: 1) expanding access to infertility treatment, and 2) how to encourage IVF clinics and patients to minimize the risk of multiple births, which can be expensive and dangerous for both the mother and children. This paper evaluates the two principle policy proposals – insurance mandates and competition restrictions – for meeting these issues. Insurance mandates, which require that insurers pay for a couple’s initial IVF treatments, can attract more patients into the market while also reducing high-order birth risks. Competition restrictions have been proposed as a way to reduce risky behavior by clinics and patients, but we find that this reasoning does not apply to US IVF markets. Additional competition can substantially increase the number of patients without increasing the chance of dangerously high-order births.

Keywords: infertility; in vitro fertilization (IVF); access to IVF treatment; multiple births; insurance mandates; competition restrictions.

JEL Classifications: I110 Analysis of Health Care Markets; L100 Market Structure, Firm Strategy, and Market Performance: General

*An earlier version of this paper circulated under the title “Competition, Insurance, and Quality in the Market for Advanced Infertility Treatment.” 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 2003 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, 314-935-8057; Brian McManus: mcmanus@wustl.edu, 314-935-4915.

1 Introduction

There is substantial debate in the United States over the appropriate policies to increase access to medical treatment and improve the quality of health care services. Some advocate universal insurance coverage or broad insurance mandates to ensure that individuals seeking care are able to afford it, while others emphasize the role that competition could play in driving down costs and prices, hence improving both access and the quality of care.¹ Conversely, critics of each policy have suggested that these proposals may reduce welfare in medical markets.² A concern about expanded insurance coverage is that it will lead to moral hazard problems and the overprovision of medical services, while critics of competition argue that patients are relatively uninformed and health care providers will compete in ways that may actually reduce efficiency and quality. Unfortunately, it has been difficult to disentangle the impacts of insurance regulations and competition on the provision and quality of health care, since consumers may self-select (or be selected) into insurance plans, third-party payers may limit the choices available to individuals, and government regulations may limit firm entry and thus competition.

In this paper we study the market for infertility treatment, which is characterized by substantial variation in both insurance coverage and competition. Private insurance coverage of technologically-advanced assisted reproductive technologies (ART) such as *in vitro* fertilization (IVF)³ is rare, but a small group of states have mandated that insurers provide generous coverage for infertility treatment. The entry of new ART clinics is largely unregulated, so competition varies across markets in response to local demand and cost conditions. These sources of variation allow us to evaluate how insurance and competition affect health care access and quality. We measure patients' access to treatment through the number of ART cycles performed,⁴ and quality is captured by birth rates and multiple-pregnancy rates.

Access to ART is a central issue in infertility treatment markets because of the large difference

¹Examples of these arguments can be found in Cutler (2004), who discusses the impact of universal insurance coverage on access to care, and Porter and Teisberg (2004), who argue for the benefits of enhanced competition in health care provision.

²Gruber (1994) summarizes the arguments for and against state health insurance mandates. Gaynor and Haas-Wilson (1999) provide an overview of the role of competition in health care markets. Dranove et al. (1992) investigate whether hospitals in competitive markets engage in a wasteful “medical arms race” to attract patients.

³Over 95% of ART treatments are IVF. In the remainder of the paper we often use these terms interchangeably, except where noted.

⁴An ART procedure consists of a sequence of treatments (a “cycle”) performed over about two weeks.

between the number of American couples who report reproductive difficulties and those who use ART. An estimated 10% – 15% of American married couples with a wife of reproductive age are infertile.⁵ For these 5 million couples, infertility treatment can include simple medical advice, ovulation drugs, or the use of an ART procedure. Of these forms of treatment, ART procedures are the most technologically advanced, as they alone involve the deliberate creation of an embryo outside of a woman’s body. Since the birth of the first test tube baby in 1978, IVF has spread rapidly and in 2003 accounted for 1% of all births in the U.S. But despite recent growth in the availability of ART, the procedure is sometimes regarded as an option primarily for the wealthy, given its high cost and the frequent absence of insurance coverage. IVF 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). Advocacy groups and some lawmakers have suggested that insurers should be required to cover ART expenses. It is 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). Arguments for mandatory insurance coverage have led some states to enact regulations which require varying forms of insurance coverage for infertility treatment. During our sample period of 1995 to 2003, fifteen states had mandates regarding insurance for ART costs. The ultimate extent of regulation is still an open issue, as two of these states enacted insurance mandates in 2001 while other states are currently considering similar legislation. This state-level variation in regulation can lead to a so-called “zip-code lottery” in which couples who learn that they have a fertility problem are exposed by chance to different forms of insurance coverage.⁶

While generous insurance coverage can improve access to care, it is important to note that an increase in competition among clinics can lead to a similar result. Although insurance coverage substantially decreases treatment costs for couples whose insurance benefits have not been exhausted, coverage typically ends after a woman has made two or three attempts at IVF. Competition may have a less drastic effect on the prices couples pay for their initial cycles, but the benefits of competitive prices continue for all treatments that a couple might require or desire. These issues related to ART access yield the first empirical objective of this paper: to measure the effects of

⁵Infertility is generally defined as the inability to become pregnant after 12 months of trying to conceive without contraception (Stephen and Chandra, 2000). Data from the 1995 National Survey of Family Growth indicate that 21% of childless women aged 35-44 have received infertility treatments (Abma et al., 1997).

⁶We return below to the issue of whether variation in insurance regulations can be regarded as exogenous to a state population’s propensity to seek treatment.

insurance mandates and competition on patients' use of IVF.

ART treatment quality is affected by restricted access to care, since the out-of-pocket expense of IVF can substantially affect the choices made within treatment that determine the probabilities of births and multiple births, the primary measures of quality in this market. Both outcomes are influenced by the number of embryos that are transferred to the patient during treatment; this is determined jointly by the couple receiving treatment and their doctor. The current incentives and technology for infertility treatment yield a multiple birth rate that is much higher with ART (30%) than is true naturally (2%). This is seen as an important failing within ART, as multiple births can be socially expensive and dangerous. High-order pregnancies involve more health risks for a woman, and low-birthweight children require additional neonatal care and may experience more health problems later in life. 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. Following this nonlinear relationship between multiple births and medical costs, we regard multiple gestations of triplets or more as a "low quality" outcome to be avoided. In contrast, sentiments about twin gestations and births are mixed. 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. An acknowledged policy goal of mandated insurance coverage for IVF is that these regulations will reduce patients' incentives to pursue aggressive treatment by reducing the costs of failure (Jain et al., 2002). Some observers of IVF markets have advocated limits on competition among clinics to further reduce multiple birth probabilities (Kolata, 2002; Bergh et al., 1999; Wells, 1999). Their argument is that competitive pressures lead clinics to counsel aggressive treatment for their patients so that the clinics can advertise high success rates. However, this argument ignores the possibility that a monopoly clinic may exploit its market power to raise the price of an IVF cycle.⁷ A patient who faces a high monopoly price may choose to transfer more embryos in order to reduce the likelihood that she will need to return for an additional expensive ART treatment. Thus, limits on competition may

⁷A survey of the literature by Dranove and White (1994) suggests that more concentrated hospital markets are associated with higher prices for hospital services.

increase multiple birth rates. The possibility that clinics will inflate their birth rates through aggressive treatment is also tempered by the many real costs of multiple births that are not paid by insurers. Savvy patients should examine all aspects of clinic performance instead of ignoring triplet and quadruplet probabilities. These (varying) predictions of how treatment choices and outcomes are determined yield the second empirical objective of the paper: to evaluate the effects of insurance mandates and competition on treatment success (i.e., quality) as measured through birth rates and multiple gestation rates.⁸

In order to achieve our empirical objectives, we define measures of insurance regulations and competition that are appropriate for ART markets. Treatment markets (metropolitan areas) may be located in states with no insurance regulation or they may have one of two forms of regulation: “Universal” and “Restricted” insurance mandates, which vary in the types of firms and insurers that are bound by these laws.⁹ Similarly, we classify markets by whether they have one clinic or two or more clinics (“competitive”). As we observe the activity of clinics and patients across ART markets, we take care to account for market characteristics (both observed and unobserved) that may complicate inference on how competition and insurance policy affect choices and outcomes. Previous studies, primarily in the medical literature, analyze the impact of insurance on IVF access and outcomes at the state level rather than market level, while research examining the impact of competition on IVF outcomes treats market structure as exogenous and does not control for differences in observed characteristics (e.g., population, per capita income) across markets.¹⁰

Using a nine-year panel of clinic activity and a rich set of market characteristics, we find that both competition and Universal insurance mandates can increase IVF usage in a market. Through our analysis of birth rates, we conclude that Universal mandates draw a less fertile group of new patients into treatment. Despite having lower innate fertility, which requires additional embryos to achieve a given birth probability, these patients take fewer embryos, on average, than patients

⁸Data on multiple *birth* rates are unavailable for all years in our panel but one.

⁹A small number of markets straddle state boundaries, and we account for the mixture of regulatory regimes within them.

¹⁰Jain et al. (2002) compare the number of IVF treatment cycles and outcomes in insurance mandate states with those in non-mandate states. Steiner et al. (2005) contrast IVF treatments and outcomes in markets with 1-2 clinics vs. markets with 3-7 and 8-22 clinics in 2000. In the economics literature, Schmidt (2006) and Bitler (2005) 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. Schmittlein and Morrison (2003) provide a theoretical analysis of the marketing and pricing strategies of IVF clinics.

in markets without mandates. Accordingly, we find that the rate of triplet pregnancies among women under age 35 is significantly reduced in markets with Universal insurance mandates, while the twin gestation rate is unaffected. With an increase in competition, the additional patients drawn into a market do not shift the average innate fertility of treated patients, and these patients' choices do not significantly change the average number of embryos transferred during treatment. While we estimate that twin pregnancy rates increase due to competition, we find that there is no significant difference in the more dangerous and costly triplet-or-greater gestation rate. These results lead us to conclude that expanding competition in ART markets does not have the harmful effects previously conjectured.

This paper contributes to the growing literature on the effect of competition on outcomes in health care markets. In contrast to the majority of cases studied in this literature (see Gaynor, 2006), much of the activity in ART markets occurs outside of hospitals and with patients directly paying for their treatment. Empirical findings, in general, have been mixed in the analysis of competition's effect in health care markets. For example, Joskow (1980), Gowrisankaran and Town (2003), and Sari (2002) find a positive relationship between competition and quality, while Capps (2005), Mukamel et al. (2001), and Propper et al. (2004) find that quality can fall with competition. These papers, like our own, are silent on the larger issue of whether changes in quality are positively related to changes in overall social welfare.

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.¹¹ 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

¹¹Infertility 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.

doctor or demanded by the patient. ART is a procedure in which 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.¹² 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 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.¹³ 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.¹⁴ 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.¹⁵ 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

¹²An exception among ART procedures is gamete intrafallopian transfer (GIFT), which does not include combining eggs and sperm outside of a woman’s body.

¹³Poor ovarian response implies that fewer and potentially lower quality eggs will be available for subsequent transfer, leading to a lower likelihood of a birth. Because ovarian response declines with age, cancellation rates are generally higher for women over 35.

¹⁴In a related paper (Hamilton and McManus, 2005) we provide evidence that ICSI diffused first to competitive IVF markets.

¹⁵ICSI is used to increase the likelihood of fertilization, although some reproductive physicians may prefer more “natural” fertilization when possible for reasons of natural selection of the sperm. Hansen et al. (2002) examine birth defect risks among children conceived using IVF with and without ICSI, and they are unable to reject the hypothesis that defect rates are unaffected by ICSI use.

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.¹⁶ 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.¹⁷

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. 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 $\phi(\overline{F}, A) \approx \phi(\overline{F}, N) \approx 1$. Given the substantial price of ART treatment, couples with very high or very low natural fertility may opt out of treatment, while 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’

¹⁶In cases where the woman is unable to produce eggs, donor eggs from another woman, or frozen embryos from a previous IVF cycle may be used. These phenomena were not very common during 1995-2003, and we do not consider them in this paper.

¹⁷This relationship between clinic quality and outcomes is complicated when patients’ innate fertility characteristics influence the way that they sort themselves across clinics.

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 price competition among clinics. 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 of birth rates below, we interpret changes in IVF success probabilities, 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 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 the lowest chance of having an individual transferred embryo yield a birth, so they also have a relatively low multiple birth risk for a fixed number of embryos. Since couples with lower values of F require more embryos to achieve a fixed success probability, as the set of treated couples expands we expect a reduction in F^L to increase the average number of embryos transferred within treatment, while an increase in F^U reduces the average. 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.

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. In contrast to concerns about dangerous birthrate races among ART clinics, competition may actually reduce multiple birth rates because patients do not feel as much pressure to maximize the success probability of their first treatment. Overall, the effects of a reduction in treatment prices on embryo transfers and multiple birth risk is ambiguous since this depends on both the fertility characteristics of new patients drawn into the market and the effects of prices and doctors' recommendations on embryo choice.

As consumers' observable characteristics and their unobserved tastes vary from market to market, the number and type of potential patients attracted to treatment will vary as well. Local tastes for medical infertility treatment, in turn, affect the number of clinics attracted to operate in a market. In all, both patients' characteristics and the resulting competition among clinics affect the number of patients treated in a market and their fertility characteristics, $[F^L, F^U]$. That is, observed market structure is likely to be endogenous with respect to unobserved patient characteristics that influence treatment decisions and outcomes. We return to this point below, when we describe a set of cost-shifting instruments that exogenously shift ART market structure and allow us to estimate consistently the impact of competition in IVF markets.

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 aggregate treatment and outcome information within several patient age categories, and we use these data for our main analysis. 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 provide 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.

Each data set contains information from virtually every clinic in the U.S., so we treat the data as exhaustive.¹⁸ There are 600 unique clinics in the data, with 114 of the 173 clinics that operated

¹⁸Reporting for both data periods was federally mandated. The 1987 data were collected via subpoena for the

during 1987 appearing in both data sets. Between 1995 and 2003 the number of active clinics grew from 257 to 396.

The remaining data are: demographic information from the US Census Bureau, annual indicators for whether a state has a Universal or Restricted insurance mandate, medical wage data from the Centers for Medicare and Medicaid Studies (CMS), and information on states' Certificate of Need (CON) laws provided to us by the Missouri CON Program. Many of these variables are observed annually, but in some cases we have data from 1990 and 2000 only. In these cases we fill in the data for the missing years via linear interpolation.

3.1 Trends in ART treatment

Between 1995 and 2003 the number of ART treatment cycles rose from approximately 56,000 to 100,000, and the number of ART-conceived babies increased from 16,600 to 48,700.¹⁹ In Table 1 we compare 1995 and 2003 treatment choices and outcomes for patients who received fresh, non-donor eggs. In both years, about half of all IVF patients are under 35 years old, and birthrates decline with a patient's age. For patients both under and over age 35, birth rates increased by 50% between 1995 and 2003, although women over 35 still fail in more than 75% of cycles. Fertility declines with age, and within this age category women over 40 years old had a 2003 success rate of 11%.

Despite substantial progress in increasing birthrates for women of all ages, there was virtually no change in the multiple birth rate between 1995 and 2003. This may be seen as evidence of imperfect progress in IVF technology, as one of the goals of the medical community has been to reduce the number of multiple births while also making treatment more likely to yield a birth. A different story is apparent, however, if we examine the types of multiple gestations experienced by patients. These data, which are available beginning in 1997, show that the twin pregnancy rate, i.e., the share of all ART pregnancies with two fetuses, increased slightly between 1997 and 2003 (by about 6%, or 2 percentage points). Meanwhile, the frequency of high-order pregnancies (triplet

Wyden hearing. The CDC estimates that it has obtained data for 95% of all clinic-year combinations between 1995 and 2003. Unfortunately for the purposes of this research, clinics have never been asked to report prices.

¹⁹Many of these children were born as a twin, triplet, or more. To calculate the number of babies born through ART in 1995, we assume that women giving birth to triplets or more had 3.2 babies, since the CDC did not report this number in that year. See Reynolds et al. (2003) for additional details on the relative importance of ART to multiple birth rates in the United States.

or greater) has fallen substantially (by 50%, or almost 6 percentage points). These changes are illustrated in Figure 3; the vertical sum of the two curves provides a year's total multiple gestation rate.

3.2 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, we believe that ART treatment is expensive and important enough to compel a couple to travel across a metropolitan area to receive the treatment they think is best, but the repeated clinic visits required for an ART cycle are likely to restrict a couple from seeking treatment outside of their home city.²⁰ 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.

Our analysis below focuses on whether IVF treatment differs between monopoly and non-monopoly markets, and we rely on an instrumental variables approach to exogenously shift the market structure of a market. There are six large US cities that are nearly certain to have multiple ART clinics, and therefore provide little usable information to identify the effects of market structure variation on outcomes. These markets are New York, Chicago, Los Angeles, San Francisco, Washington D.C., and Philadelphia. We exclude clinics from these markets in the analysis below. This reduces to 336 the number of unique clinics in the data. An implication of this choice is that we are unable to exploit the variation in New Jersey's insurance mandate status within the panel, as virtually all of the state's population is within the New York or Philadelphia metropolitan areas. In the data description and analysis that follows we base our analysis on data with these large cities (and their clinics) excluded.

²⁰Steiner et al. (2005) also treat the MSA as the relevant market for ART.

3.2.1 Competition

We characterize the amount of competition in a market with a simple discrete indicator for whether the market is a monopoly. In 1995 55% of all markets with clinics were monopolies, and by 2003 this figure fell to 47%. The mean number of clinics in a market (conditional on at least one clinic) from 1995 to 2003 was 2.27.²¹ The number of clinics increased steadily during 1995-2003, with the market average rising from 1.95 to 2.34 during this period. The increase in competition over time provides another reason to look at how changing market structure affects treatment outcomes.

We create a supplemental measure of competition by searching for other markets within 75 miles that also had at least one clinic. This measure receives a value of one if there is a neighboring market that fit these criteria, and otherwise we assign a value of zero. Across markets and years, the mean value of this measure is 0.46.

3.2.2 Insurance mandates for ART

Fifteen states currently have mandates regarding insurance for infertility treatment, summarized in Table 2. See Schmidt (2006) 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 1985 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. 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").²² In this paper we analyze the effects of infertility regulations that were effective between 1995 and 2003, include IVF procedures, and are

²¹Additionally, the treatments were fairly concentrated within markets. The average Herfindahl-Herschman Index (HHI) in the markets is over 7,300. For comparison, the average number of clinics was 14.7 in the six cities excluded from the analysis.

²²For example, Arkansas excludes HMOs from its regulation, while the Ohio and West Virginia mandates apply to HMOs only.

mandates to cover the expense of treatment. Among these mandates of interest, we treat Universal and Restricted coverage regulations separately in the empirical analysis of Sections 4 and 5.

We incorporate insurance mandates into our data by calculating the portion of each MSA's population under an IVF-specific regulation. This treatment of insurance coverage accounts for MSA boundaries that cross state lines. For example, the St. Louis MSA is a mixture of Missouri and Illinois counties, and these states differ in their insurance regulations. Our coverage measure therefore accounts for the fact that some of the patients at Washington University's IVF clinic, which is located in Missouri, live and work in Illinois. An MSA that is entirely within one state is a simpler case – all of its population is exposed to the same insurance regime. No markets cross state boundaries in a way that leads to both regulations existing in the same market.

Among the 900 market-year combinations with at least one clinic, there are 57 observations (6.3%) that have a positive share of population covered by a Universal insurance mandate. 52 market-year combinations (5.8%) have a positive share associated with a Restricted mandate. Markets with mandates have the same average number of clinics as markets without mandates.

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.

3.2.3 Demand shifters

The number of clinics in a market and the number of treatment cycles are affected by several important exogenous demographic characteristics. MSAs with ART clinics tend to be larger, richer, and have more educated residents. See Table 3 for a description of markets with and without ART clinics in 2000.²³ It is not surprising that a large population of potential patients is required to support clinics with substantial fixed costs of entry. It is interesting to note that MSAs with clinics have larger percentages of women in the labor force and with post-secondary degrees. This supports the notion that clinics may largely serve women who delayed childbearing in favor of education or employment. In comparing markets with one versus multiple IVF clinics, there are few demographic variables that differ between the types of markets other than market size and income.

²³We choose to report statistics for 2000 because of the decennial census.

3.2.4 Cost shifters

We are concerned that the number of firms in a market is correlated with unobserved factors that also affect consumer demand and treatment decisions. For example, suppose that couples in a particular market are especially disposed to attempt IVF if they encounter reproductive difficulties. This factor would likely increase the equilibrium number of clinics in a market, thereby leading to correlation between market structure and an unobserved component of patients' tastes. Additionally, we argued above that treatment decisions (e.g., number of embryos) are related to patients' characteristics, and the distribution of treated couples' traits changes as demand shifts and more clinics enter a market. Since we use competition as a predictor of access and outcome measures in our analysis below, we employ a pair cost-shifting instruments to control for the endogeneity of market structure.

First, we calculate a medical wage index for each market. We expect IVF clinic entry to be costly (and occur less frequently) in markets with greater medical wages. The wage index we employ comes from the US Centers for Medicare and Medicaid Services (CMS), which prepares the index for the Acute Inpatient Prospective Payment System. The wage index captures local deviations from a normalized national average. Second, we employ 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). Summary statistics on medical wages and CON laws are in the bottom rows of Table 3.

3.2.5 Are insurance mandates exogenous?

An obvious concern in our empirical analysis below is whether observed differences in ART usage rates, treatment decisions and outcomes are due to regulatory policy or market- (or state-) specific unobserved preferences for infertility treatment. This is important for policy, since we would like to know whether a mandate actually increases ART usage or simply provides a transfer to treated couples who would have purchased treatment even without a subsidy through insurance. We investigate the exogeneity of insurance mandates with respect to preferences for IVF treatment in two ways.

First, in Table 4 we compare the *observable* characteristics of states that have or had IVF-specific mandates with the characteristics of states that never had mandates. At the top of the table we present demographic measures that may be related to families' childbearing decisions or likelihood to take infertility treatment. The demographic variables we consider include female labor force participation rates, female educational attainment, average family size, and median household income. We use data from the 1990 decennial census for its relative proximity to when most mandate laws were enacted.

We test whether the means of the demographic variables are significantly different from each other, and we find that there are no significant differences. In fact, the largest t-statistic from the comparison of means is only 0.58. The bottom rows of Table 4 show that the main observable difference between states with and without IVF regulations appear to be in their residents' preferences for government intervention in medical markets. IVF regulations tend to be a small part of a broad slate of insurance mandates that cover a variety of health issues. The presence of an IVF mandate is correlated with laws that support colorectal cancer screenings, Medicaid funding of abortions, and mental health parity.²⁴ Moreover, residents of IVF insurance states are more likely to vote for a Democrat in presidential elections. These findings are evidence that state residents vary in their governing tastes but not necessarily their preferences for children or other related life-cycle decisions.

Second, we search for evidence of *unobserved* differences between states with and without IVF-specific mandates by analyzing the 1987 data on clinic size and the number of clinics in each market. We include all clinics and markets, as the six large cities excluded from the 1995-2003 data are appropriate to use in this study of insurance mandates. As we discussed above, few states had implemented insurance mandates by 1987. Consequently, we estimate a "pre-program" regression (Heckman and Hotz, 1989) of the number of patients receiving treatment at ART clinics in 1987 as a function of future regulatory status along with other contemporary control variables. If a particular state's residents are especially disposed to take infertility treatment independent of the regulatory environment, then the markets in these states will exhibit high treatment levels even before an insurance mandate is approved. The coefficient estimates presented in the first

²⁴One might argue that the extensive use of health insurance mandates in states with coverage for IVF may lead employers to drop insurance coverage for employees or to self-insure. If true, mandates may have little effect on access to IVF. Gruber (1994) finds no evidence, however, that states with more mandates have lower rates of insurance coverage or higher rates of self-insurance.

column of Table 5 show that this is not the case. Clinics in markets that will be covered by a Universal mandate in the future actually see fewer patients than clinics in markets that never adopt a mandate, although the difference is not statistically significant. In addition, the second column of Table 5 indicates no significant difference between the number of clinics in future-mandate and never-mandate markets. Combined with our findings from Table 4, we conclude that residents of mandate states do not differ from others in their underlying preferences for infertility treatment, and that the passage of mandate laws appears to reflect the political preferences of these state residents for government intervention in a wide variety of medical markets.

3.3 Clinics and infertility treatment

The treatment data are aggregate statistics that track the progress of cycles initiated at an ART clinic. The CDC statistics are divided into several categories by patients' ages, but the ages that define the boundaries of these categories vary from year to year. In order to handle these categories consistently across years of data, we combine the treatment statistics into two broad age groups for patients: under and over 35 years old. Age 35 is near the median patient age.

We take a preliminary look at the relationship between competition and treatment in Table 6. Competitive clinics are larger than those in monopoly markets. In the other measures presented in the table, monopoly and non-monopoly clinics appear to perform very similarly. Comparisons of embryo transfer rates and multiple gestation rates across market structures suggests that there is little to fear from changes to ART treatment practices as competition intensifies.

The differences across markets are sharper when we divide markets according to their insurance mandates, as seen in Table 7. In markets with both Universal and Restricted insurance mandates, clinics treat a greater fraction of patients over age 35. This may indicate that, in general, insurance mandates encourage more low-fertility couples to seek treatment. In addition to being more heavily weighted toward patients over age 35, clinics in Universal mandate markets are substantially larger than those in markets without mandates. As in comparisons across different market structures, the separation of markets by insurance regime does not reveal many strong differences in treatment practices or outcomes.

4 Determinants of ART Market Structure

Market characteristics such as consumer demographics, mandated insurance policies, and cost conditions affect the number of ART clinics that opt to serve a market. These factors shift the number of potential patients a clinic might treat and the costs of treatment. In turn, as additional clinics enter a market, all potential patients may benefit because subsequent price competition can expand access to treatment. In this section we present a descriptive model of ART market structure that serves two purposes. First, we evaluate whether insurance mandates have the consequence of stimulating entry into ART markets. Second, we use the predicted outcomes of this model to serve as an instrument for observed market structure in our analysis of clinic-level outcomes.

We use an ordered probit model to estimate the effects of various market characteristics on the number of clinics. For market m in year t , we define the following vectors. X_{mt} contains the demand-shifting demographic variables discussed above, plus a dummy variable for each year in our panel. The vector $INSUR_{mt}$ includes measures of Universal and Restricted insurance mandates for m . Finally, we define Z_{mt} to contain the cost-shifting variables which affect the probability of clinic entry. In addition to these observable variables, we assume that there are unobserved components to tastes and fixed costs among the potential entrants in m that are captured in the error term ε_{mt} . Let ε_{mt} be distributed $N(0, 1)$, *iid* across markets (m), but clustered within m across t to account for time-invariant local tastes. We assume that n^* is a latent, continuous measure of competition in each market in a free entry equilibrium, and

$$n_{mt}^* = X_{mt}\theta_1 + INSUR_{mt}\theta_2 + Z_{mt}\theta_3 + \varepsilon_{mt}.$$

While we do not observe n^* , we estimate θ with n , the actual number of clinics in i during t . We restrict the model and sample to markets with at least one clinic, as these are the same markets included in the clinic-level analysis below. This empirical model differs from the static entry models more commonly specified in the industrial organization literature.²⁵ These models explicitly account for the way in which a firm's profit falls as the number of competitors in a market increases. We choose our entry specification in order to facilitate analysis of a different set of issues. Specifically, we use the results of our entry model to construct instrumental variables estimates of the impact of competition on IVF access and outcomes in the clinic-level analysis in the next section.

²⁵See, for example, Bresnahan and Reiss (1991) and Abraham et al. (2005).

The results from our entry model using data from the years 1995 to 2003 are presented in Table 8.²⁶ We find that markets with Universal insurance mandates are no more likely to have additional clinics than those without mandates.²⁷ This prevents a potential spillover from insurance-covered patients to the uninsured, as patients in the latter group would have benefited from lower prices. Similarly, there is no significant relationship between the presence of a Restricted mandate and IVF market structure.

Many of the demand-shifting demographic characteristics have a significant effect on market structure and the intuitive sign. The number of clinics increases significantly with population and income. The point estimates for the effects of educational attainment and family size are positive but insignificantly different from zero. We include a market’s land area to allow for geographically larger markets to sustain more clinics due to travel inconvenience, but land area does not affect the number of clinics in a market. Both cost-shifting variables in Z_{mt} have a negative effect on clinic entry, although the coefficient on CON scores is insignificantly different from zero ($p = 0.28$). The coefficient estimates on CON score and the medical wage index are jointly significant at $p = 0.04$.

5 Clinic-level choices and outcomes

We now consider how changes to market structure and insurance policy can affect ART access, treatment, and outcomes. Throughout this section, we employ the following regression model:

$$y_{ait} = COMP_{mt}\alpha_{1a} + INSUR_{mt}\alpha_{2a} + X_{mt}\alpha_{3a} + W_{it}\alpha_{4a} + D_{it}\alpha_{4a} + e_{ait} \quad (1)$$

For patients of age category a in market m at clinic i during year t , we regress treatment practices or outcomes (y_{ait}) on measures of m ’s insurance mandate status ($INSUR_{mt}$), a measure of the competitiveness of the market ($COMP_{mt}$), the same vector of market demographic characteristics as used in the market-level analysis (X_{mt}), a set of clinic characteristics (W_{it}) which are fixed across patients, and a set of treatment decisions (D_{it}) that may be varied by patients and their doctors, depending on the preferences and characteristics of the decision-makers. The variables in W include dummy variables for whether the clinic is a member of the Society for Assisted

²⁶To prevent the table from becoming too lengthy, we omit the year-specific dummy variable coefficients from the reported results. With 1995 as the omitted year, we estimate a pattern of increasing entry that is consistent with the diffusion of IVF clinics described above.

²⁷A similar result is uncovered by Abraham et al. (2005) in their study of factors that affect hospital entry. The authors find that the presence of an HMO reduces entry in a market.

Reproductive Technology (SART), whether the clinic accepts single women as patients, and the overall rate of IVF over other forms of ART at the clinic. The vector D includes two variables: the average number of embryos transferred during a treatment, and the share of patients that use ICSI to improve fertilization chances. The error term e_{ait} accounts for unobserved clinic and market characteristics.

$COMP$ is a dummy variable equals one if clinic i operates in a market with two or more clinics, and zero if it is a monopoly.²⁸ We suspect that our measure of competition may be correlated with e , so we report two sets of estimates for each regression model. First, we estimate (1) under the assumption that the number of clinics is exogenous, as in OLS. Next, we estimate (1) while treating $COMP$ as a dummy endogenous variable. Following the suggestion of Angrist (2001), we correct for endogeneity by first using the estimates reported in Table 8 to predict whether a market will not be a monopoly as a function of X , $INSUR$, and the cost-shifting variables in Z . These predicted values are then used as instruments for $COMP$ in the second stage estimation of (1). In the discussion below, we refer to the set of estimates obtained under the assumption of exogenous $COMP$ as OLS, and the estimates that treat $COMP$ as endogenous are identified as IV results.

5.1 Clinic size and IVF access

We begin by describing whether adverse (or beneficial) effects of competition may be detected through clinic size. A potential concern regarding competition is that additional clinics will cannibalize each others' potential patients without substantially increasing the size of the market. This could be welfare-reducing through duplicated fixed costs. The OLS results on Table 9 indicate that non-monopoly markets have significantly smaller clinics than monopoly markets for women both below and above age 35. When we estimate the effect of competition using IV, however, we find that an exogenous shift in competition leads to a positive but insignificant change in a clinic's number of cycles. This result of no change at the clinic level is unambiguously positive in evaluating the impact of competition on market-level ART access. We control for market size through X , so the IV estimate of competition's impact on clinic size indicates that if we exogenously insert a

²⁸We also estimate two supplemental specifications. First, using the full data set of clinics and cities, we decompose non-monopoly markets into those with 2 to 4 clinics and 5+ clinics in order to investigate the impact of high levels of competition on outcomes. Second, we estimate the model with HHI as our measure of competition. The qualitative patterns in the results are largely unchanged. These results are available from the authors upon request.

second clinic into a monopoly market, the number of treatments will double.²⁹

As expected, a Universal insurance mandate has a strong positive effect on the number of patients treated by a clinic. According to the OLS estimates in Table 9, the number of cycles for women under 35 increases by 89% while cycles for women above 35 increases by 91% with the introduction of a Universal insurance mandate. This increase in ART access through clinic size may be sufficient to satisfy policymakers even though Universal mandates do not affect the number of clinics in a market, as reported above. In contrast with the apparent success of Universal mandates in increasing ART access, we find that Restricted mandates have a substantially smaller impact on clinic size, and in all specifications the change is insignificantly different from zero.

Among the other variables included in the models, very few displayed a significant effect on clinic size. A notable exception is a clinic's SART affiliation, which patients are likely to interpret as a quality signal. Clinics that are members of SART treated almost 80% more patients than those without SART membership. Clinics that offer treatment to unmarried women also have relatively large numbers of patients over age 35. It may be the case that these older patients' choices for less traditional childbearing timing decisions is correlated with less traditional family structures. The correlation is weak between market structure and these clinic characteristics, and excluding the clinic characteristics from the model has no effect on the other results described above. During the nine years of the data panel, clinics have been growing through their treatment of women under age 35, but the number of cycles for women over 35 has not changed significantly.

5.2 Birthrates

The introduction of an insurance mandate or a reduction in clinic concentration increases the number of couples in a market who receive fertility treatment. Are competition and insurance mandates associated with higher or lower birthrates for these patients? The model in Section 2 suggests that insurance mandates and competition may be associated with reduced birthrates if lower fertility patients are disproportionately drawn in to the market. On the other hand, if clinics engage in "birthrate races," birthrates may be higher in more competitive markets, perhaps due to more aggressive treatment or the earlier adoption of newer technologies by these clinics (Hamilton and McManus, 2005). Finally, the distributions of consumer tastes and fertility characteristics may vary by market, which affects both market structure and birthrates.

²⁹We confirm this result with unreported market-level models in which we find that markets with an exogenous increase in *COMP* experience an increase in cycles of 113% for women under 35 and 82% for women over 35.

Our OLS results for the effect of competition on birth rates, shown in the first row of Table 10, indicate that moving from monopoly to a competitive market is associated with a decline in birthrates for women over 35. The estimate declines in magnitude but still remains significant even when measures of the aggressiveness and quality of treatment at the clinic (average number of embryos transferred, percentage of treatments with ICSI) are held constant (Column 8). However, once we account for the potential endogeneity of competition, we see that this relationship is no longer significant. The differences in coefficient estimates between the OLS and IV models may indicate that clinic entry is associated with the presence of an idiosyncratically large population of women with fertility problems who seek treatment.

The second and third rows of Table 10 show that success rates are, on average, lower in markets with insurance mandates. Excluding controls for clinic technology and embryo choice (Columns 1 and 5), the effect is significant for women both under and over 35 in markets with a Universal insurance mandate. From the model in Section 2, one interpretation of this finding is that Universal mandates disproportionately attract low fertility patients into clinics, leading to reduced birthrates. On the other hand, it may also be the case that clinics in Universal mandate markets provide lower quality treatment. If the use of ICSI is a measure of the quality of treatment at a clinic (as is suggested by the result in Table 10 that birthrates increase substantially with ICSI use), then inclusion of this control into the regression should reduce the impact of Universal mandates on birthrates. In fact, the coefficient estimates for Universal mandates for women under 35 are virtually unchanged when the control for clinic technology (and embryo choice) are included in the specification (Column 3). For women over 35, the impact of mandates becomes more negative when we include these controls (Column 7), suggesting that women over 35 are more likely to use ICSI in mandate markets. Overall, these findings are consistent with the view that stricter insurance mandates induce lower innate fertility couples to use ART.

5.3 Embryo transfers

We now investigate the impact of market structure and insurance on treatment decisions made by physicians and patients, as given by the choice of the number of embryos to transfer. Recall that a major concern of many policy advocates is that competition will lead to dangerous “birthrate races” among clinics in the same market. We report the effects of market structure, insurance mandates, and clinic characteristics on embryo choices in Table 11. While an assumption that *COMP* is exogenous may lead to the conclusion that competition causes an increase in embryo

transfers (Column 1), the IV results indicate no significant impact of competition on this treatment decision. For women both under and over 35 the IV estimate of competition's effect on embryos is negative and insignificantly different from zero. Given our results on birth outcomes, this indicates no increase in treatment aggressiveness with competition, as both innate fertility and embryo transfers are insignificantly related to market structure.

The table shows that women under age 35 in markets with Universal mandates take a significantly reduced number of embryos despite our results that indicate lower innate fertility. This is strong evidence that the Universal mandates shift the choices of patients within treatment, and do not simply attract a different selection of patients into IVF. Among women over age 35 the effect of a Universal mandate on embryos is negative but insignificant. There is no significant effect of a Restricted mandate on the embryo choices of women of any age.

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. 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.

5.4 Multiple Gestation

We next turn to the question of whether insurance and competition increase the incidence of multiple births, as feared by some policy advocates. It is important to recall that twin and triplet+ pregnancies are substantially different from each other in health hazard, expense, and desirability. There may be less concern if competitive markets increase the incidence of twin births without affecting the much more expensive and dangerous high-order pregnancies. 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.³⁰ Table 12 shows that despite the strong

³⁰Separate 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.

relationship between Universal insurance mandates and embryos for women under 35, we find no significant relationship between these policies and twin pregnancies (as a fraction of all pregnancies). Similarly, Universal mandates for women over 35 and Restricted mandates have no significant effect on twin pregnancy rates. While the OLS results indicate that competition has no effect on twin gestations, the IV estimates indicate that an exogenous shift in competition results in a significantly greater share of pregnancies that have twins. This may indicate that ART clinics are not scaling-back their treatment sufficiently to meet the increased fertility of patients drawn into the market by competition, or that they are attempting to match patient preferences.

It is not clear that increased twin pregnancy rates are reason for alarm. Despite decreased embryos transfer rates over time and other indicators that ART has improved, twin pregnancy rates have actually increased significantly over time. This is likely due to changes in the rate of higher-order pregnancies. Some patients who might have carried twins in the mid- or late-1990s are now more likely to have a singleton pregnancy; others who would have had triplets or more now experience twin pregnancies and births. The positive time trend in twin pregnancies is likely explained by the former effect being smaller than the latter. We see evidence of this in specifications 5-8 in Table 12, in which we report results on the share of pregnancies that have triplets or more. Over time, the rate of these pregnancies has fallen substantially, by magnitudes greater than the increase in the frequency of twins. The reduction in triplet pregnancies is significant for women under 35 in markets with Universal insurance mandates, and negative but insignificant for women over 35. While our OLS results indicate that women under 35 in competitive markets have a significantly greater chance of a triplet pregnancy, raising concerns about potentially harmful effects of competition, the IV results indicate that this is not the case. After accounting for the potential endogeneity of market structure, competitive markets are estimated to have triplet pregnancy rates that are no different than those in monopoly markets. Overall, our results suggest that the observed relationship between market structure and embryo transfer and higher-order pregnancies (for women under 35) reflects unobserved market characteristics rather than the dangerous consequences of clinic birthrate races. Universal insurance mandates also lead to more conservative treatment for women under 35. While we do find that clinics in competitive markets have more twin births, it should be emphasized that the health and financial costs of multiple gestations are most strongly associated with triplet+ outcomes, and it may even be the case that couples seeking treatment prefer twin outcomes over all others.

6 Discussion and 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 competitive structure of markets or the extent of insurance coverage can affect both access to care and quality. 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. While price-reducing competition is likely to improve access to IVF, there exist concerns that competing clinics will attempt to win new patients by inflating birthrates using treatments that also raise the risk of high-order (triplet+) births. However, concerns about quality-reducing competition may be unfounded. Additional competition can decrease multiple birth rates by reducing patients' incentive to seek aggressive treatment for their fertility problems. With the present paper we evaluate the impacts of both mandated insurance coverage and an increase in competition 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, in the effects of Universal and Restricted mandates. The latter has negligible effects on IVF treatments and outcomes. Additionally, we find that competition substantially increases ART usage without changing embryo transfer rates. 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. Finally, it is the case that women under 35 treated at clinics in competitive markets are more likely to have a twin pregnancy. However, attitudinal surveys of IVF patients suggest that the majority of couples may prefer a twin birth to a singleton. The substantially higher cost of a triplet+ pregnancy, with the associated negative long-term health effects, suggest that the greater concern regards the impact of competition on high-order pregnancies. We find that the observed positive relationship between high-order pregnancies and competition for women under 35 reflects unobserved market

characteristics rather than the negative effects of competition. Consequently, we find little evidence to support the view that competition in ART markets leads to a costly and dangerous “birthrate race” among clinics.

Although our results indicate that high-order pregnancy *rates* from IVF may not change or will fall with competition and insurance, 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 or an increase in competition. 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 0.7% in 2000. For women over age 35, the share of IVF births increased from 0.9% to 1.6% during the same period.³¹ 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 the late 20th century 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

³¹Note that the “1% of all births” statistic earlier in the paper includes IVF treatments that involved eggs from donors, frozen eggs, and surrogate mothers.

have children.³² 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, 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.

³²Between 1970 and 2000 the average age of the mother at first birth in the United States rose 3.5 years (Mathews and Hamilton, 2002).

References

- [1] Abma, J; A Chandra; W Mosher; L Peterson; L Piccinino (1997): “Fertility, Family Planning, and Women’s Health: New Data from the 1995 National Survey of Family Growth,” National Center for Health Statistics, *Vital Health Statistics* 23 (19), 1997.
- [2] Abraham, Jean; Martin Gaynor; William B. Vogt (2005): “Entry and Competition in Local Hospital Markets,” Carnegie-Mellon University working paper.
- [3] Angrist, Joshua (2001): “Estimation of Limited Dependent Variables Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice,” *Journal of Business and Economic Statistics* 19, 2-28.
- [4] 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.
- [5] Bitler, Marianne (2005): “Effects of Increased Access to Infertility Treatment on Infant Health Outcomes: Evidence from Twin Births,” RAND working paper.
- [6] Bresnahan, Timothy and Peter Reiss (1991): “Entry and Competition in Concentrated Markets,” *Journal of Political Economy* 99 (5), 977-1009.
- [7] Callahan, Tamara; Janet Hall; Susan Ettner; Cindy Christiansen; Michael Greene; and William Crowley (1994): “The Economic Impact of Multiple-Gestation Pregnancies and the Contribution of Assisted-Reproductive Technologies to Their Incidence,” *New England Journal of Medicine* 331 (4), 244-249.
- [8] Capps, Cory (2005) “The quality effects of hospital mergers,” Northwestern University working paper.
- [9] Cutler, David (2004): *Your Money or Your Life*. New York: Oxford University Press.
- [10] Dranove, David; Shanley, Mark; and Carol Simon (1992): “Is Hospital Competition Wasteful?,” *RAND Journal of Economics*, 247-262.
- [11] Dranove, David and William D. White (1994): “Recent Theory and Evidence on Competition in Hospital Markets,” *Journal of Economics and Management Strategy* 3(1), 169-209.

- [12] Fidler, Anne and Judith Bernstein (1999): “Infertility: From a Personal to a Public Health Problem,” *Public Health Reports* 114, 494-511.
- [13] Goldin, Claudia and Lawrence Katz (2002): “The Power of the Pill: Oral Contraceptives and Women’s Career and Marriage Decisions,” *Journal of Political Economy* 110 (4), 730-770.
- [14] Gaynor, Martin (2006): “What do we know about competition and quality in health care markets?,” Carnegie Mellon University working paper.
- [15] Gaynor, Martin and Deborah Haas-Wilson (1999): “Change, Consolidation, and Competition in Health Care Markets,” *Journal of Economic Perspectives* 13, 141-164.
- [16] Gowrisankaran, Gautam and Robert Town (2004): “Competition, payers, and hospital quality,” *Health Services Research* 38, 1403-1422.
- [17] Gruber, Jonathan (1994): “State Mandated Benefits and Employer Provided Insurance,” *Journal of Public Economics* 55(3), 433-464.
- [18] Hamilton, Barton H. and Brian McManus (2003): “A Model of an Assisted Reproductive Technology (ART) Market,” Washington University Olin School of Business working paper.
- [19] 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.
- [20] Heckman, James; 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.
- [21] Hidlebaugh, DA; Thompson, IE; and MJ Berger (1997): “Cost of Assisted Reproductive Technologies for a Health Maintenance Organization,” *Journal of Reproductive Medicine* 42 (9), 570-574.
- [22] Jain, Tarun; Bernard Harlow; and Mark Hernstein (2002): “Insurance Coverage and Outcomes of *In Vitro* Fertilization,” *New England Journal of Medicine* 347 (9), 661-666.
- [23] Joskow, Paul L. (1980) “The effects of competition and regulation on hospital bed supply and the reservation quality of the hospital,” *Bell Journal of Economics* 11, 421-447.

- [24] Kolata, Gina (2002): “Fertility Inc.: Clinics Race to Lure Clients,” *The New York Times*, January 2, 2002.
- [25] Mathews, TJ and BE Hamilton (2002): “Mean age of mother, 1970-2000,” *National Vital Statistics Reports* 51 (1).
- [26] Menken, Jane; James Trussell; Ulla Larsen (1986): “Age and Infertility,” *Science* 233 (4771), 1389-1394.
- [27] Mukamel, D.; Zwanziger, J.; and Tomaszewski, K.J. (2001): “HMO penetration, competition, and risk-adjusted hospital mortality,” *Health Services Research* 36, 1019-1035.
- [28] Pinborg, Anja; Loft, Anne, Schmidt, Lone; and Anders Nyboe Andersen (2003): “Attitudes of IVF/ICSI-Twin Mothers Towards Twins and Single Embryo Transfer,” *Human Reproduction* 18, 621-627.
- [29] Porter, Michael and Elizabeth Olmstead Teisberg (2004): “Redefining Competition in Health Care,” *Harvard Business Review*, June, 64-77.
- [30] Propper, C.; Burgess, S.; and Green, K. (2004): “Does competition between hospitals improve the quality of care? Hospital death rates and the NHS internal market,” *Journal of Public Economics* 88, 1247-1272.
- [31] Reynolds, Meredith; Laura Schieve; Joyce Martin; Gary Jeng; Maurizio Macaluso (2003): “Trends in Multiple Births Conceived Using Assisted Reproductive Technology, United States, 1997-2000,” *Pediatrics* 111 (5), 115-1162.
- [32] Sari, N. (2002): “Do competition and managed care improve quality?” *Health Economics* 11, 571-584.
- [33] Schmidt, Lucie (2006): “Effects of Infertility Insurance Mandates on Fertility,” *Journal of Health Economics*, forthcoming.
- [34] Schmittlein, David and Donald Morrison (2003): “A Live Baby or Your Money Back: the Marketing of *In Vitro* Fertilization Procedures,” *Management Science* 49 (12), 1617-1635.
- [35] Steiner, Anne; Paulson, Richard; Katherine Hartmann (2005): “Effects of Competition Among Fertility Centers on Pregnancy and High-Order Multiple Gestation Rates,” *Fertility and Sterility* 83(5), 1429-1434.

- [36] Stephen, Elizabeth Hervey and Anjani Chandra (2000): “Use of Infertility Services in the United States: 1995,” *Family Planning Perspectives* 32 (3), 132-137.
- [37] Wells, Matt (1999): “Doctors Warn on Test-Tube Births,” *The Guardian*, November 5 1999.

Figure 1: Treatment timeline

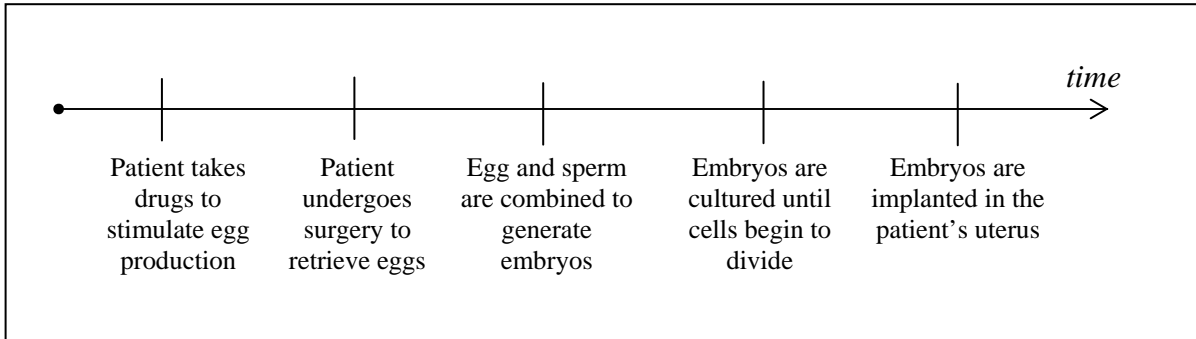


Figure 2: Sorting across ART treatment

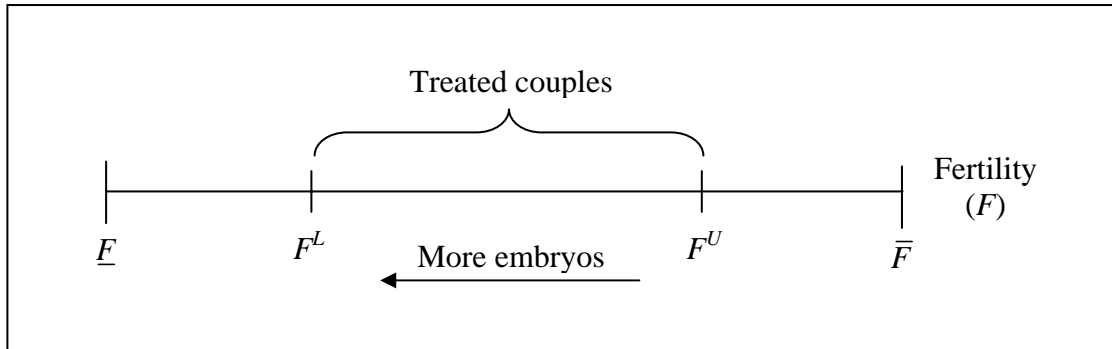


Figure 3: Multiple gestation rates, 1995-2003

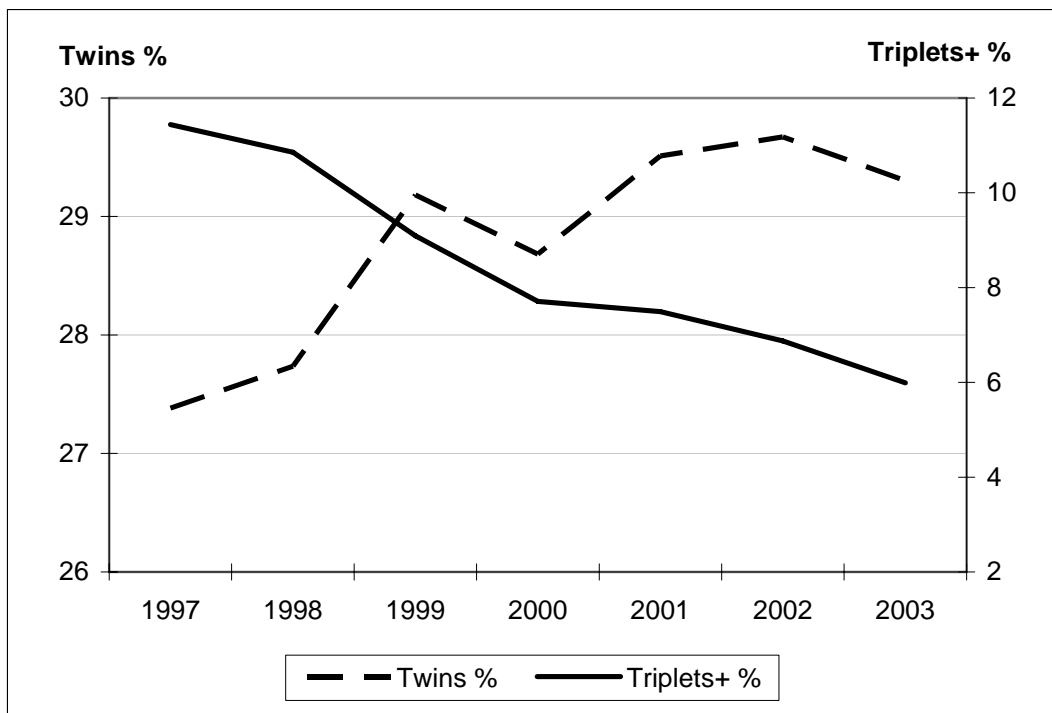


TABLE 1:
ART Outcomes

Patient's Age	Under 35	Over 35	Under 35	Over 35
	1995		2003	
Number of cycles	19,249	23,123	39,695	46,723
Number of embryos	3.95	4.02	2.56	3.06
% cycles with a birth	25.8	15.2	37.4	22.9
% births with twins +	39.7	29.4	37.9	28.3

Note: We focus on cycles of fresh, non-donor eggs. We omit cycles and outcomes from the six large US cities that are excluded from the analysis below.

TABLE 2:
ART Regulations

<u>States with coverage mandates for IVF</u>		<u>Other states with infertility treatment regulations</u>			
	Year ¹		Year ¹	Include ART?	Cover or Offer?
Universal mandate					
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:

1: Year that the regulation was passed or repealed. We assume that the regulatory changes becomes effective during the following year.

2: The extent of Montana's law is untested, as there has never existed an ART clinic in the state.

3: Ohio and West Virginia updated their regulations to effectively exclude IVF from coverage.

TABLE 3:
Market Characteristics, 2000

	With no ART Clinics (N = 192)	With One Clinic (N = 46)	With Two+ Clinics (N = 57)
Number of markets with any population under insurance mandate			
Universal	8	3	4
Restricted	8	2	1
Means of demographic characteristics			
Female population age 25-44	33,086	78,069	277,514
Bachelor's Deg (%)	16.2%	21.0%	20.6%
Graduate Deg (%)	6.0%	8.3%	8.0%
Per Capita Income	\$24,502	\$27,987	\$29,651
Avg. Household Size	2.53	2.47	2.53
Women in Labor Force (%)	56.4%	60.4%	59.2%
Means of cost-shifting instruments			
Medical Wage	.92	.98	.98
CON score	8.31	7.98	8.35

TABLE 4:
Characteristics of states with and without mandates to cover IVF

	States <u>with</u> Mandates	States <u>without</u> Mandates
Number of ART clinics in 2003	76	399
<i>State characteristics from the 1990 decennial census</i>		
Total population (millions)	47.9	200.2
Percentages of women:		
Age 25+ with high school degree	75.80 (4.65)	75.37 (5.42)
Age 25+ with bachelor's degree	18.10 (4.52)	18.43 (4.07)
Age 25+ with post-college degree ²	5.81 (1.79)	6.05 (1.73)
Age 16+ in labor force	56.68 (6.09)	56.48 (5.78)
Average family size	3.16 (0.13)	3.14 (0.06)
Median Household Income (1989)	\$31,416 (7,728)	\$31,734 (6,857)
<i>Political leanings and medical mandates</i>		
Percentage of states with mandated insurance coverage for:		
Medicaid funding of abortion	70%	40%
Colorectal cancer screening	50%	22.5%
Percentage of states with:		
Plurality of 1992 votes for Bill Clinton	100%	55%
Mandated mental health parity	90%	65%
	<i>N</i> = 10	<i>N</i> = 40

Notes: Standard deviations are given in parentheses. On this table we do not differentiate between Universal and Restricted mandates.

TABLE 5:
Pre-Program Regressions, 1987 Data

Dependent Variable	Log Cycles at Clinic	Number of Clinics in Market
Specification	OLS	Ordered Probit
<u>Future insurance mandate</u>		
Universal	-0.605 (-1.27)	-1.218 (-1.25)
Restricted	0.041 (0.12)	0.918 (1.49)
Observations	154	71

Notes: t-ratios in parentheses. Standard errors in first column account for clustering of clinics within markets. Regression in first column also includes the demographic controls listed in Table 3 and indicators for the number of clinics operating in the market. The ordered probit model in second column includes demographic controls and the cost-shifting variables in Table 3.

TABLE 6:
Mean Treatment and Outcome Statistics by Market Structure

Market Structure:	Monopoly		2+ Clinics	
	Under 35	Over 35	Under 35	Over 35
Cycles per clinic	73.8	64.9	82.4	85.5
Birthrate ¹	33.0	21.5	33.5	20.8
Embryos transferred ¹	3.05	3.40	3.03	3.38
Twin gestation % ²	33.1	25.8	32.7	24.7
Triplet+ gestation % ²	8.1	6.8	8.6	6.8

TABLE 7:
Mean Treatment and Outcome Statistics by Insurance Regime

Insurance Regime:	No Mandate		Restricted Mandate		Universal Mandate	
Clinics in market	2.29		1.77		2.75	
Patient Age	Under	Over	Under	Over	Under	Over
	35	35	35	35	35	35
Cycles per clinic	70.9	66.6	94.3	113.9	110.1	155.0
Birthrate ¹	34.4	21.6	32.6	20.1	32.2	19.9
Embryos transferred ¹	3.08	3.41	3.18	3.58	3.08	3.51
Twin gestation % ²	29.4	25.2	28.4	24.2	28.6	24.2
Triplet+ gestation % ²	8.1	7.0	8.4	7.4	7.8	7.1

Notes for Tables 6 and 7

1: weighted by number of cycles

2: weighted by number of pregnancies

TABLE 8:
ART Market Structure

Dependent Variable	Number of Clinics in Market
Specification	Ordered Probit
Insurance mandates	
Universal	.160 (0.30)
Restricted	.005 (0.02)
Market characteristics	
Female population (ages 25 – 44)	.126 (7.01)
Female population ²	-.081 (-4.22)
Bachelor's Deg (%)	.033 (0.66)
Graduate Deg (%)	.031 (0.57)
Per Capita Income (\$1,000s)	.060 (2.00)
Avg. Household Size	.734 (0.98)
Women in Labor Force (%)	-.057 (-1.89)
Land Area	-.005 (-0.18)
Neighboring market with clinic	.152 (0.72)
Cost-shifting instruments	
Medical Wage	-2.552 (-2.33)
Certificate of need (CON) score	-.014 (-1.07)
N	900

TABLE 9:
Number of cycles at a clinic

Patient age group	Women under age 35		Women over age 35	
	OLS	IV	OLS	IV
Specification	1	2	3	4
2+ clinics	-.461 (-4.10)	.225 (0.42)	-.475 (-4.40)	.107 (0.21)
Universal insurance mandate	.896 (3.24)	.857 (2.69)	.917 (3.16)	.883 (2.72)
Restricted insurance mandate	.279 (1.32)	.250 (1.10)	.213 (0.75)	.188 (0.63)
Clinic is SART member	.766 (5.09)	.789 (5.08)	.748 (4.59)	.770 (4.55)
Clinic accepts single women	.045 (0.41)	.069 (0.64)	.153 (1.48)	.174 (1.65)
Female population	.032 (3.48)	.012 (0.68)	.039 (4.26)	.022 (1.28)
Female population ²	-.024 (-2.62)	-.007 (-0.42)	-.031 (-3.38)	-.017 (-1.05)
Bachelor's Deg (%)	-.019 (-0.78)	-.027 (-1.03)	-.005 (-0.23)	-.013 (-0.50)
Graduate Deg (%)	.034 (1.14)	.037 (1.12)	.063 (2.26)	.065 (2.20)
Per Capita Income	-.016 (-1.01)	-.014 (-0.84)	.008 (0.46)	.010 (0.55)
Avg. Household Size	.039 (0.10)	.055 (0.13)	.576 (1.31)	.592 (1.30)
Women in Labor Force (%)	.050 (2.95)	.058 (3.19)	.016 (1.03)	.024 (1.36)
Land Area	.014 (1.02)	.008 (0.53)	.008 (0.56)	.002 (0.14)
Neighboring market with clinic	.106 (0.99)	.029 (0.24)	.123 (1.15)	.057 (0.49)
R^2	0.182	0.140	0.213	0.183
N	2060	2060	2056	2056

TABLE 10: Births per 100 cycles

Patient age group	Women under age 35				Women over age 35			
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Estimation strategy	1	2	3	4	5	6	7	8
Specification	1	2	3	4	5	6	7	8
2+ clinics	-1.397 (-1.24)	-1.373 (-0.28)	-1.161 (-1.05)	-.049 (-0.01)	-2.043 (-2.59)	-.183 (-0.05)	-1.965 (-2.58)	1.691 (0.50)
Universal insurance mandate	-3.967 (-1.92)	-3.966 (-1.89)	-3.797 (-1.91)	-3.780 (-1.98)	-2.760 (-2.02)	-2.650 (-1.84)	-1.969 (-1.47)	-1.737 (-1.20)
Restricted insurance mandate	-1.692 (-1.10)	-1.693 (-1.08)	-1.086 (-0.69)	-1.156 (-0.73)	-2.744 (-1.84)	-2.832 (-1.87)	-2.098 (-1.36)	-2.255 (-1.43)
Clinic is SART member	2.614 (1.52)	2.614 (1.52)	2.362 (1.39)	2.361 (1.36)	.333 (0.26)	.374 (0.28)	.235 (0.18)	.314 (0.22)
Clinic accepts single women	-2.226 (-1.93)	-2.224 (-1.97)	-1.801 (-1.59)	-1.737 (-1.55)	-1.333 (-1.77)	-1.267 (-1.70)	-1.394 (-1.76)	-1.264 (-1.56)
IVF	.211 (0.08)	.214 (0.08)	-2.280 (-0.99)	-2.215 (-0.98)	2.803 (1.74)	2.949 (1.85)	3.377 (1.82)	3.652 (1.93)
% of treatments with ICSI	-	-	8.633 (4.05)	8.649 (4.07)	-	-	6.335 (3.67)	6.497 (3.75)
Average number of embryos	-	-	-1.816 (-2.77)	-1.864 (-2.56)	-	-	.670 (1.05)	.668 (1.07)
Female population	.155 (1.87)	.155 (0.98)	.103 (1.25)	.074 (0.50)	.124 (2.05)	.080 (0.69)	.092 (1.54)	.004 (0.03)
Female population ²	-.197 (-2.33)	-.197 (-1.37)	-.161 (1.93)	-.138 (-1.02)	-.160 (-2.61)	-.126 (-1.22)	-.133 (-2.23)	-.066 (-0.67)
Bachelor's Deg (%)	.203 (0.66)	.203 (0.55)	.364 (1.15)	.331 (0.90)	.141 (0.59)	.075 (0.25)	.295 (1.23)	.169 (0.57)
Graduate Deg (%)	-.045 (-0.14)	-.044 (-0.13)	-.169 (-0.56)	-.147 (-0.45)	-.050 (-0.23)	-.006 (-0.03)	-.162 (-0.75)	-.079 (-0.32)
Per Capita Income	.315 (1.82)	.315 (1.86)	.320 (1.89)	.326 (1.97)	.224 (1.79)	.237 (2.04)	.178 (1.45)	.203 (1.78)
Avg. Household Size	10.071 (2.38)	10.069 (2.42)	9.261 (2.17)	9.175 (2.20)	3.391 (1.08)	3.270 (1.07)	1.841 (0.56)	1.581 (0.50)
Women in Labor Force (%)	.234 (1.37)	.235 (1.13)	.071 (0.41)	.093 (0.46)	.308 (2.65)	.355 (2.29)	.221 (1.86)	.312 (2.00)
Land Area	.127 (0.60)	.127 (0.55)	.200 (0.95)	.188 (0.82)	.213 (1.21)	.192 (0.99)	.295 (1.73)	.255 (1.36)
Neighboring market with a clinic	1.257 (0.84)	1.255 (0.76)	1.536 (1.03)	1.450 (0.89)	1.843 (1.47)	1.680 (1.22)	2.121 (1.74)	1.830 (1.36)
R^2	0.232	0.232	0.255	0.254	0.251	0.247	0.268	0.251
N	2060	2060	2060	2060	2056	2056	2053	2053

TABLE 11:
Embryos transferred per cycle

Patient age group	Women under age 35		Women over age 35	
	OLS	IV	OLS	IV
Specification	1	2	3	4
2+ clinics	.127 (1.84)	-.403 (-1.20)	.002 (0.03)	-.296 (-0.97)
Universal insurance mandate	-.324 (-2.78)	-.340 (-2.16)	-.185 (-1.53)	-.204 (-1.39)
Restricted insurance mandate	-.096 (-0.82)	-.064 (-0.51)	.055 (0.35)	.068 (0.42)
Clinic is SART member	-.109 (-0.89)	-.111 (-0.79)	.032 (0.33)	.025 (0.26)
Clinic accepts single women	.169 (2.32)	.142 (1.74)	.135 (1.79)	.124 (1.58)
IVF	-1.338 (-4.46)	-1.400 (-4.88)	-1.325 (-4.99)	-1.348 (-5.19)
% of treatments with ICSI	.263 (1.56)	.252 (1.55)	.239 (1.51)	.226 (1.42)
Female population	-.009 (-1.91)	.004 (0.43)	-.001 (-0.27)	.006 (0.61)
Female population ²	.005 (1.13)	-.005 (-0.63)	-.004 (-0.79)	-.009 (-1.20)
Bachelor's Deg (%)	-.008 (-0.46)	.007 (0.34)	.004 (0.23)	.014 (0.68)
Graduate Deg (%)	-.003 (-0.18)	-.014 (-0.65)	.009 (0.43)	.002 (0.09)
Per Capita Income	.018 (1.45)	.015 (1.04)	.038 (3.10)	.036 (2.74)
Avg. Household Size	.305 (1.04)	.354 (1.13)	.807 (2.60)	.828 (2.62)
Women in Labor Force (%)	-.023 (-1.95)	-.035 (-2.45)	-.026 (-2.13)	-.034 (-2.24)
Land Area	-.006 (-0.56)	-.0001 (-0.01)	-.010 (-0.85)	-.006 (-0.56)
Neighboring market with clinic	-.013 (-0.18)	.028 (0.35)	0.036 (0.50)	.059 (0.74)
R^2	0.519	0.473	0.385	0.369
N	2060	2060	2053	2053

TABLE 12: Multiple gestations per 100 transfers

Type of pregnancy	Twins				Triplets or more			
	Women under age 35		Women over age 35		Women under age 35		Women over age 35	
Estimation strategy	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Specification	1	2	3	4	5	6	7	8
2+ clinics	-.884 (-1.02)	6.906 (1.97)	-1.301 (-1.51)	-1.061 (-0.36)	1.448 (2.04)	-.779 (-0.30)	.405 (0.66)	.477 (0.26)
Universal insurance mandate	.433 (0.33)	.636 (0.29)	.081 (0.06)	.096 (0.07)	-2.140 (-1.80)	-2.198 (-2.11)	-.808 (-1.06)	-.804 (-1.02)
Restricted insurance mandate	-.360 (-0.70)	-1.361 (-0.81)	-.333 (0.18)	-.360 (-0.19)	-.909 (-0.80)	-.623 (-0.53)	-.810 (-0.83)	-.819 (-0.82)
Clinic is SART member	.883 (0.71)	.870 (0.64)	1.713 (0.97)	1.717 (0.97)	-.364 (-0.36)	-.361 (-0.36)	-.386 (-0.39)	-.385 (-0.39)
Clinic accepts single women	-1.594 (-1.61)	-1.133 (-1.07)	-.997 (-0.95)	-.986 (-0.96)	1.076 (2.08)	.943 (1.64)	.719 (1.47)	.722 (1.47)
IVF	1.800 (0.94)	3.192 (1.62)	9.265 (4.13)	9.295 (4.05)	-5.169 (-3.95)	-5.567 (-3.94)	-.080 (-0.04)	-.071 (-0.03)
Female population	-.002 (-0.03)	-.211 (-1.76)	.018 (0.28)	.012 (0.12)	-.062 (-1.36)	-.003 (0.03)	-.036 (-0.79)	-.038 (-0.65)
Female population ²	-.011 (-0.17)	.156 (1.38)	-.009 (-0.15)	-.005 (-0.05)	.022 (0.52)	-.026 (-0.40)	.011 (0.30)	.013 (0.28)
Bachelor's Deg (%)	.267 (1.36)	.027 (0.11)	.072 (0.35)	.063 (0.27)	.087 (0.48)	.156 (0.85)	.224 (1.78)	.221 (1.62)
Graduate Deg (%)	-.321 (-1.31)	-.163 (-0.56)	-.148 (-0.67)	-.142 (-0.63)	-.081 (-0.47)	-.127 (-0.73)	-.226 (-1.75)	-.223 (-1.62)
Per Capita Income	.055 (0.43)	.114 (0.69)	-.118 (-1.04)	-.115 (-0.99)	-.004 (-0.04)	-.013 (-0.13)	-.035 (-0.42)	-.031 (-0.36)
Avg. Household Size	4.556 (1.30)	3.167 (0.85)	.060 (0.02)	.019 (0.01)	.395 (0.17)	.792 (0.32)	-.796 (-0.37)	-.808 (-0.37)
Women in Labor Force (%)	.005 (0.04)	.165 (1.06)	.094 (0.74)	.100 (0.67)	-.181 (-1.64)	-.227 (-1.86)	-.145 (-1.61)	-.143 (-1.46)
Land Area	.068 (0.52)	-.009 (-0.06)	.050 (0.42)	.048 (0.38)	.066 (0.75)	.088 (0.92)	.050 (0.69)	.050 (0.69)
Neighboring market with clinic	.784 (1.06)	.152 (0.15)	.748 (0.90)	.728 (0.79)	.592 (0.99)	.773 (1.14)	1.096 (2.26)	1.091 (2.09)
R ²	0.028	-	0.025	0.025	0.141	0.133	0.055	0.055
N	1671	1671	1624	1624	1671	1671	1624	1624