ABORTION POLICY AND TEEN REPRODUCTIVE BEHAVIOR IN THE U.S.: THE CASE OF PARENTAL INVOLVEMENT LAWS

by

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Abstract

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Laws that require that physicians either notify or acquire the consent of the parent(s)' of a minor seeking an abortion have gained in popularity over the years. Currently 36 states enforce a parental involvement law in some form. Yet, the evidence on the effect of these laws on minors' reproductive behavior is mixed. In Chapter I of this essay we argue that the lack of consensus is related to limitations in available data on abortions that have undermined the identification strategies. Using individual-level data on abortions and births from Texas, we show that analyses based on minors' age at the time of the abortion or birth overestimate the decline in the abortion rate and underestimate the rise in the birth rate, and can lead to the erroneous inference that pregnancy rates decline in response to a parental involvement law. We utilize a robust identification strategy by minimizing the age difference between our treatment and control groups in order to make the two more comparable. We find a decline in the abortion rate of minors ages 17 years and 6-9 months at the time of conception, where the decline is smaller for those closer to age 18, and some evidence of a rise in the birth rate of the younger group, although not statistically significant. We find no change in the pregnancy rate of either group. Consequently, the law is associated with an increase in the probability of birth for teens ages 17 years and 6-9

months; for those ages 17 years and 8-9 months the association is weaker. Since we find no evidence of a change in pregnancies, the increase in the probability of giving birth conditional on pregnancy is likely the result of an increase in unintended childbearing. In Chapter II we evaluate a behavior that has mostly been overlooked in previous studies, namely the likelihood that older 17 year-olds delay the abortion until age 18 in order to avoid compliance with the parental notification requirement. This behavior persists even 4 years after introduction of Texas's law. We provide some suggestive evidence that exposure to the risks associated with second-trimester abortions increased among teens who responded to the law by delaying the abortion until age 18.

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Chapter I. Minors' fertility decisions in the wake of a parental involvement requirement: new evidence from improved data and identification

1. Introduction

Since the nationwide legalization of abortion in 1973, many states have sought to pass laws requiring parents' participation in minors' decision to obtain an abortion. These laws are commonly referred to as "parental involvement laws", and usually require that a physician either notify a parent of a minor's intention to obtain an abortion or request the parents' consent before performing the procedure. Minors who do not want to inform their parents about their desire to seek an abortion must either travel to a state that does not have a law or go through a judicial bypass procedure. At a minimum, for these minors both choices increase the effort required to secure abortion services. Currently 36 states enforce a parental involvement law in some form.[1]

Most researchers have found that abortions to minors decrease after the introduction of a parental involvement law. (Rogers et al. 1991; Haas-Wilson 1996; Ellertson 1997; Levine 2003). Whether the reduction in abortions associated with such a law is the result of a fall in pregnancies or a rise in births remains unresolved, yet it has important implications for policy. For example, a fall in minors' abortion rate unaccompanied by a rise in their birth rate implies a fall in pregnancies, indicating that minors respond to the law by having less sex or by using more effective contraception. On the other hand, a fall in minors' abortion rate and a rise in their birth rate, with no change in the pregnancy rate, implies an increase in unintended childbearing.

[1] Source: National Abortion and Reproductive Action Rights League / NARAL. http://www.prochoiceamerica.org/choice-action-center/in_your_state/who-decides/key-issues/young-women.html, accessed on November 12th, 2007.

Methodological limitations in previous work have likely led to biased estimates and erroneous inferences about minors' response to a parental involvement law. First, most analyses compare the outcomes of 18-19 year-olds to that of 15-17 year-olds, despite the large differences in the abortion and birth rates between the two groups. Second, differences in trends over time in the reproductive outcomes between minors and older teens poses a problem for both short-term and long-term analyses. Third, most studies determine exposure to the law by the teens' age at the time of abortion or birth, which led researchers to overestimate the law's impact on minors' abortion rate and underestimate its impact on their birth rate.

In this study we advance the literature on the effect of parental involvement laws in several ways. First, we demonstrate the bias present in previous analyses that stems from researchers' inability to determine exposure to the law based on age at the time of conception. We are able to correct this source of misclassification with unique data from Texas that provides information on patients' date of birth, the date of the procedure as well as an estimate of gestational age. Second, we provide new and improved estimates of the effect of parental involvement laws on minors' abortion, birth and pregnancy rates, as well as employ a birth-probability model that allows for a richer specification, and enables us to control for teens' characteristics such as race, parity, experience with previous terminations and marital status. The advantage of our analysis over previous studies is that we determine which minors were subject to the law based on their age at the time of conception, when teens are faced with the decision on how to resolve the pregnancy, as well as we narrow the age difference between our treatment and control group so that they are only a few months apart in age, and therefore enhance the

comparability of those exposed and unexposed to the law. Finally, while most previous studies are biased due to the difficulty in obtaining accurate counts of abortions to minors which occur outside their state of residence, we have evidence to suggest that cross-state travel by minors seeking to avoid the parental notification requirement in Texas does not pose a problem in our study. The large size and geographic location of Texas, as well as the fact that a number of nearby states had a parental involvement law in effect at the time Texas enacted its own law, substantially increases the travel distance to the nearest out-of-state provider.

Our results indicate that the way exposure to the law is determined can significantly alter the estimates as well as the conclusions as to the likely impact of the law. While the estimates based on age at the time of abortion or birth show a big decline in abortion, as well as a reduction in births, the analyses based on age at conception indicate a smaller decline in abortions and a slight increase in births, leading to no change in pregnancies. In our analysis of closer comparison groups, we find that the law is associated with a 20 percent reduction in the abortion rate of teens ages 17 years and 6-7 months at the time of conception, and a more moderate reduction of 12 percent among teens ages 17 years and 8-9 months. We found an increase of 4 percent in the birth rate of minors ages 17 years and 6-7 months, however not statistically significant, and no change in the pregnancy rate of either of the age groups. We show that the probability that pregnant minors of ages 17 years and 6-9 months carry a pregnancy to term increases significantly in the four years following Texas's law, where the increase was greater among teens ages 17 years and 6-7 months. Since we find no change in the pregnancy rate in response to Texas's law, the rise in the probability of birth is most likely the result

of an increase in unintended childbearing. This result suggests that there may be relatively little feedback from the enforcement of the law and teen sexual activity and contraceptive use. Our analyses by race are less conclusive. We find some evidence that abortions declined among white non-Hispanics and Hispanics, with no statistically significant evidence of a change in births or pregnancies. We are not able to draw any conclusions for black non-Hispanics, since by stratifying the analysis by age in months we substantially reduce the sample size for this group and thereby introduce a considerable noise in the data.

The rest of the paper is organized as follows. Section 2 provides background information as well as gives a critical review of previous literature on parental involvement laws. Section 3 describes our data in detail. In section 4, we discuss our outcomes and estimation strategy, and present our findings. Section 5 concludes.

2. Background and Literature Review

2.1 Conceptual considerations

Parental involvement laws are expected to lower abortion rates because they increase the cost of an abortion for minors who do not want to inform their parents. Whether the decline in abortion should be accompanied by a rise in births, or is the result of a fall in pregnancies is unclear. Some economists argue that the option to terminate a pregnancy serves as insurance against the risk of an unwanted birth. The insurance allows a woman to obtain additional information about her prospects and that of her relationship should she carry a pregnancy to term. Policies that increase the cost of abortion, such as a parental involvement law, raise the cost of this option and decrease

both abortions and conceptions as fewer women use pregnancy to gather information about the likely consequences of giving birth (Levine 2003; Levine 2004; Levine and Staiger 2002).[2] Thus, one may observe the seemingly counterintuitive result that an increase in the cost of abortion leads to a fall in births.

Others have argued that teens and especially minors may be less forward looking in their decision making. The high rate of unintended pregnancy among teens suggests that they become pregnant first, and then assess their choices. To the extent that parental involvement laws raise the cost of abortion for some minors, this theory would predict a fall in abortions and a rise in births among minors after implementation of such a law. Thus, the predicted impact of a parental involvement law on minors' birth rate depends on whether teens take into account changes in laws and policies pertaining to abortion when making decisions about sex. If they do, then a parental notification law could decrease sexual activity and increase contraceptive use. The results would be a fall in abortions and pregnancies. If instead, minors react to the law after becoming pregnant, then we would expect a fall in abortions, but a rise in births and no change in pregnancies. This question can only be resolved empirically.

2.2 Previous studies

The academic literature on the impact of parental involvement laws has not reached a consensus. Some studies suggest that parental involvement laws lower abortion rates among minors, but have little effect on birth rates (Rogers et al. 1991;

[2] Additional evidence that teens decrease sexual activity or increase the use of contraception in response to a parental involvement law comes from a study that found that parental involvement laws were negatively correlated with rates of sexually transmitted diseases (Klick and Stratmann 2007).

Ohsfeldt and Gohmann 1994; Haas-Wilson 1996; Levine 2003). Other studies suggest that the observed decline in abortions is spurious, since abortions to minors obtained outside their state of residence are often not recorded (Cartoff and Klerman 1986; Henshaw 1995; Joyce and Kaestner 1996; Ellertson 1997). The conflicting findings reflect the difficulty of evaluating the impact of such laws on reproductive behavior. The canonical research design is a pre-post analysis with a comparison group. Changes in abortion and/or birth rates among minors are compared to changes among older teens. This seemingly straight forward test, however, is fraught with pitfalls that have not been fully appreciated by researchers, policy makers and advocates.

One reason that the estimates of the effect of parental involvement laws on abortions vary greatly is due to poor data quality. The analyses are either based on state aggregate data using multiple states or on individual-level data from state health departments from one or more states. Studies based on state aggregates use data from either the Centers for Disease Control and Prevention (CDC) or the Alan Guttmacher Institute (AGI), which are available annually by state of occurrence and one other characteristic such as age or race, but not both. The advantage of studies based on aggregate data is that most states are represented, and this permits analyses based on pooled time-series cross-sections with state fixed effects (Ohsfeldt and Gohmann 1994; Haas-Wilson 1996; Blank et al. 1996; Levine 2003). However, the CDC and AGI aggregate abortion data are reported by state of occurrence rather than by state of residence, and are therefore not well suited for the evaluation of parental involvement laws.

Minors, who reside in a state that enforces a parental involvement statute, will seek an abortion in a nearby state without such requirement. Similarly, minors for whom the nearest abortion provider is out-of-state may stop coming to that provider after the introduction of a parental involvement statute in the provider's state. For this reason, studies that employ the AGI or CDC aggregate data tend to overestimate the effect of the law because they do not account for the possibility of minors leaving the state or stop coming into the state for an abortion.[3]

In some studies that employ individual level data from state health departments, researchers addressed the problem of cross-state travel by minors, and have secured some information on abortions to minors performed outside their state of residence. The general finding from these studies is that abortions by state of occurrence fall significantly, but the decline by state of residence is considerably less. The other advantage of using individual level data is that it enables researchers to stratify analyses by age, race, state of residence and the month of the abortion and thereby define those exposed and unexposed to the law with greater precision (Cartoff and Klerman 1986; Joyce and Kaestner 1996; Henshaw 1995; Ellertson 1997).

As mentioned earlier, a common research design is to use changes in the abortion and birth rate of 18-19 year-olds as the counterfactual for the changes among minors ages 15-17 (Rogers et al. 1991; Oshfeldt and Gohmann 1994; Ellertson 1997; Joyce and Kaestner 1996; Haas-Wilson 1996; Kane and Staiger 1996). However, the abortion and

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[3] The AGI produces estimates of abortions by age and state of residence that are produced by incorporating migration rates of all women provided by the CDC. These estimates, however do not take into account higher migration rates by minors in response to a parental involvement law. Consequently, AGI researchers warn against the use of these data for the evaluation of parental involvement laws. Stanley Henshaw, who directed the AGI abortion survey for many years, writes, …."Thus, the estimated abortion and pregnancy rates should not be used to assess the impact of parental involvement laws on minors' abortion and pregnancy rates" (Henshaw, 1997, p. 116).

birth rates of older teens are several times greater than that of minors, which raises questions as to the appropriateness of the comparison group (Meyer 1995). It suggests large differences in sexual activity, contraceptive use, previous pregnancy experience, schooling and labor market participation, all of which may affect trends in reproductive outcomes over time.

In addition, the large difference in the abortion and birth rate between minors and older teens can make the relative trends between the two age groups sensitive to measurement issues. For example, while the abortion and birth rates of both 15-17 and 18-19 year-olds started to decline in the late 1980s, early 1990's, the rate of decline varies depending on whether it is measured in absolute or relative terms. Between 1990 and 2000, the birth rate of 15-17 year-olds declined from 37.5 to 26.9. This represents a decline of about 11 births per thousand population, or -33 percent in relative terms. During the same period the birth rate of 18-19 year-olds declined from 89.8 to 78.4, which in absolute terms is also a decline close to 11 births per thousand population. In percentage terms, however, this amounts to a decline of 14 percent, as opposed to 33 percent in the case of 15-17 year-olds (Guttmacher Institute, 2006). The trend in the abortion rate between the two groups during this period differs both in absolute and in relative terms. Thus, previous estimates are likely biased not only because they do not account for the differing trends in the reproductive outcomes between the treatment and control groups, but are also sensitive to whether the changes in outcomes are measured in absolute or percentage terms.

In all previous studies researchers have determined exposure to the law based on teen's age at the time of the abortion or birth. However, as we will demonstrate in this

study, there is evidence that some minors who are contemplating having an abortion will, if feasible, wait to do so until their 18th birthday, in order to avoid having to notify their parents. Some of them are willing to wait even if it leads to a more risky second-trimester abortion. The delay in the timing of abortion by older 17 year-olds causes a decline in the number of abortions obtained at age 17 and a rise in the number of abortions obtained at age 18, which leads researchers to overestimate the effect of the law on the abortion rate of 17 year-olds, if exposure to the law is determined based on age at the time of abortion rather than age at the time of conception. The bias will be more notable if the comparison group is older teens in the same state, since the delay of abortions by 17-year-olds will spuriously reduce the number of abortions performed on 17-year-olds and at the same time increase the number of abortions performed on 18-year-olds. If minors in states without a parental involvement law serve as the counterfactual, the bias results from excluding the delayed abortions from the analysis altogether.

The way exposure to the law is determined also affects inferences as to the effect of the law on minors' birth rates. About three-fourths of all minors who conceive as 17-year-olds, give birth when they are 18 years of age. Thus, a pregnant 17-year-old who carries to term because of a parental involvement law will most likely give birth when she is 18 years of age. In all but one previous analysis, age has been measured at the time of delivery. Thus, births to 18-year-olds who may have been affected by the law during pregnancy will not be counted if comparisons are between 17-year-olds in different states, or such births will be included among the controls if changes among 18-year-olds within the state serve as the counterfactual. This form of misclassification bias drives

estimates of the law's impact on birth rates towards the null, and may even lead to the erroneous inference that birth rates have declined or remained unchanged in response to the law (Rogers et al. 1991; Oshfeldt and Gohmann 1994; Ellertson 1997; Joyce and Kaestner 1996; Kane and Staiger 1996; Levine 2003).

With unique data from Texas, we attempt to correct for many of the shortcomings of previous studies, and provide new evidence of the effect of parental involvement laws on teen reproductive behavior. After describing the important details of the Texas data, we begin our analysis by demonstrating the importance of classifying teens as exposed or unexposed to the law from the point of conception rather than from the point of pregnancy resolution. We provide evidence of the bias from this type of misclassification in previous estimates of the effect of parental involvement laws on the abortion, birth and pregnancy rates of minors. Next, utilizing our data by age in months at the time of conception, we provide new and improved estimates of the effect of the law on minors' abortion, birth and pregnancy rates, as well as the probability of giving birth conditional on pregnancy. And finally, we analyze the differential impact of the law by teens' race.

3. Data

We use data from individual birth and induced termination certificates obtained from the Texas Department of State Health Services (TDSHS) for the years 1997 to 2004. The Texas Abortion Facility Reporting and Licensing Act of 1989 mandates that every facility performing abortions such as hospitals, physicians' offices or abortion clinics, submit an annual report on every abortion performed at the facility to the TDSHS on forms provided by the department. Although reporting has been mandatory since

1989, the number of abortions reported to the TDSHS is generally lower compared to the estimates collected by the Guttmacher Institute. Figure 1 compares the statistics on the total number of abortions in Texas that were reported to the TDSHS to those based on the Guttmacher Institute's survey of abortion providers. The number of abortions as counted by the abortion certificates collected by the TDSHS is shown for every year between 1992 and 2005. Estimates reported by the Guttmacher Institute are only available for selected years, since the survey is not conducted annually. In 1995 and 1996 the number of abortions reported by the two sources are very close; in the other three years for which estimates from both sources are available (1992, 2000, 2005), the numbers reported by the TDSHS are about 85-94 percent of that estimated by the Guttmacher Institute. While the Guttmacher Institute's survey of abortion providers is considered the most accurate source of abortion statistics, they are inadequate for the evaluation of parental involvement laws for several reasons. First, they report the number of abortions by state of occurrence and not by state of residence and thereby making it impossible to account for cross-state travel by minors with the intention to avoid the parental involvement requirement. Second, data are not available by age or by any other characteristics.[4] For the purpose of this study the individual-level data from abortion certificates is more suitable. As long as the underreporting of the abortion certificates is independent of the patients' age, the result of our analysis in relative terms will not be affected.

[4] Estimates by age-groups are available for certain years, however they are based on the age distribution of abortions from data reported to the CDC by the state health departments.

3.1 Patients' age in months at conception and pregnancy resolution

One of the unique features of the Texas data is that Texas's abortion certificates contain patient's date of birth on the abortion certificates. With patient's exact date of birth on both the abortion and birth certificates, the date of the event (abortion or birth) and a clinical estimate of gestational age, we can estimate patient's age in months at two points in time, at the time of conception and at the time of pregnancy resolution (abortion or birth). Specifically, we subtract gestational age in weeks from the teen's age in weeks at the time of the abortion or birth to measure age at conception. We divide age in days by 30.5 to estimate age in months. Gestational age on both the abortion and birth certificates is based on the clinician's estimate and is reported in weeks only.

One limitation of the Texas abortion data is that reporting of patients' date of birth on the abortion certificates is incomplete prior to 1999; however, the reporting improved over time. About 24 percent of abortion certificates for teens ages 15-19 lacked the patient's exact date of birth in 1997, as did 6.4 percent in 1998-1999, and 4.3 percent in 2000-2001. The percent of abortions to women of all ages that lack exact date of birth is about 2 percent in 2002-2004.[5] In contrast, the mother's date of birth is well recorded on birth certificates: less than one percent lacked this information each year. We exclude all cases in which data were missing on the exact date of birth.

A greater proportion of missing data in the pre-law relative to the post-law period may introduce a bias into our estimates. However, in section 4 we demonstrate that as long as the missing data in the pre-law period are distributed independently of age, an analysis that contrasts changes in outcomes among minors to that of older teens in

[5] Reported age is not recorded in our data for these years, thus we are not able to report the missing date of birth among teens.

relative terms will be unaffected. Table 1 shows our results for the chi-squared test of independence separately for the years 1997, 1998 and 1999. In 1997 - the year with the lowest reporting of date of birth - 23.59 percent of observations to 17 year-olds and 24.33 percent to 18-year-olds has missing date of birth. Similarly, 76.41 percent of records with missing date of birth were to 17-year-olds compared to75.67 percent to 18-year-olds. A chi-squared test of independence cannot reject the hypothesis that these proportions are significantly different ($p = 0.49$). The results for 1998 and 1999 give the same conclusion ($p=0.621$ in 1998 and $p=0.469$ in 1999).

However, even if the proportion of missing date of birth is independent of age, any analyses that rely on absolute changes in abortions are still subject to the bias resulting from the underreporting of date of birth in the pre-law years. For this reason, we limit some of our analysis to one year before and one year after the law was introduced. Reporting was quite good over these two years. In section 4 we discuss the possibility of bias as it relates to the specific methods we employ and the measures we take to limit this source of bias.

3.2 Pre- and post-law sample years

We define our pre-law sample as all births and abortions that were conceived between August 1, 1997 and July 31, 1999. Minors who conceived between August 1, 1999 and December 31, 1999 could be exposed to the law given the time that may elapse between pregnancy recognition and pregnancy resolution. For simplicity, from here on we refer to this period as 1998-1999. We include all births and abortions conceived between January 1, 2000 and December 31, 2003 as the post-law events. The reason we cannot include pregnancies that were conceived before 1997 into our pre-law sample is

because Texas only began collecting patients' date of birth on the abortion certificates in 1997. Our analysis is based on patients' exact age at the time of conception and at the time of abortion; without knowledge of patients' date of birth we cannot calculate either. We also exclude from our analysis all pregnancies conceived in 2004 in order to avoid confounding from Texas's Women's Right to Know Act, which went into effect in January of 2004. It requires, among other things, that every abortion at 15 weeks gestation or later be performed at an ambulatory surgical center. Since not one provider in 2004 met the requirements, many women sought late abortions in neighboring states. Because individual level data with patient's date of birth from neighboring states is not available to us, we would be unable to include these cases in our analysis.

3.3 Texas resident data

Both, the abortion and birth certificates provide information on state and county of residence, making it possible to limit the analyses to Texas residents. This is important for two reasons. One, minors may leave Texas to obtain an abortion in a state without a parental involvement requirement (Cartoff and Klerman 1986; Henshaw 1995; Joyce and Kaestner 1996); two, non-resident minors may stop coming into Texas for an abortion. Both of these events would lead to an undercount of the post-law abortions and would therefore lead to biased estimates if we based our analysis on abortions performed in Texas rather than on abortions to Texas residents. As evidence that fewer non-resident minors went to Texas for an abortion after the law, in Table 2 we show the number of abortions to non-resident teens that were performed in Texas, by reported age and state of residence, for the year before (1999) and the year immediately after introduction of the law (2000). Most non-resident minors that obtained an abortion in Texas came from

three bordering states, Louisiana, New Mexico and Oklahoma, and from Mexico. The total number of non-resident abortions among 17-year-olds fell from 124 to 70 whereas abortions to non-resident 18-year-olds fell inconsequentially from 155 to 152 between 1999 and 2000. The difference in the decline in abortions between 17- and 18-year-olds is statistically significant ($p<0.01$). There was no meaningful change in the number of non-resident abortions among 15- and 16-year-olds (see footnote to Table 2).

The results in Table 2 are consistent with findings from several other studies regarding differences in behavior among minors by age. For instance, 17-year-olds are the least likely to communicate with their parents regarding an abortion or the use of reproductive health services relative to younger minors, which suggests that they are more likely to be affected by a parental involvement statute (Henshaw and Kost 1992; Jones et al. 2005). The 41 percent decline in non-resident abortions to 17-year-olds relative to 18-year-olds indicates that parental notification laws are effective in discouraging non-resident older minors from obtaining an abortion in the state. Furthermore, the lack of minors from Mississippi, Arkansas, or Tennessee—states with parental involvement laws that are further away from Texas—suggests that a minor's travel across state lines is limited to nearby urban areas. In Texas, for example, over 95 percent (n=128) of minors 15 to 17 years of age from Oklahoma obtained their abortions in Dallas County in 1999 and 2000. Eighty-one percent (n=162) of minors from New Mexico went to El Paso county and 14 percent (n=28) went to Lubbock county for an abortion. Sixty percent (n=101) of minors from Mexico went to El Paso County and 24 percent (n=41) went to Webb County in which the city of Laredo is located. The finding that most non-resident minors travel to the nearest urban center in Texas for an abortion

likely explains why so few minors from Texas left the state for an abortion. Among the border-states, New Mexico and Oklahoma did not enforce a parental involvement law in 2000.[6] But for minors in the population centers of Dallas, Houston, and San Antonio the nearest abortion provider in New Mexico is hundreds of miles away.

As we mentioned earlier, it is equally important to account for Texas minors who are induced by the law to seek abortions in nearby states without a parental involvement requirement. Unfortunately, not all abortions to Texas residents that occur outside Texas are reported back to the TDSHS by the health department of the states where the abortions occur. To make sure that cross-state travel does not pose a problem for our analysis, we obtained data on the number of abortions to residents of Texas performed in neighboring states as recorded by the respective state health departments. In 2000, there were 13 abortions obtained by Texas minors in New Mexico, 5 in Oklahoma and 5 in Arkansas.[7] Louisiana does not report the state of residence on the induced termination certificate. However, the state has enforced a parental consent law since 1978, which makes it unlikely that minors would seek abortions in Louisiana in response to the parental notification law in Texas. We do not know whether minors sought abortions in Mexico after the law. Legal access to abortion in Mexico is more limited than in the US, although the extent of illegal abortions is not well-known. The finding that a significant number of women from Mexico seek abortions in the US may indicate the difficulty of obtaining the procedure in Mexico. During 1997-2004, in total 10, 316 (1.63%)

[6] The Oklahoma legislature introduced a bill limiting minors' access to abortion in 1999. As of 2002, the law was declared unenforceable (NARAL 2003).

[7] Personal communications with Stanley Henshaw from the Alan Guttmacher Institute and authors' tabulations of induced termination files from Oklahoma and Arkansas Departments of Health

abortions were performed in Texas to women from Mexico compared to 13,015 (2.06%) abortions to residents of the U.S. other than Texas.[8]

3.4 Summary of final sample

In Table 3 we give the size of our final sample of abortions and births to 17 and 18 years old Texas residents with known date of conception, date of event (abortion or birth), who conceived between 1998 and 2003, as well as show the distribution of their characteristics. During our sample period, there were 39,282 abortions and 185,887 births conceived by 17 and 18 year-olds combined. About 38 percent of the abortions and 43 percent of the births were to 17 year-olds. The greatest proportion of abortions was to white non-Hispanic teens (40 percent), while the majority of births were to Hispanic teens (55.7 percent). Only about 5 percent of teens who had an abortion were married, compared to 33.5 percent of those who had a birth. The proportion of the abortion sample who reported to have at least one prior termination was about twice the proportion birth sample (9.2 vs. 18.2 percent), while the proportion with a previous birth was more similar in the two samples (21.5 in the abortion sample vs. 28.5 in the birth sample).

4. Methods and results

We begin this section with an overview of methods that we employ in the analysis of abortion, birth and pregnancy rates. We then discuss our empirical results, starting with the estimates of the bias resulting from misclassification of exposure to the law.

[8] Authors' tabulation of Texas abortion certificates with known state of residence for the years 1997-2004. (In total 2,213 or 0.35% of records had missing state of residence.)

After establishing the importance of determining which teens were subject to the law from the point of conception, we give new estimates of the effect of the law on the abortion, birth and pregnancy rates of minors, as well as the law's impact on the conditional probability of giving birth, where we limit the analysis to a sub-sample of teens in an effort to narrow the differences between our treatment and control groups. And finally, we evaluate the differential impact of the law by teens' race.

4.1 Overview of methods used for the analysis of abortion, birth and pregnancy rates

Given that we have data by detailed age, and there is a clear age cutoff that identifies which teens are subject to the law, it would seem natural to apply a regression discontinuity design to our data. However, after further consideration we found this approach to be unsuitable for the evaluation of parental involvement laws. The reason we cannot apply a regression discontinuity design is that minors can control the timing of the abortion. There is about a 2 month window from the time she recognizes the conception within which a pregnant teen can manipulate the timing of the abortion without incurring the added risk and monetary cost of a second-trimester abortion. This gives teens who conceive within a few months before their 18th birthday the opportunity to delay the abortion until age 18 and avoid the parental notification requirement. The closer a teen is to her 18th birthday at the time of conception, the easier it becomes to schedule the abortion at age 18.[9] Therefore, we expect that the law's impact on minors' abortion rate diminishes, as age approaches 18, where the law should have no impact at the limit (at age infinitely close to 18 years and 0 months). But even without a deliberate

[9] See Chapter II for a detailed evaluation of the effect of the law on the delay in the timing of abortion.

delay in the timing of abortion, teens closer to their 18th birthday when becoming pregnant are more likely to schedule the abortion at age 18. Therefore, even if the law reduces abortions among younger minors, the law's impact diminishes as age approaches 18, and therefore there should be no discontinuity at the limit of 18 years and 0 months.

While we do not utilize a regression discontinuity design, we do take advantage of our detailed data on age and analyze the effect of Texas's law on the of abortion, birth and pregnancy rates of minors using comparison groups that are much closer in age than was done previously. We calculate abortion and birth rates as the number of induced abortions or live births per 1000 age-specific female population.[10] Pregnancy rates are the sum of induced abortions and live births also divided by the age-specific female population. We calculate the rate ratios for 17-year-olds as the rate in the post-law period divided by the rate in the pre-law period. If there were no trends over time in the abortion, birth and pregnancy rates, the rate ratio would give the change in the rates among 17-year-olds associated with the law. However, since we cannot assume that there was no change in these outcomes over time, we calculate the rate ratios for 18-year-olds and use it as the counterfactual, or the change in the abortion, birth and pregnancy rates of 17-year-olds that would have occurred had the law not gone into effect. We calculate the relative rate ratio for abortions, births and pregnancies by dividing the rate ratio of each outcome for 17-year-olds by the rate ratio of the 18-year-old comparison group. Thus the relative rate ratios (RRR) give us the change in the abortion, birth and pregnancy rate of 17 year-olds associated with the law. A RRR of 1 indicates no association between Texas's parental notification requirement and the abortion, birth or

[10] The population data that we use for the computation of rates are population estimates by single year of age, sex, race, and Hispanic origin from the National Cancer Institute (2004 vintage). They are available for download at http://seer.cancer.gov/popdata.

pregnancy rate of 17-year-olds. An RRR of less than 1 suggests that the law reduced the abortion rate of 17-year-olds, while an RRR of greater than 1 indicates a rise in the abortion rate associated with the law.

The relative rate ratio is expressed as:

$$RRR = \frac{R_{17\,pre} / R_{17\,post}}{R_{18\,pre} / R_{18\,post}},$$

where $AR_{17,pre}$ is the (abortion, birth or pregnancy) rate of 17-year-olds in the pre-law period; $AR_{17,post}$ is the rate of 17-year-olds in the post-law period; $AR_{18,pre}$ and $AR_{18,post}$ stand for the rate of 18-year-olds in the pre- and post-law period, respectively. We calculate the standard error of the natural log of the relative rate ratio using the Delta method (Kirkwood and Sterne, 2003). It is defined as:

$$s.e.(\log RRR) = \sqrt{\text{var}(\log R_{17,\,pre}) + \text{var}(\log R_{17,\,post}) + \text{var}(\log R_{18,\,pre}) + \text{var}(\log R_{18,\,post})},$$

where $var(\log R_{17,pre})$ and $var(\log R_{18,pre})$ is the variance of the natural logarithm of the pre-law abortion, birth or pregnancy rate of 17 and 18-year-olds, respectively. Analogously, $var(\log R_{17,post})$ and $var(\log R_{18,post})$ are the variances of the natural logarithm of the rates in the post-law period, and are equal to $\frac{1}{N} - \frac{1}{P}$, where N is the relevant number of abortions, births or pregnancies, and P is the relevant population number. Thus the standard error of the relative rate ratio can be expressed as:

$$s.e.(\log RRR) = \sqrt{\frac{1}{N_{17,\,pre}} - \frac{1}{P_{17,\,pre}} + \frac{1}{N_{17,\,post}} - \frac{1}{P_{17,\,post}} + \frac{1}{N_{18,\,pre}} - \frac{1}{P_{18,\,pre}} + \frac{1}{N_{18,\,post}} - \frac{1}{P_{18,\,post}}}.$$

While we only report the relative rate ratios, we perform all hypothesis testing using the log of the relative rate ratio and the standard error of the log of the relative rate ratio. The

log relative rate ratio and its standard error can be obtained from a Poisson regression model with interaction terms for indicators of age and the post-law period.

In an alternative specification, we calculate a difference-in-differences estimate of the effect of the law on the rates of 17-year-olds, where we subtract the pre- to post-law change in the abortion, birth and pregnancy rates among 18-year olds from the pre- to post-law change in the rates among 17-year olds. Specifically, the difference-in-differences estimate is calculated as:

$$DD = (R_{17\,post} - R_{17\,pre}) - (R_{18\,post} - R_{18\,pre}).$$

The DD estimate and its standard error can be obtained from a linear regression model with an interaction term for age 18 and the after-law period.

The reason for the alternative specification is that the abortion, birth and pregnancy rates of 18 year-olds are about 1.5 times greater than the rates of 17 year-olds, and the large differences in the pre-law rates between the treatment and comparison group can make relative changes sensitive to functional form. In other words, an estimate of a percent change in the rates as given by the relative rate ratio may provide very different inferences than an absolute change in the level of the rates. For example, if the pre-law abortion rate were 10 for our treatment group and 15 (1.5 times bigger) for our control group, an absolute decline of 5 abortions per thousand population in both the treatment and control group, would give us a difference-in-differences estimate of 0, indicating no association between the law and the abortion rate of minors. On the other hand, we would reach a very different conclusion based on the estimate given by the relative rate ratio. It would indicate that the law was associated with a 25 percent reduction in minors' abortion rate ([5/10]/[15/10]).

One problem with applying the difference-in-differences estimates in levels to our abortion data is that proportionately more observations lack exact date of birth in the pre- as compared to the post-law years, thus we underestimate the number of abortions and therefore the abortion rate in the pre-law period. As we showed in Table 1, the proportion of missing cases is equally distributed among 17 and 18-year-olds, therefore the relative rate ratios will be unaffected. However the difference-in-differences estimates in levels will be biased. To illustrate, let π be the proportion of cases with exact date of birth ($0< \pi<1$):

$$RRR = \frac{\pi R_{17\,pre} / R_{17\,post}}{\pi R_{18\,pre} / R_{18\,post}} = \frac{R_{17\,pre} / R_{17\,post}}{R_{18\,pre} / R_{18\,post}}$$

$$DD = (R_{17\,post} - \pi R_{17\,pre}) - (R_{18\,post} - \pi R_{18\,pre}) = (R_{17\,post} - R_{18\,post}) - \pi(R_{17\,pre} - R_{18\,pre}).$$

While π drops out from the relative rate ratio, it introduces a bias into the difference-in-differences estimate. Because of this biasing factor, we limit the pre-law years of all analyses in which we employ the difference-in-differences in levels to 1999, the year in which reporting of date of birth was relatively complete compared to the after-law years (see Section 3.1 for more detail).

4.2 Misclassification bias

Having information on teens' age at two points in time, conception and pregnancy resolution, enables us to evaluate the extent of the misclassification bias present in previous studies that result from determining exposure to the law based on teens' age at the time of abortion or birth. Initially, we follow previous work and use age at the time of abortion or birth to classify teens as affected and unaffected by the law. We then evaluate the change in the abortion, birth and pregnancy rate of 17-year-olds relative to

18 year-olds, from one year before the introduction of Texas's law to one year after. Next, we repeat the analysis, but use age at conception to define exposure and contrast the two sets of estimates. We limit the analysis to 17 and 18 year-olds in order to minimize differences in our treatment and control groups and to one year before and one year after the law in order to minimize the bias from differences in trends in reproductive outcomes by age over time.

The results of the difference-in-differences in levels and the relative rate ratios for the abortion, birth and pregnancy rates are presented in Tables 4, 5 and 6, respectively. In all three tables, the top panel (Panel A) has the estimates based on age at the time of pregnancy resolution (abortion or birth) and in the bottom panel (Panel B) exposure is determined based on age at conception. The abortion rate of 17-year olds fell by 4.4 per thousand when measured by age at the time of abortion (Table 4, Panel A, column 3). This represents a decline of about 25 percent as measured by rate ratio (Table 4, Panel A, column 4). The abortion rate of 18-year olds fell by 0.9 per thousand or by 3 percent in relative terms (Table 4, Panel A, columns 3 and 4). Thus, Texas's parental notification law was associated with a decline of 3.5 abortions per thousand or 23 percent ($p<0.01$) among 17-year-olds if exposure to the law is determined based on age at the time of abortion. The relative decline in the abortion rate of 17-year-olds when age is measured at the time of conception is -1.9 per thousand, or -14 percent ($p<0.01$) (Table 4, Panel B, columns 5 and 6), which is substantially less than the previous estimate of 23 percent. The greater decline in the abortion rate of 17-year-olds when exposure is measured by age at the time of the abortion is due to the delay in the timing of abortion by older 17-year-olds until after their 18th birthday.

As evidence of this delay, in Figure 2 we show the number of abortions by age in months at the time of abortion for 17 and 18-year-olds. One series shows the number of abortions that were conceived in 1999 and the other pertains to abortions conceived in 2000, the first year that the law was in effect. The number of abortions to 17-year-olds is noticeably less in 2000 compared to 1999. But more importantly, in conception year 2000, there is a noticeable dip in the number of abortions that were obtained at age 17 years and 10 or 11 months and a jump in abortions that were obtained at exactly 18 years of age (18 years and 0 months). The difference in the number of abortions between minors 17 years and 11 months and teens 18 years and 0 months at the time of abortion is 173 in conception year 2000. In contrast, the number of abortions conceived in 1999 steadily increases with age. There were 264 abortions to minors who were 17 years and 11 months at the time of abortion and 305 abortions to teens who were exactly 18 years old, a change of only 41 abortions compared with 173 in 2000. The delay does not pose a problem, if exposure is measured at the time of conception, as shown in Figure 3. There is no break in the series at age 18 years and 0 months in 2000. The number of abortions among 17 year-olds increases gradually and converges to the 1999 level as age approaches 18.

Estimates of the law's impact on the birth rate also differ depending on whether exposure is measured from the point of conception or at the time of birth. The birth rate of 17-year olds fell by 4.85 per thousand between 1999 and 2000 whereas the birth rate of 18-year olds was practically unchanged. Thus the birth rate of 17-year-olds declined by 4.66 birth per thousand ($p<0.1$) more than the birth rate of 18-year-olds if exposure to the law is based on age at the time of birth (Table 5, Panel A, columns 5). In relative

terms this is a decline of about 7 percent ($p<0.01$). However, when exposure is measured at conception, the changes are reversed. The birth rate of 17-year olds is nearly unchanged whereas the birth rate of 18-year olds declined by 2.98 births per thousand (Table 5, Panel B, columns 3). Thus, in relative terms the birth rate of 17-year old rose by 2 percent more than that of 18-year olds, although not statistically insignificant ($p=0.15$). The difference-in-differences in the rates, however gives a statistically significant rise of 2.6 births per thousand ($p<0.1$).

In Table 6 we complete the comparisons by analyzing changes in pregnancy rates. Again, associations between the law and changes in pregnancy rates vary dramatically by how exposure to the law is determined. If it is based on age at the time of the birth or abortion as has been done in previous work, Texas's parental notification law is associated with an 10 percent ($p<0.01$) decline in the pregnancy rate of 17-year-olds (Table 6, Panel A, column 6). However, we uncover no change in the pregnancy rate of 17-year-olds when exposure to the law is determined based on age at the time of conception (Table 6, Panel B, column 6).

4.3 Evaluation of the law's impact using narrowly defined comparison groups

Thus far, we discussed how limitations in earlier work produced biased estimates of the effect of parental involvement laws on the abortion, birth and pregnancy rate of minors. We also showed that part of the bias could be explained by minors who delay their abortion until they are 18 years of age, a behavioral response that has been overlooked in previous studies. Although these estimates improve on previous work, they may still suffer from confounding from differing trends in the outcomes between 17 and 18 year-olds over time. In this section we improve the internal validity of our

research design by narrowing the age difference between minors exposed to the law and the comparison group. By limiting the analysis to older 17 year-olds we minimize the bias that stems from large differences in the reproductive behavior between minors and older teens. While this makes it difficult to generalize our results to all minors, 17 year-olds are an important group to study. They are less likely to involve their parents in their decision regarding abortion and reproductive health services than are younger minors (Henshaw and Kost 1992; Jones et al.2005). To the extent that parental involvement among minors decreases as age increases, older 17-year-olds are the most likely to be affected by the law given that they have the most pregnancies and the least communication with their parents regarding reproductive health services.

To demonstrate the importance of a close comparison group, in Table 7a we show changes in the observed characteristics available to us from the abortion and birth certificates as teens age. The differences are striking. The proportion of pregnant teens that are married rises gradually with age, as does the proportion of pregnant teens with at least one previous live birth or with at least one previous abortion. For example, about 15.8 percent of 15-year-olds are married compared to 37.3 percent of 19 year-olds; only 8.1 percent of 15-year-olds had a previous birth compared to 40.6 percent of 19-year-olds; and 4.2 percent of 15-year-olds had at least one previous abortion compared to 16.1 percent of 19 year-olds. Even when the comparison is between 17 and 18 year-olds, there remains a difference of 6.2 percentage points in the proportion of married, 8.4 percentage points in the proportion with at least one previous birth and 3.3 percentage points in the proportion with one or more previous abortion.

The racial composition of pregnant teens also changes with age. The proportion that are white non-Hispanic rises with age, while the proportion that are Hispanic falls. For example, about 22 percent of 15-year-olds are white non-Hispanics, compared to 33 percent of 19 year-olds; and about and 62 percent of 15-year-olds are Hispanic compared to 50 percent of 19-year-olds. The proportion of pregnant teens that are black non-Hispanic does not seem to vary much with age.

In table 7b we show how the characteristics change by age in quarters among 17 and 18-year-olds. The same pattern as we observed in Table 7a holds in Table 7b. The proportion of teens that are married, had a previous birth or an abortion rises with age, however, the difference in the proportions is substantially smaller as we narrow the age difference between our comparison groups. For example, the proportion of pregnant teens who are married changes 11.2 percentage points between the ages of 17 years and 1-3 months and 18 years and 9-11 months (from 22.1 percent to 33.3 percent), compared to a change of only 1.6 percentage points between the ages of 17 years and 9-11 months and 18 years and 1-3 months (from 27.0 percent to 28.6 percent). The same applies to previous live births and abortions. There is a 15.5 percentage point difference in the proportion with at least one previous birth between the ages 17 years and 1-3 months and 18 years and 9-11 months, and only a 1.5 percentage point difference between the ages of 17 years and 9-11 months and 18 years and 1-3 months. Similarly, the racial composition of pregnant teens is more comparable the closer the age.

Given the large differences in observed characteristics between minors and older teens, it is likely that they differ in unobserved or hard to measure characteristics as well, which can potentially bias the estimates of the law if the behavior of older teens is used

as the counterfactual. As is evident from Table 7a, limiting the analysis to 17 and 18 year-olds may not be sufficient if our goal is to minimize unobserved differences between the two groups. Therefore in this section we perform the analysis on a limited group of 17 year-olds and stratify it by age in months.

According to a 2004 national survey of women having an abortion, for teens ages 17 years or younger it takes on average about 54 days from the time of their last menstrual period until they recognize that they are pregnant, and another 22 days until the abortion is actually performed (Finer et al. 2006). The length of this time interval between conception and abortion suggests that teens who are 1 to 2 months away from their 18th birthday are in effect unexposed to the law, since they are most likely 18 by the time they schedule the abortion. In fact, our data from Texas indicates that even before the law went into effect, during the period of 1998-1999, 96 percent of teens ages 17 years and 10-11 months at the time of conception were 18 by the time of abortion.[11] Naturally, this proportion is lower for those further away from being 18 at the time of conception, such as those ages 17 years 10 months, and increases to 100 percent among teens ages 17 years and 11 months at the time of conception. However, even teens ages 17 years and 10 months who in absence of the law would have terminated at less than 8 weeks gestation, and thus would still be 17 at the time of abortion, could postpone the abortion by a couple of days or a week until age 18 without increasing the risk of complications or the monetary price of the abortion.

In light of the above arguments, we use the outcomes of teens ages 17 years and 10-11 months as the counterfactual, since this is the youngest group of teens who are unaffected by the law, and thus the closest in age to our treatment group. Using 17 year-

[11] Evidence of this is presented in Figure 2a of Chapter II.

olds as controls is preferable to 18 year-olds, even if we were to limit the controls to those ages 18 years and 1-2 months, since turning 18 may be associated with unobserved changes in behavior that could introduce a bias into the estimates. To limit the age difference, we define the treatment group as those ages 17 years and 6-9 months at the time of conception. We allow the effect of the law to vary for ages 17 years and 6-7 months and 17 years and 8-9 months, as the older age group is closer to being 18 and therefore the law may have a different impact on their behavior. The older group may only be partially affected, since it is feasible for some of them to delay the abortion until 18 years of age if they are willing to incur the greater costs and risks of a second-trimester abortion.

Before we can report the relative rate ratios associated with the law and assume a causal relationship, we need to evaluate changes in the age profile of abortions, births and pregnancies at the threshold of 17 years and 10 months. If any of these outcomes changed in response to the law, there should be a rise or fall in the after-law age profile compared to the pre-law age profile in the outcomes at exactly age 17 years and 10 months. Changes in the age profile above or below this threshold would indicate that either we are not correct in assuming that the youngest group unexposed to the law are those ages 17 years and 10 months at conception, or that the rise/fall in the outcome cannot be attributed to the law.

Figures 4, 5 and 6 have the plots of abortions, birth and pregnancies, respectively by age in months for 17 and 18 year-olds, separately for the before (1998-1999) and after-law (2000-2003) periods. In Figure 4 we see a visible decline in the number of abortions at age 17 years and 10 months in the after-law period compared to the before-

law period, and the number of abortions among all 17 years-olds in 2000-2003 is below the 1998-1999 level. This confirms that teens ages 17 years and 10 months or older were unaffected by the law, and therefore constitute a valid comparison. In Figures 5 and 6, the changes in births and pregnancies are not so apparent. We see no visible sign of a change in either case. However, this does not mean that births and pregnancies did not change in response to the law, rather the change may be too small to be noticeable in the age profile. The number of abortions is only about one-fifth of the number of births and about one-sixth of the number of pregnancies, therefore any change in abortions would correspond to a small fraction of that change in births and pregnancies. However, it is reassuring that we see no discontinuities in the age profiles of births and pregnancies below or above the threshold of 17 years and 10 months.

In Table 8 we show the abortion, birth and pregnancy rates as well as the rate ratios and relative rate ratios for teens ages 17 years and 6-11 months at the time of conception. As explained in Section 4.1, the effect of the law is given by the relative rate ratios, where the rate ratio of teens ages 17 years and 10-11 months serves as the denominator. A limitation of this analysis is that population estimates are not available by age in months, therefore we use one-sixth of the population for 17-year-olds as the population denominator for the abortion, birth and pregnancy rates for all three age groups. Although the population numbers do not play a role in the relative rate ratios, since they cancel out, they are still important for the estimation of the standard error.

As was suggested by Figure 4, the results in Table 8 confirm that the abortion rate of both treatment groups declined after the law, where the decline was greater among the younger age group. There was a 29 percent decline in the abortion rate of teens ages 17

years and 6-7 months, as suggested by the rate ratio, compared to a 22 percent decline among teens ages 17 year and 8-9 months, and a 12 percent decline among teens ages 17 years and 10-11 months. Thus, the reduction in the abortion rate associated with the law, was 20 percent ($p<0.01$) for teens ages 17 year and 6-7 months and 12 percent ($p<0.05$) for teens ages 17 years and 8-9 months.

While all three age groups experienced a slight decline in their birth rate between 1998-1999 and 2000-2003, the decline in the birth rate of both treatment groups was smaller compared to the control group, suggesting a positive association with the law. The birth rate of teens ages 17 years and 6-7 months increased by 4 percent in response to the law, while the birth rate of teens ages 17 years and 8-9 months increased by only 1 percent. However, none of the results are statistically significant at conventional levels. The results suggest no association between the law and the pregnancy rate of either treatment group. The relative rate ratio for teens ages 17 year and 6-7 months is 1.00, while for teens ages 17 years and 8-9 months there is a statistically insignificant decline of 1 percent.

Table 9 shows the results of the relative rate ratios for each year during the period 2000-2003 compared to 1998-1999 for our two treatment groups. For teens ages 17 years and 6-7 months, in three out of the four years the reduction in the abortion rate is statistically significant and ranges between a decline of 19-24 percent. For this group, two of the three years show a significant increase in the birth rate of about 6-7 percent, and no significant change in the pregnancy rate in any of the four years. For the older teens, those ages 17 years and 8-9 months, the results are much weaker. They only

experienced a statistically significant reduction in their abortion rate in one of the four years, and no significant change in their birth rate or pregnancy rate in any of the years.

4.3.1 Alternative specification: evaluating the law's impact on the conditional probability of birth

Next, we evaluate the law's impact on the probability of birth conditional on pregnancy. The advantage of studying pregnancy resolution as an outcome over rates is that it allows us to utilize our micro-level data and employ a richer specification using all available information from teens' abortion and birth certificates. We can conduct multivariate analyses at the individual level and control for characteristics such as age, race, marital status, parity, previous abortions as well as region of residence. Our finding of no change in the pregnancy rate associated with the law for either of our treatment group enables us to evaluate the law's impact on the conditional probability of birth, because it gives a straightforward interpretation to our results. Only if the likelihood of becoming pregnant does not change as a result of a parental involvement law can we conclude that an increase in the probability of birth is the result of a decline in abortions and a rise in births. In such a case the additional births are most likely unwanted, since they would have been aborted in absence of the law. Such an outcome would indicate that minors are not aware of the legal environment surrounding abortion, and only find out about the parental notification requirement after becoming pregnant. On the other hand, if an increase in the probability of giving birth were the result of a decline in pregnancies due to a reduction in abortions and no change in births, it would have very different implications. In such a case, the increase in the probability of birth would not mean a rise in unintended births, but rather a reduction in abortions due to a decline in

unintended pregnancies. This would indicate that minors adjust to the law by either reducing sexual activity or increasing the use of contraception. Given the very different implications of a rise in the probability of birth, studying this outcome is only meaningful once we established that pregnancies did not change as a result of the law.

We begin the analysis of pregnancy resolution by plotting the percent of pregnancies that resulted in births by age in months at the time of conception for 17 and 18 year-olds, separately for the before (1998-1999) and the after-law period (2000-2003) (Figure 7). The series in Figure 7 provide a strong indication that the probability of birth among 17 year-olds was increased by Texas's parental notification law. The difference in the percent of pregnancies that ended in a live birth between 1998-1999 and 2000-2003 is greater for 17 year-olds than it is for 18 year-olds. In addition, this difference seems to narrow as age approaches 18, which supports a causal interpretation. At age 17 years and 10 months, the birth probability converges to the level of 18 year-olds. This is consistent with our earlier evidence indicating that this group of minors is not affected by the law. Since the law only applies to unemancipated minors, as an additional robustness check we repeated Figure 7 by teens' marital status. Figures 8a and 8b have the percent of pregnancies that resulted in birth for married and single teens, respectively. These figures suggest that the rise in the probability of birth after Texas's law evident from Figure 7 only occurred among single minors. This finding is further supportive of a causal relationship between the law and the conditional probability of birth. [12]

[12] In Texas all minors less than 18 years of age need their parents' consent in order to get married, therefore marriage is an unlikely solution for minors who want to get avoid the parental notification requirement. It is possible that parental involvement laws affect minors' marriage rate if upon learning of the pregnancy parents force the minors to marry. Our data from Texas, however, show no evidence of an increase in the proportion of minors or teens obtaining an abortion or giving birth that are married.

We now continue our analysis of birth probabilities in more detail. Our specific approach is a difference-in-differences analysis, where we compare the change in the probability of birth before and after the introduction of the law among those exposed to the law to the change among those who are unexposed. The basic regression is as follows:

$$(1) \quad P_{it} = \alpha_0 + \beta E_i + \alpha Y_t + \gamma (E_i * Y_t) + \mathbf{X}\boldsymbol{\pi} + e_{it}$$

where P_{it} is the probability that teen i who conceived in year t gives birth; Y_t is a dichotomous indicator of the post-law period (2000-2003), where the omitted years are 1998-1999; E_i is a dichotomous indicator for minors who were exposed to the law during pregnancy, and are defined the same way as in our analysis of rates; E_i*Y_t is the interaction of year and age, where we allow the effect of the law to differ for each year after the law; **X** is a vector of characteristics that includes indicators for race/ethnicity, previous live births, previous induced abortions, marital status at the time of the birth or abortion and health service region of residence.[13] We use a linear probability model which simplifies interpretation as well as the estimation of the standard errors given the extensive set of interactions that we include.

Table 10 shows the results from equation (1) for our sample of teens between the ages 17 years and 6-7 months and 17 years and 8-9 months at the time of conception. In the top panel (Panel A) we allow the effect of the law to differ for every year between 2000-2003, and in the bottom panel (Panel B) we show the average effect of the law for the entire period 2000-2003. For minors ages 17 years and 6-7 months the law is associated with a statistically significant increase in the probability of birth in all four

[13] Texas is divided into 11 health service regions. For a map go to: http://www.dshs.state.tx.us/regions/stregctymap.pdf.

years following Texas's law. The estimates range from an increase of 1.7 percentage points in 2000 ($p<0.01$) to an increase of 4.1 percentage points in 2002 ($p<0.01$). The average effect for all years combined among this group is an increase of 3.2 percentage points ($p<0.01$). The law's impact on the probability of birth among minors of ages 17 years and 8-9 months at the time of conception is weaker. For them, the estimates range between a statistically insignificant rise of 0.8 percentage points in 2001 and a statistically significant increase of 2 percentage points ($p<0.05$) in 2002. The average effect of the law during 2000-2003 for this group is an increase of 1.5 percentage points ($p<0.01$).

4.4 Evaluating the differential impact of the law by teens' race

A 1990 survey of minors having an abortion in states without a parental involvement law indicates that parents of black minors were more likely to know about the pregnancy compared to the parents of white minors (Henshaw and Kost, 1992). If black minors are more likely to talk to their parents about their pregnancy or about their intention to seek an abortion, parental involvement laws should have a smaller impact on their reproductive behavior. In this section we evaluate whether Texas's parental notification requirement had a differential impact on minors of different racial backgrounds. Tables 11, 12 and 13 have the results of the relative rate ratios for abortions, births and pregnancies for white non-Hispanic, Hispanic, and black non-Hispanic teens, respectively. We calculate the relative rate ratios by race for the same age-groups as we did in the analyses of all races. We show the relative rate ratios for every post-law year, as well as for the whole post-law period combined (2000-2003).

The magnitude and direction of the relative rate ratios for white non-Hispanics and Hispanics in Tables 11 and 12, respectively, suggest a very similar story as was given in the case of all teens. However, due to the smaller sample size the relative rate ratios may be less precisely estimated. The estimates for 2000-2003 suggest a decline of 17 percent ($p<0.05$) in the abortion rate of teens ages 17 years and 6-7 months for white non-Hispanics and 14 percent in the case of Hispanics, however the latter is not significant at conventional levels. The effect of the law on the abortion rate of the older age group, teens ages 17 years and 8-9 months is more modest and statistically insignificant for both races. We found no consistent evidence of a statistically significant change in the birth rate and pregnancy rate of white non-Hispanic and Hispanic teens for either of the age groups.

The results for black non–Hispanic teens, displayed in Table 13, are unexpected. Based on the survey of minors seeking abortion mentioned above, we expected to find that the law had a smaller impact on the abortion rate of black non-Hispanic teens, and therefore a smaller impact on their birth rate and pregnancy rate. Instead, we found a greater decline in their abortion rate compared to white non-Hispanics, and a stronger case for a rise in their birth rate. As measured by the relative rate ratio for the entire after-law period 2000-2003, we found a reduction of 31 percent ($p<0.01$) in the abortion rate of teens ages 17 years and 6-7 months, and 20 percent ($p<0.1$) reduction for the older age group. We also found a statistically significant rise of 16 percent ($p<0.05$) in the birth rate of teens ages 17 years and 8-9 months, and while there is no significant change in their pregnancy rate in 2000-2003, the results for some of the years show a statistically significant rise of implausible magnitudes in the pregnancy rate of this group.

Examination of the plot of the number of abortions, birth and pregnancies by race in Figures 9-17 reveal that some of our results stratified by race are driven by noise in the data. This is especially true for black non-Hispanics, since they have the smallest sample size. Only 15 percent of pregnant 17 and 18 year-olds in Texas are black non-Hispanic, compared to 30 percent white non-Hispanic and 52 percent Hispanic (see Table 3). While the series are fairly stable for whites and Hispanics (Figures 9-14), the plots of abortions, births and pregnancies for blacks (Figures 15-17) are considerably more noisy, especially in the pre-law period, for which we only have two years of data. Consequently, we are not confident that our results for black non-Hispanics are attributable to Texas's law. We are more confident about the results for white non-Hispanics and Hispanics, however, racial differences should be interpreted with caution due to smaller sample sizes and reduced power.

5. Conclusions

The policy implications of our findings are significant. We showed that results from previous studies as to the likely impact of parental involvement laws are biased due to methodological limitations and therefore should be interpreted with caution. We demonstrated the importance of identifying those affected and unaffected by the law during pregnancy based on age at the time of conception instead of age at the time of abortion or birth. We found that Texas's parental notification law is associated with a fall in all, the abortion, birth and pregnancy rates of 17-year-olds when exposure is inappropriately determined by age at the time of pregnancy resolution. In contrast, we found a smaller decline in the abortion rate and no change in the pregnancy rate when

exposure to the law is determined by age at conception. In order to produce more reliable estimates, we limited our sample to minors who are only a few months apart in age from the unaffected control group and evaluated the law's impact on the abortion, birth and pregnancy rates as well as on the probability of birth, using the tight comparison groups. We showed that there was no change in the pregnancy rates associated with the law among minors ages 17 years and 6-9 months at the time of conception, compared to their older and thus unexposed counterparts. At the same time, there was a significant increase in the probability of birth among this group, where the effect was concentrated among single minors. Combined, these results suggest that our sample of minors did not respond to the law by using better contraception or by practicing abstinence, as a result unintended childbearing most likely increased among this group. The disadvantage of our tight comparison group is the inability to generalize our results to all minors. However, 17 year-olds are an important group to study, since they have the highest pregnancy rate among minors, and are less likely to talk to their parents about their pregnancy. Furthermore, we feel that there is a great need and value in an accurate assessment of the effect of the law, even if it only applies to a selected group.

Table 1. Pearson's chi-squared test for the hypothesis that the proportion of observations with missing date of birth is independent of reported age among 17 and 18-year-olds[#]

	Year of abortion:		
	1997	**1998**	**1999**
(1) % missing DOB among 17-year-olds	23.59	10.58	2.95
(2) % missing DOB among 18-year-olds	24.33	10.19	2.64
(3) % known DOB among 17-year-olds	76.41	89.42	97.05
(4) % known DOB among 18-year-olds	75.67	89.81	97.36
(5) % 17-year-olds among missing DOB	38.87	40.00	43.37
(6) % 17-year-olds among known DOB	39.83	38.99	40.58
(7) % 18-year-olds among missing DOB	61.13	60.00	56.63
(8) % 18-year-olds among known DOB	60.17	61.01	59.42
Pearson's chi2	0.447	0.244	0.524
p-value	[0.490]	[0.621]	[0.469]
N	6,689	6,187	6,002

[#]The values in each column come from a two-by-two table of reported age (17 or 18) and reported date of birth (known or missing). Each column represents a separate test for the years 1997, 1998 and 1999, respectively. For example, row *(1)* shows the proportion of observations with reported age of 17 that have missing date of birth; row *(5)* shows the proportion of observations with missing date of birth that have reported age 17. Rows *(1)* and *(3)* add up to 100, as do rows *(2)* and *(4)*, *(5)* and *(7)*, *(6)* and *(8)*.

Table 2. Number of abortions to non-Texas resident teens that were performed in Texas, by year of conception, age at conception and state of residence [a]

	17-year-olds			18-year-olds		
	1999[+]	**2000**	**Dif.**	**1999**[+]	**2000**	**Dif.**
Louisiana	23	19	-4	36	28	-8
New Mexico	33	18	-15	47	46	-1
Oklahoma	25	12	-13	27	26	-1
Mexico	37	12	-25	41	42	1
Other	6	9	3	4	10	6
Total	124	70	-54[*]	155	152	-3

[a] We show only changes among 17- and 18-year-olds since there were no meaningful changes among 15- and 16-year-olds. The number of abortions to non-residents changed from 34 to 42 among 15-year-olds and from 58 to 52 among 16-year-olds between conception years 1999 and 2000. Neither change was statistically significant.

[+]Refers to the period from August 1, 1998 to July 31, 1999.

*$p<0.01$ based on Fisher's exact test of the difference between the totals for 17- and 18-year-olds in 1999 and 2000.

Table 3. Final sample of abortions and births to Texas teens ages 17 and 18 at the time of conception who conceived during the period 1998-2003*

	Abortions	Births	Total
Obs.	39,282	185,887	225,169
Age at conception *(%)*:			
17	37.9	42.8	41.9
18	62.1	57.2	58.1
Race / ethnicity *(%)*:			
White non-Hispanic	40.4	28.8	30.8
Black non-Hispanic	18.1	14.6	15.2
Hispanic	35.4	55.7	52.1
Other	2.9	1.0	1.3
Unknown	3.1	0.0	0.5
Marital status *(%)*:			
Married	4.9	33.5	28.5
Unknown	1.8	0.1	0.4
Previous births *(%)*:			
1+	21.5	28.5	27.3
Unknown	0.5	1.3	1.2
Previous abortions *(%)*:			
1+	18.2	9.2	10.8
Unknown	0.6	2.4	2.1

*1998-2003 refers to the period between August 1, 1997 and July 31, 1999, and between January 1, 2000 and December 31, 2003. Sample includes those observations with known state of residence, date of birth, date of abortion/birth, and gestational age.

Table 4. Abortion rates for 17 and 18-year-olds by age at the time of abortion vs. age at the time of conception, and by year of conception[#]

	Rates		Diff. in Rates	Rate Ratio	Diff.-in-Diff. in Rates	Relative Rate Ratio[§]
	1999[+]	2000				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Panel A – Age at abortion:						
17	17.48	13.06	-4.42	0.75	-3.54 (0.72)***	0.77 (0.04)***
18	27.00	26.12	-0.88	0.97		
Panel B – Age at conception:						
17	18.72	15.30	-3.42	0.82	-1.93 (0.75)***	0.86 (0.03)***
18	28.35	26.86	-1.49	0.95		

[#]In **c**olumns (1) and (2), the rates are defined as the number of abortions per 1000 age specific female population. Column (3) has the difference in the rates between 2000 and 1999. Column (5) shows the difference-in-differences (DD) in the rates. In column (4) the rate ratio is defined as the ratio of abortion rate in 2000 divided by the rate in 1999. In column (6) we divide the rate ratio of 17 year-olds with the rate ratios for 18 year-olds to obtain the relative rate ratio.

[§]The standard errors of the log of the relative rate ratios are in parentheses.

[+]Refers to the period from August 1, 1998 to July 31, 1999.

***significant at 1%; **significant at 5%; *significant at 10%.

Table 5. Birth rates for 17 and 18-year-olds by age at the time of abortion vs. age at the time of conception, and by year of conception [#]

	Rates		Diff. in Rates	Rate Ratio	Diff.-in-Diff. in Rates	Relative Rate Ratio[§]
	1999[+]	2000				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Panel A – Age at birth:						
17	66.66	61.81	-4.85	0.93	-4.66 (1.36)***	0.93 (0.02)***
18	94.07	93.88	-0.19	1.00		
Panel B – Age at conception:						
17	85.96	85.57	-0.39	1.00	2.60 (1.52)*	1.02 (0.02)
18	116.81	113.83	-2.98	0.97		

[#]In **c**olumns (1) and (2), the rates are defined as the number of births per 1000 age specific female population. Column (3) has the difference in the rates between 2000 and 1999. Column (5) shows the difference-in-differences (DD) in the rates. In column (4) the rate ratio is defined as the ratio of birth rate in 2000 divided by the rate in 1999. In column (6) we divide the rate ratio of 17 year-olds with the rate ratios for 18 year-olds to obtain the relative rate ratio.

[§]The standard errors of the log of the relative rate ratios are in parentheses.

[+]Refers to the period from August 1, 1998 to July 31, 1999.

***significant at 1%; **significant at 5%; *significant at 10%.

Table 6. Pregnancy rates for 17 and 18-year-olds by age at the time of abortion vs. age at the time of conception, and by year of conception[#]

	Rates		Diff. in Rates	Rate Ratio	Diff.-in-Diff. in Rates	Relative Rate Ratio[§]
	1999[+]	2000				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Panel A – Age at pregnancy resolution:						
17	84.14	74.87	-9.27	0.89	-8.20 (1.52)***	0.90 (0.02)***
18	121.06	120.00	-1.07	0.99		
Panel B – Age at conception:						
17	104.68	100.87	-3.81	0.96	0.67 (1.66)	0.99 (0.01)
18	145.16	140.68	-4.48	0.97		

[#]In **c**olumns (1) and (2), the rates are defined as the number of pregnancies per 1000 age specific female population. Column (3) has the difference in the rates between 2000 and 1999. Column (5) shows the difference-in-differences (DD) in the rates. In column (4) the rate ratio is defined as the ratio of pregnancy rate in 2000 divided by the rate in 1999. In column (6) we divide the rate ratio of 17 year-olds with the rate ratios for 18 year-olds to obtain the relative rate ratio.

[§]The standard errors of the log of the relative rate ratios are in parentheses.

[+]Refers to the period from August 1, 1998 to July 31, 1999.

[***]significant at 1%; [**]significant at 5%; [*]significant at 10%.

Table 7a. Characteristics of pregnant teens at the time of abortion or birth, by age in years at the time of conception; 1998-2003*

	Age at conception:				
	15	**16**	**17**	**18**	**19**
Marital status:					
Married *(%)*	15.8	19.4	25.0	31.2	37.3
Previous live births:					
1+ previous births *(%)*	8.1	14.8	22.7	31.1	40.6
Previous abortions:					
1+ previous abortions *(%)*	4.2	6.5	9.1	12.4	16.1
Race:					
White non-Hispanic *(%)*	21.5	25.9	29.6	32.0	32.8
Black non-Hispanic *(%)*	16.1	15.4	14.9	15.6	16.0
Hispanic *(%)*	61.5	57.7	54.4	51.0	49.6

*1998-2003 refers to the period between August 1, 1997 and July 31, 1999, and between January 1, 2000 and December 31, 2003.

Table 7b. Characteristics of pregnant teens at the time of abortion or birth, by age in quarters at the time of conception (17 and 18 year-olds only); 1998-2003*

	Age 17 :				Age 18:			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Marital status:								
Married *(%)*	22.1	24.5	25.9	27.0	28.6	30.4	32.1	33.3
Previous live births:								
1+ previous births *(%)*	19.3	20.9	23.7	26.1	27.6	29.7	32.0	34.8
Previous abortions:								
1+ previous abortions *(%)*	7.9	8.7	9.4	10.1	11.0	11.7	13.1	13.8
Race:								
White non-Hispanic *(%)*	28.8	29.2	29.9	30.2	31.2	31.7	32.3	32.7
Black non-Hispanic *(%)*	14.8	14.7	14.8	15.1	15.6	15.4	15.3	15.8
Hispanic *(%)*	55.4	54.9	54.1	53.4	51.8	51.4	50.9	50.0

*1998-2003 refers to the period between August 1, 1997 and July 31, 1999, and between January 1, 2000 and December 31, 2003.

Table 8. Association between Texas's law and the abortion, birth and pregnancy rates of minors ages 17 years and 6-7 months and 17 years and 8-9 months as given by the Relative Rate Ratios

	Rates[§]		Rate Ratio	Relative Rate Ratio (s.e.)[¶]
	1998-1999	2000-2003		
Abortions:				
17y, 6-7m	19.6	13.9	0.71	0.80 (0.05)***
17y, 8-9m	19.9	15.5	0.78	0.88 (0.05)**
17y, 10-11m	22.6	19.9	0.88	
Births:				
17y, 6-7m	87.4	85.4	0.98	1.04 (0.03)
17y, 8-9m	93.5	88.9	0.95	1.01 (0.02)
17y, 10-11m	98.4	92.4	0.94	
Pregnancies:				
17y, 6-7m	107.0	99.3	0.93	1.00 (0.02)
17y, 8-9m	113.4	104.5	0.92	0.99 (0.02)
17y, 10-11m	121.0	112.3	0.93	

[§]Number of abortions, births and pregnancies per 1000 age specific female population.
[¶]Standard errors of the log of relative rate ratios are in parentheses.
The yearly average number of abortions between 1998 and 2003 was 412, 445 and 545 for minors ages 17 years and 6-7 months, 17 years and 8-9 months and 17 years and 10-11 months, respectively. The yearly average number of births for the same age groups was 2255, 2370 and 2473.
We use one-sixth of the population for 17-year-olds as the population denominator for the abortion, birth and pregnancy rates for all three age groups.
*p < 0.1; **p < 0.05; ***p < 0.01.

Table 9. Association between Texas's law and the abortion, birth and pregnancy rate of minors ages 17 years and 6-9 months as given by the Relative Rate Ratios, by year of conception[¶]

	2000	2001	2002	2003
Abortions:				
17y, 6-7m	0.88	0.76 ***	0.76 ***	0.81 ***
	(0.08)	(0.08)	(0.08)	(0.08)
17y, 8-9m	0.88	0.96	0.80 ***	0.90
	(0.08)	(0.08)	(0.08)	(0.08)
Births:				
17y, 6-7m	1.04	1.07 **	1.06 *	0.99
	(0.04)	(0.04)	(0.04)	(0.04)
17y, 8-9m	1.04	1.02	0.98	1.01
	(0.03)	(0.04)	(0.04)	(0.04)
Pregnancies:				
17y, 6-7m	1.01	1.02	1.01	0.96
	(0.03)	(0.03)	(0.03)	(0.03)
17y, 8-9m	1.01	1.01	0.95	0.99
	(0.03)	(0.03)	(0.03)	(0.03)

[¶]Reference category is minors ages 17 years 10-11 months. Standard errors of the log of relative rate ratios are in parentheses. The number of abortions, births and pregnancies vary by age and year. The yearly average number of abortions between 1998 and 2003 was 412, 445 and 545 for minors ages 17 years and 6-7 months, 17 years and 8-9 months and 17 years and 10-11 months, respectively. The yearly average number of births for the same age groups was 2255, 2370 and 2473.
We use one-sixth of the population for 17-year-olds as the population denominator for the abortion, birth and pregnancy rates for all three age groups.
*p < 0.1; **p < 0.05; ***p < 0.01.

Table 10. Change in the probability that a pregnancy resulted in birth among teens ages 17 years and 6-7 and 8-9 months associated with Texas's law

	17 y, 6-7 months	17 y, 8-9 months
Panel A – Estimates by year		
Year: 2000	0.017***	0.017*
	(0.004)	(0.007)
Year: 2001	0.037***	0.008
	(0.008)	(0.009)
Year: 2002	0.041***	0.020**
	(0.002)	(0.007)
Year: 2003	0.032***	0.014**
	(0.004)	(0.004)
N = 51,001		
R^2 = 0.142		
Panel B – Estimates for 00-03		
Year: 2000-2003	0.032***	0.015***
	(0.003)	(0.002)
N = 51,001		
R^2 = 0.142		

[#] Results are from a linear probability model, and are adjusted for teens' race/ethnicity, marital status, parity, previous terminations and region of residence. The omitted age group is those between the ages of 17 years and 10-11 months. The omitted years are 1998-1999. Standard errors clustered by age in months are in parentheses.
*** significant at 1%; ** significant at 5%; * significant at 10%.

Table 11. Association between Texas's law and the abortion, birth and pregnancy rate of white non-Hispanic minors ages 17 years and 6-9 months as given by the Relative Rate Ratios, by year of conception[¶]

	2000	2001	2002	2003	00-03
Abortions:					
17y, 6-7m	0.88	0.81	0.71 ***	0.93	0.83 **
	(0.12)	(0.13)	(0.13)	(0.13)	(0.08)
17y, 8-9m	0.95	1.03	0.71 ***	0.89	0.89
	(0.12)	(0.12)	(0.12)	(0.13)	(0.08)
Births:					
17y, 6-7m	1.07	1.06	1.15 **	0.95	1.06
	(0.07)	(0.07)	(0.07)	(0.07)	(0.05)
17y, 8-9m	1.07	0.98	0.99	1.00	1.01
	(0.06)	(0.07)	(0.07)	(0.07)	(0.05)
Pregnancies:					
17y, 6-7m	1.02	1.00	1.02	0.94	1.00
	(0.06)	(0.06)	(0.06)	(0.06)	(0.04)
17y, 8-9m	1.04	0.99	0.91	0.98	0.98
	(0.06)	(0.06)	(0.06)	(0.06)	(0.04)

[¶] Reference category is white non-Hispanic minors ages 17 years 10-11 months.
Standard errors of the log of relative rate ratios are in parentheses. Standard errors of the log of relative rate ratios are in parentheses. The number of abortions, births and pregnancies vary by age and year. The yearly average number of abortions between 1998 and 2003 was 178, 190, and 215 for white non-Hispanic minors ages 17 years and 6-7 months, 17 years and 8-9 months and 17 years and 10-11 months, respectively. The yearly average number of births for the same age groups was 615, 657, and 686.
We use one-sixth of the race-specific population for 17-year-olds as the population denominator for the abortion, birth and pregnancy rates for all three age groups.
*p < 0.1; **p < 0.05; ***p < 0.01.

Table 12. Association between Texas's law and the abortion, birth and pregnancy rate of Hispanic minors ages 17 years and 6-9 months as given by the Relative Rate Ratios, by year of conception[¶]

	2000	2001	2002	2003	00-03
Abortions:					
17y, 6-7m	1.03	0.77 *	0.91	0.76 **	0.86
	(0.13)	(0.14)	(0.14)	(0.14)	(0.10)
17y, 8-9m	0.99	0.96	0.99	0.96	0.97
	(0.14)	(0.13)	(0.13)	(0.13)	(0.09)
Births:					
17y, 6-7m	1.04	1.05	1.06	0.97	1.03
	(0.05)	(0.05)	(0.05)	(0.05)	(0.03)
17y, 8-9m	1.03	0.99	0.96	0.97	0.99
	(0.05)	(0.05)	(0.05)	(0.05)	(0.03)
Pregnancies:					
17y, 6-7m	1.04	1.02	1.04	0.95	1.01
	(0.04)	(0.05)	(0.04)	(0.04)	(0.03)
17y, 8-9m	1.03	0.99	0.97	0.97	0.99
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)

[¶] Reference category is Hispanic minors ages 17 years 10-11 months. Standard errors of the log of relative rate ratios are in parentheses. The number of abortions, births and pregnancies vary by age and year. The yearly average number of abortions between 1998 and 2003 was 136, 150 and 195 for Hispanic minors ages 17 years and 6-7 months, 17 years and 8-9 months and 17 years and 10-11 months, respectively. The yearly average number of births for the same age groups was 1308, 1350 and 1408.
We use one-sixth of the race-specific population for 17-year-olds as the population denominator for the abortion, birth and pregnancy rates for all three age groups.
*p < 0.1; **p < 0.05; ***p < 0.01.

Table 13. Association between Texas's law and the abortion, birth and pregnancy rate of black non-Hispanic minors ages 17 years and 6-9 months as given by the Relative Rate Ratios, by year of conception[¶]

	2000	2001	2002	2003	00-03
Abortions:					
17y, 6-7m	0.75	0.67 **	0.70 **	0.62 **	0.69 ***
	(0.18)	(0.20)	(0.18)	(0.19)	(0.13)
17y, 8-9m	0.63 **	0.97	0.82	0.85	0.80 *
	(0.19)	(0.19)	(0.18)	(0.18)	(0.13)
Births:					
17y, 6-7m	0.96	1.21 **	0.96	1.13	1.06
	(0.09)	(0.10)	(0.10)	(0.10)	(0.07)
17y, 8-9m	1.06	1.27 **	1.08	1.28 ***	1.16 **
	(0.09)	(0.09)	(0.09)	(0.10)	(0.06)
Pregnancies:					
17y, 6-7m	0.91	1.09	0.90	0.99	0.97
	(0.08)	(0.09)	(0.08)	(0.09)	(0.06)
17y, 8-9m	0.96	1.20 **	1.02	1.17 *	1.08
	(0.08)	(0.08)	(0.08)	(0.08)	(0.06)

[¶] Reference category is black non-Hispanic minors ages 17 years 10-11 months. Standard errors of the log of relative rate ratios are in parentheses. The number of abortions, births and pregnancies vary by age and year. The yearly average number of abortions between 1998 and 2003 was 76, 77 and 102 for black non-Hispanic minors ages 17 years and 6-7 months, 17 years and 8-9 months and 17 years and 10-11 months, respectively. The yearly average number of births for the same age groups was 313, 339 and 356.
We use one-sixth of the race-specific population for 17-year-olds as the population denominator for the abortion, birth and pregnancy rates for all three age groups.
*p < 0.1; **p < 0.05; ***p < 0.01.

Figure 1. Total number of abortions performed in Texas by year and source

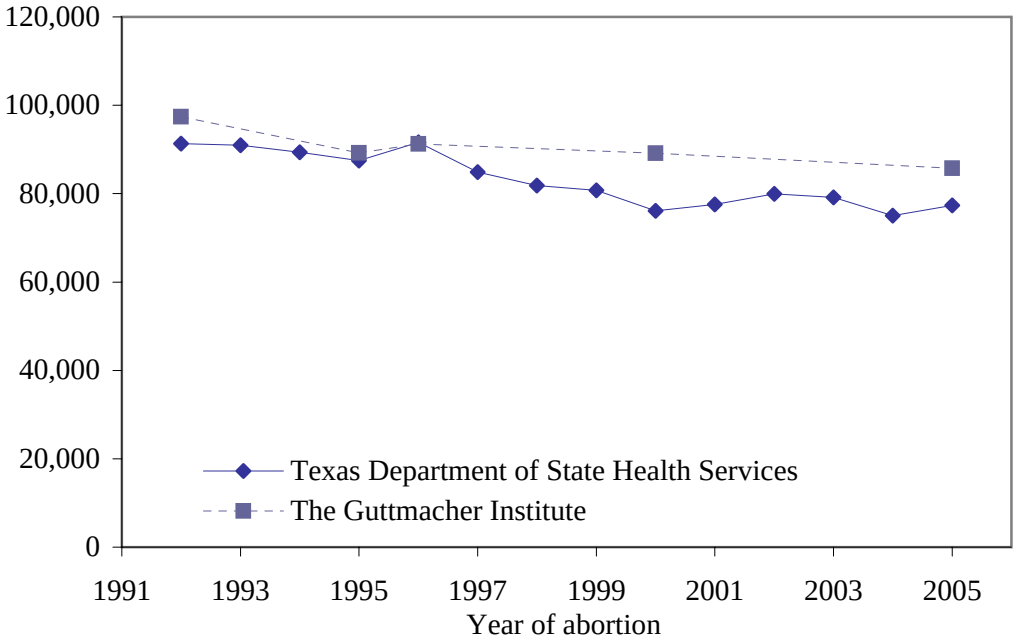


Figure 2. Number of abortions to 17 and 18 year-olds by age in months at the time of abortion and year of conception; Texas residents

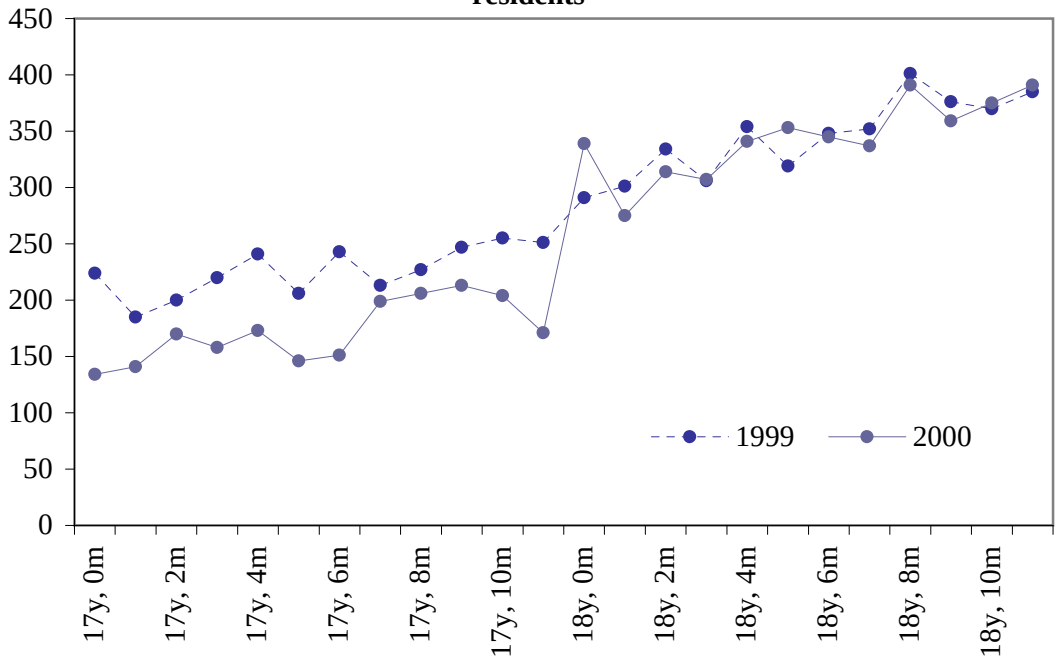


Figure 3. Number of abortions to 17 and 18 year-olds by age in months at the time of conception and year of conception; Texas residents

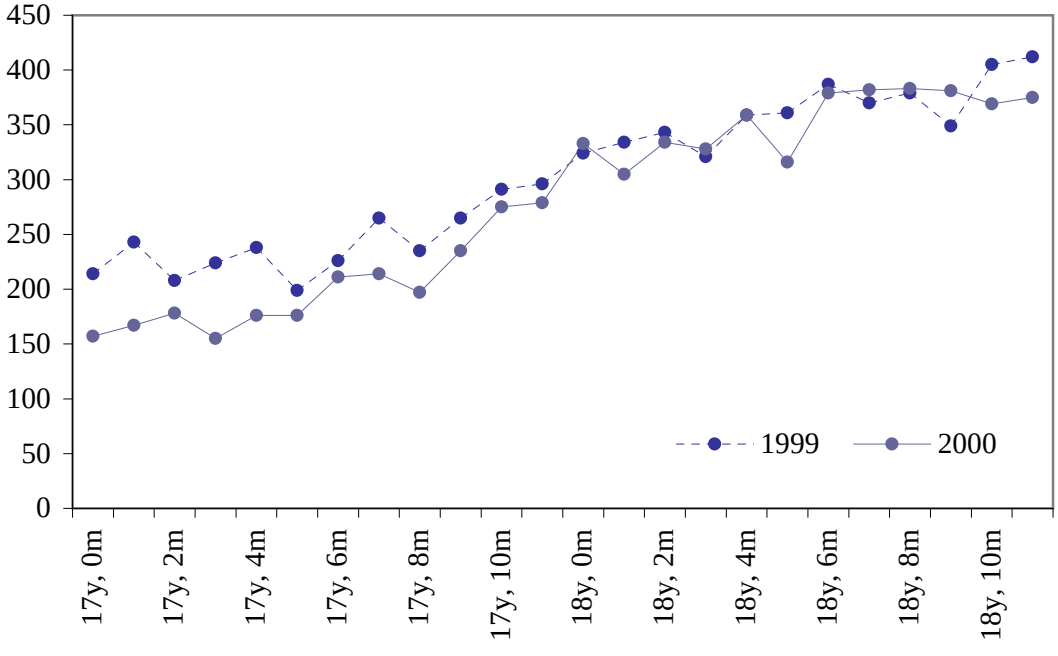


Figure 4. Average yearly number of abortions to Texas teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception

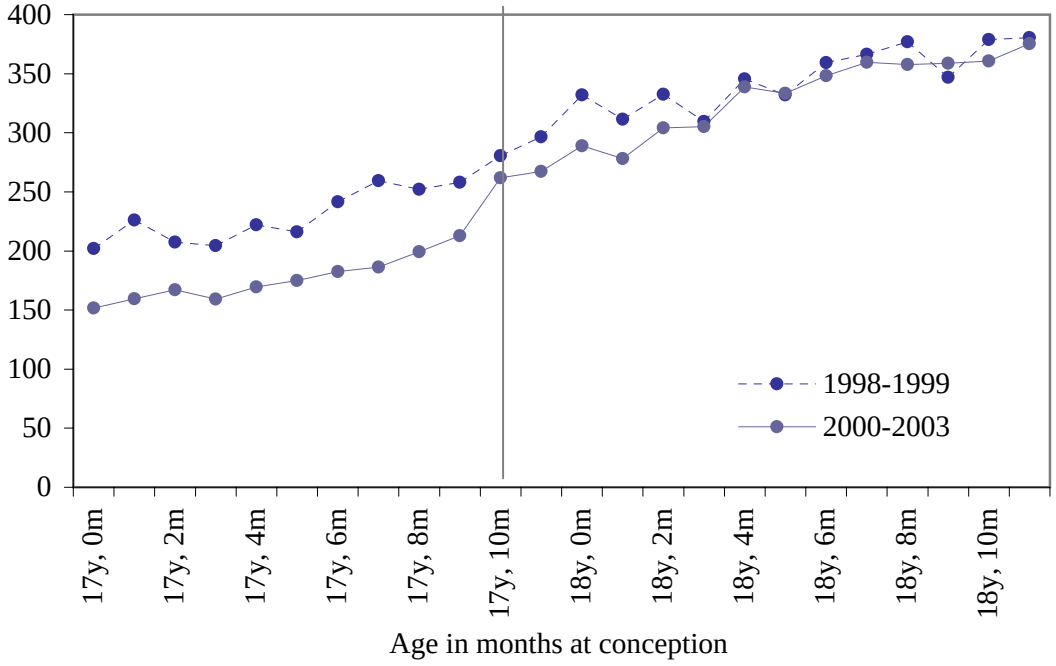


Figure 5. Average yearly number of births to Texas teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception

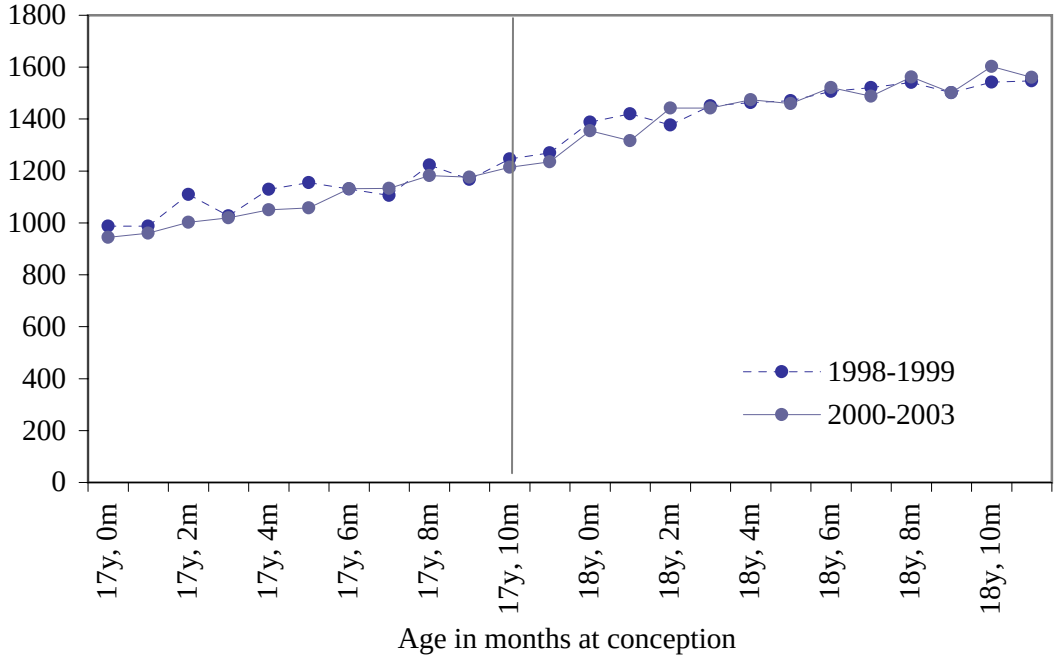


Figure 6. Average yearly number of pregnancies to Texas teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception

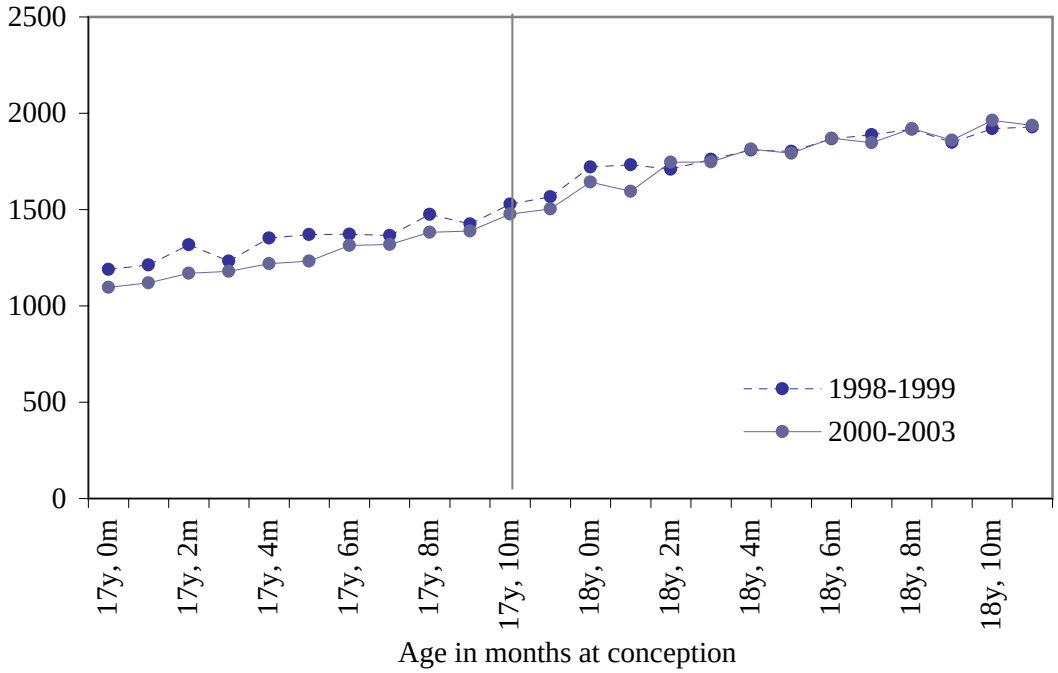


Figure 7. Probability that a pregnancy resulted in birth among 17 and 18 year-olds, by age in months at the time of conception and year of conception; Texas residents

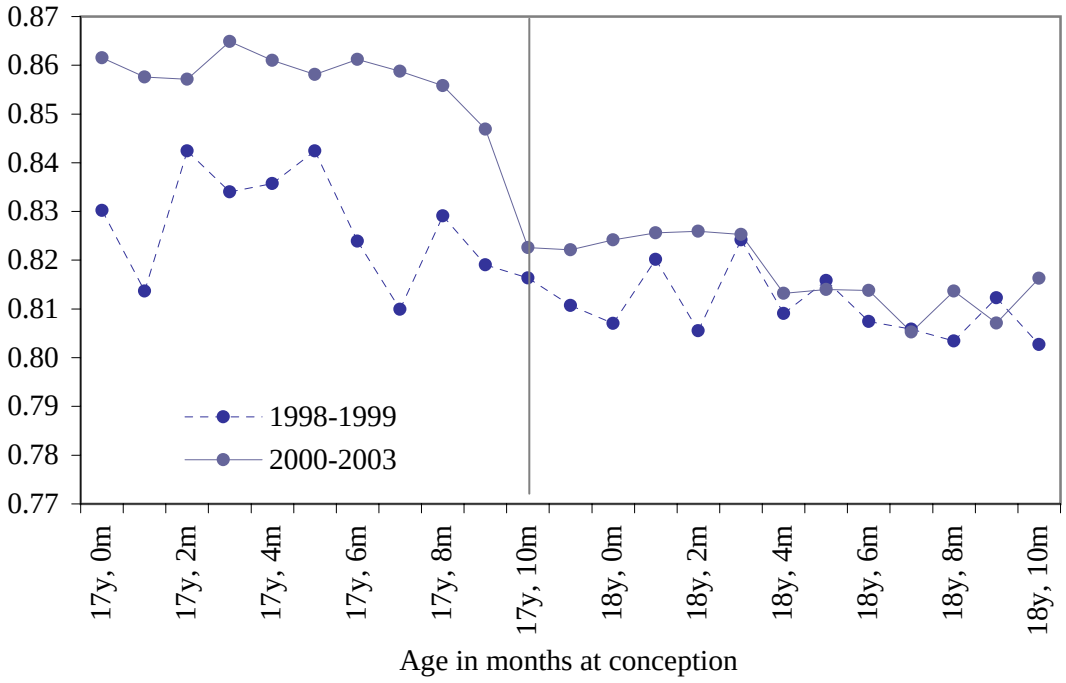


Figure 8a. Probability that a pregnancy resulted in a birth among single 17 and 18 year-olds, by age in months at the time of conception and year of conception; Texas residents

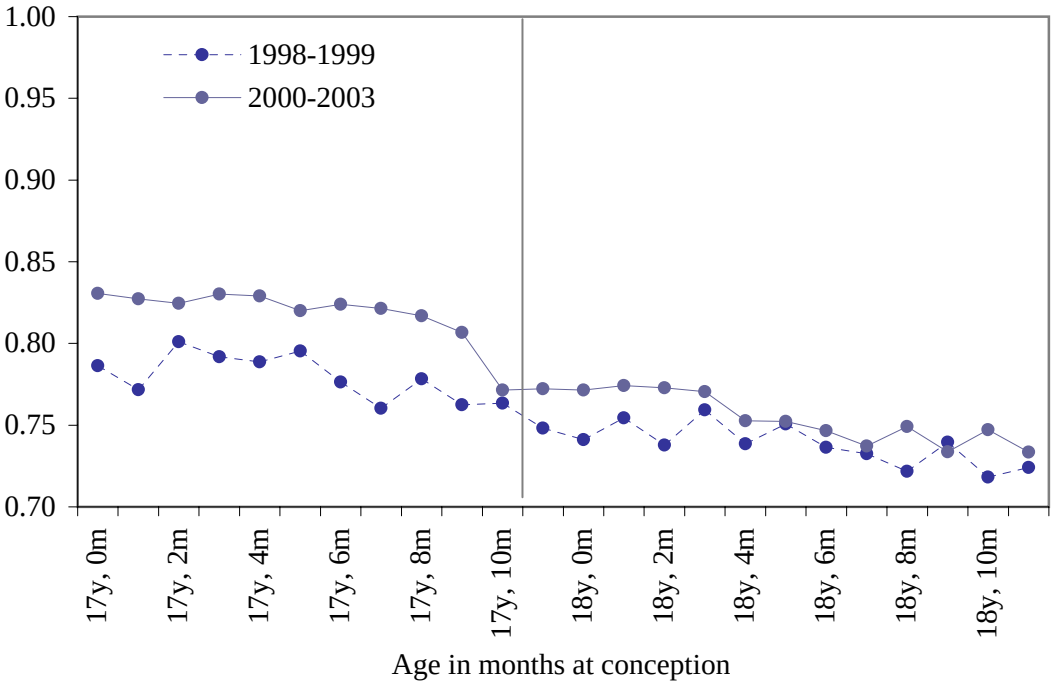


Figure 8b. Probability that a pregnancy resulted in a birth among married 17 and 18 year-olds, by age in months at the time of conception and year of conception; Texas residents

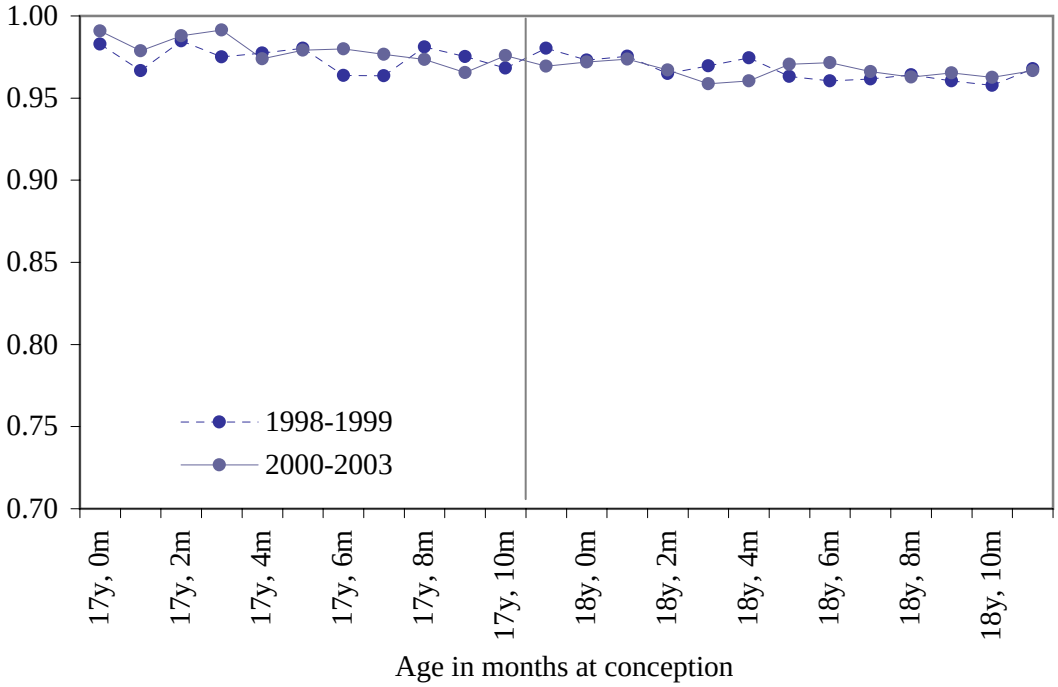


Figure 9. Average yearly number of abortions to white non-Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

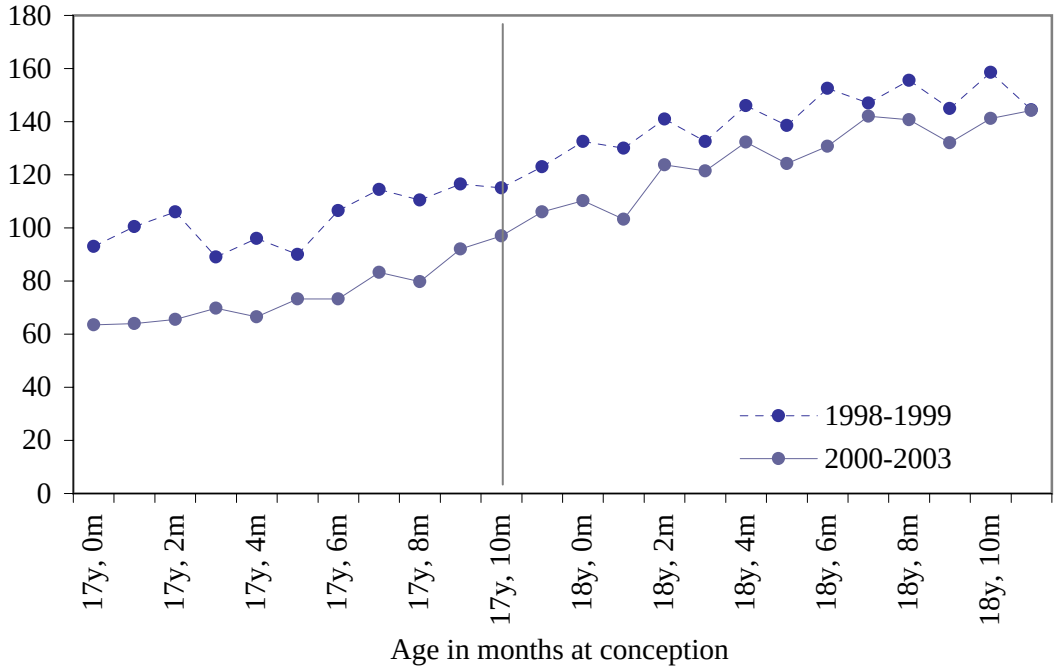


Figure 10. Average yearly number of births to white non-Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

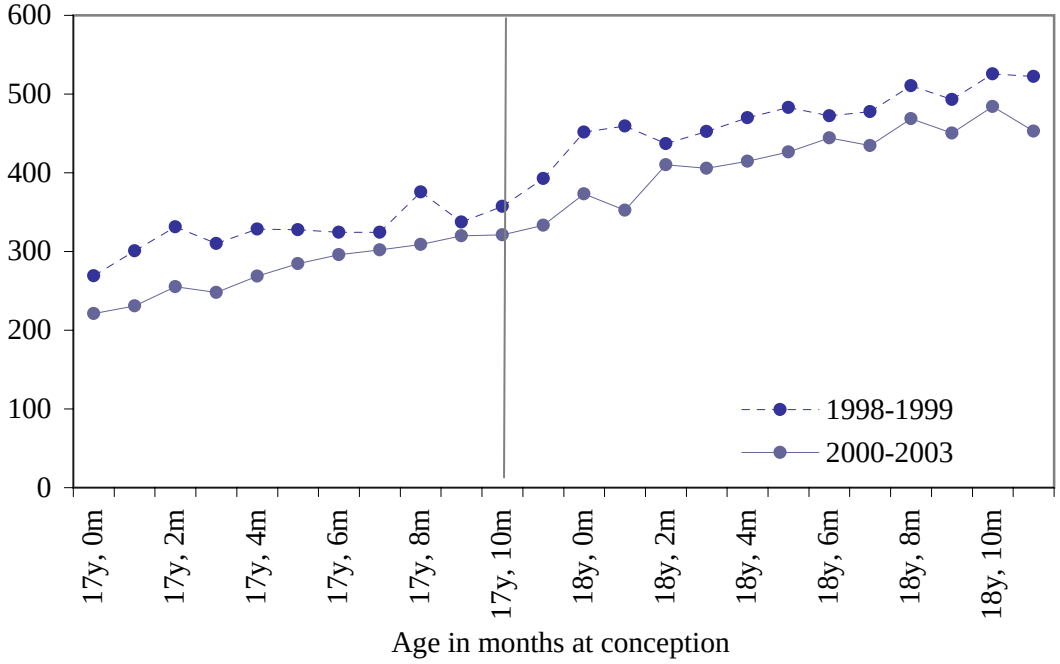


Figure 11. Average yearly number of pregnancies to white non-Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

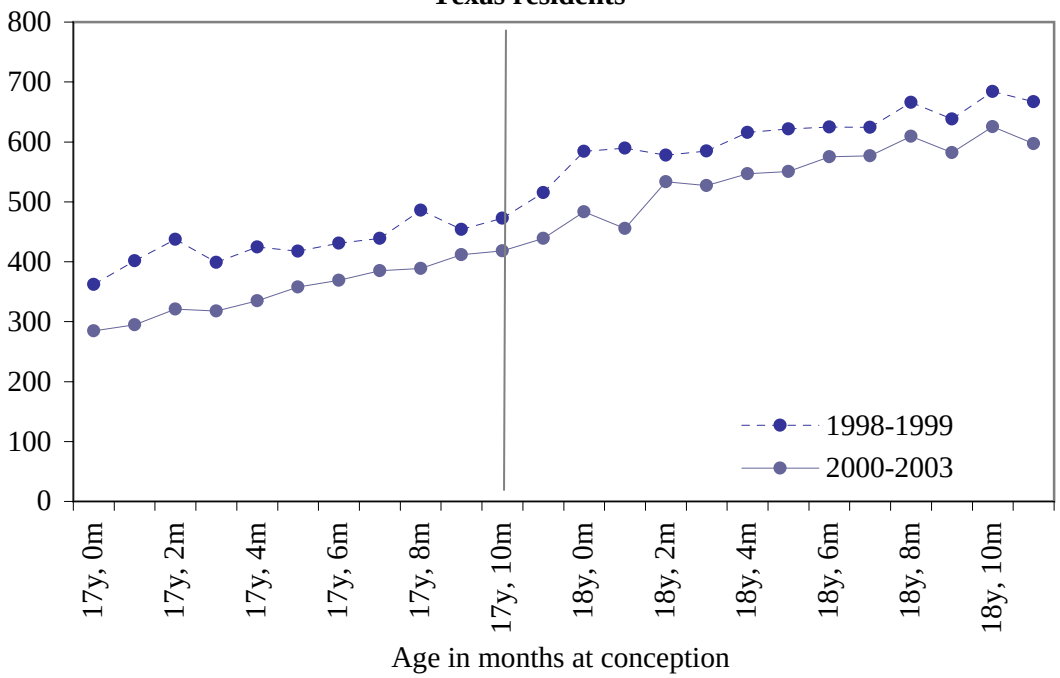


Figure 12. Average yearly number of abortions to Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

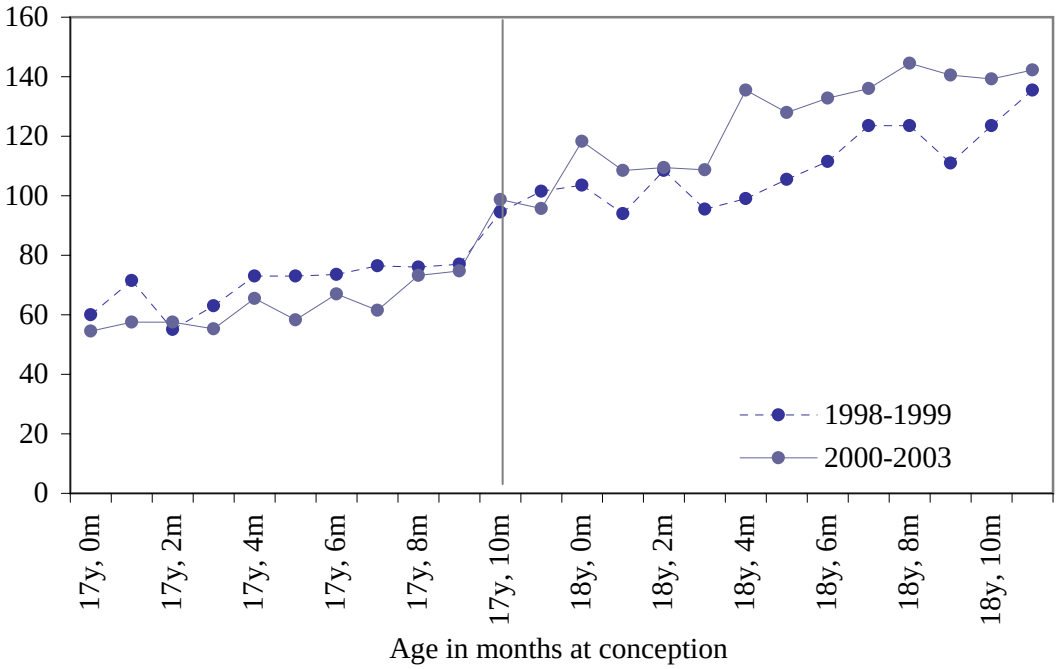


Figure 13. Average yearly number of births to Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

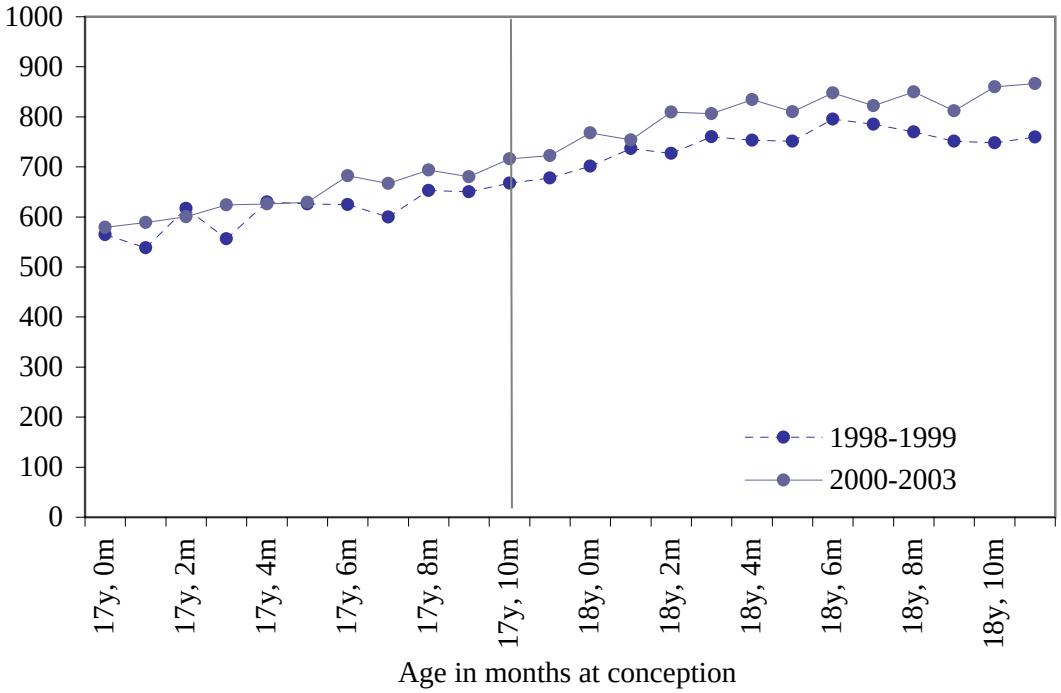


Figure 14. Average yearly number of pregnancies to Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

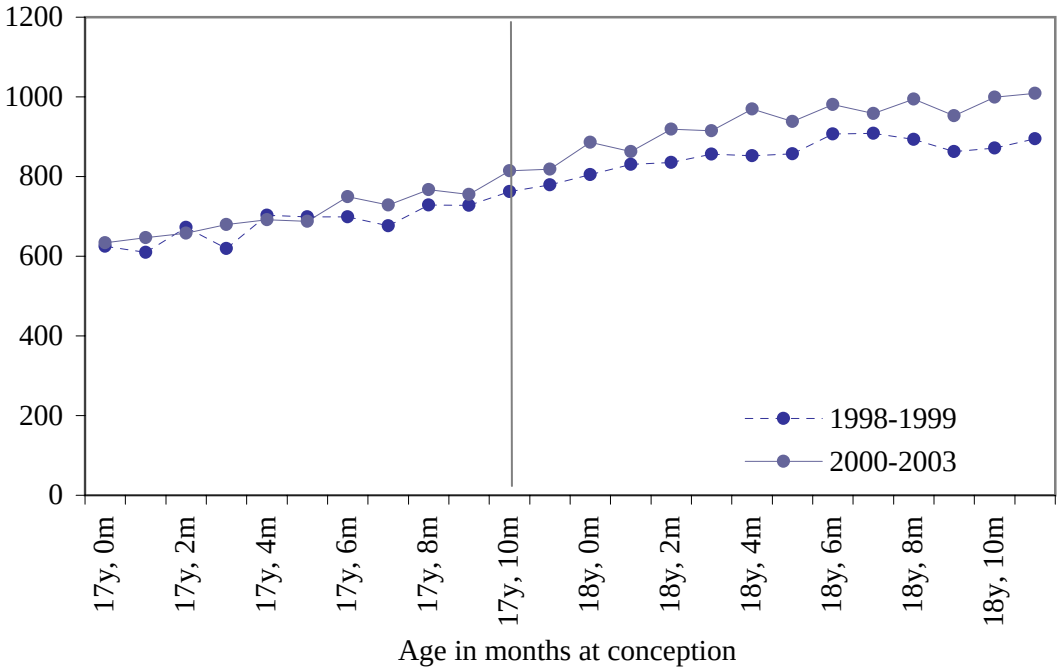


Figure 15. Average yearly number of abortions to black non-Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

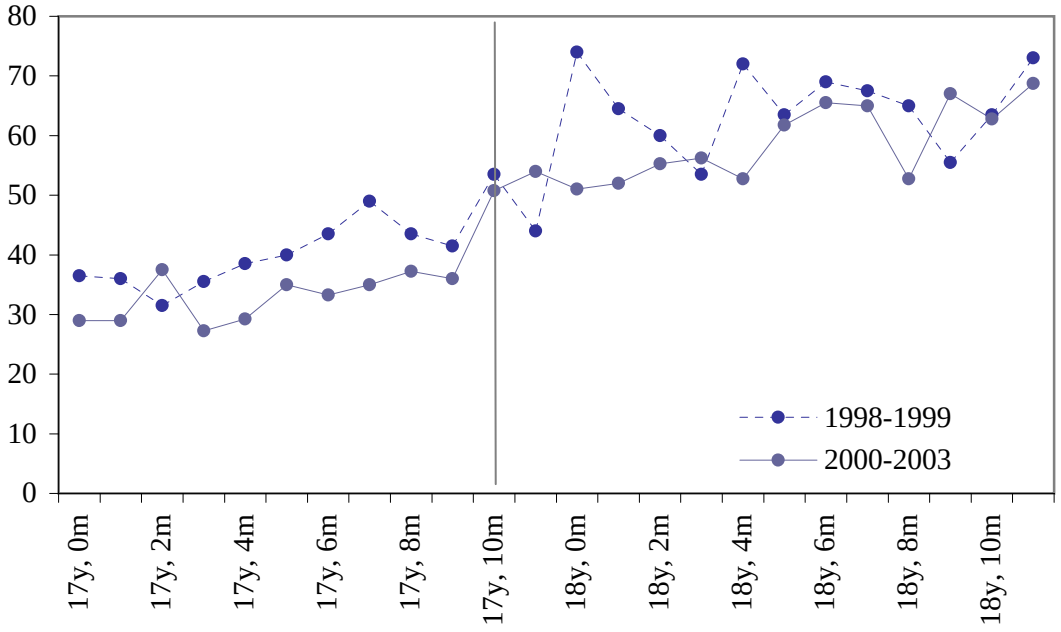


Figure 16. Average yearly number of births to black non-Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents

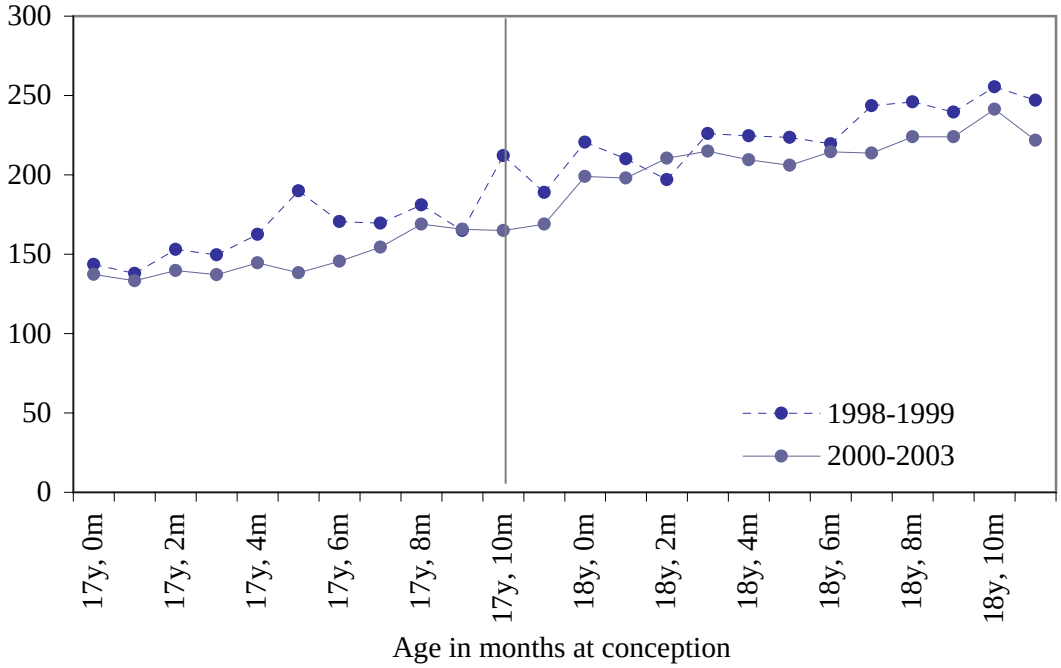
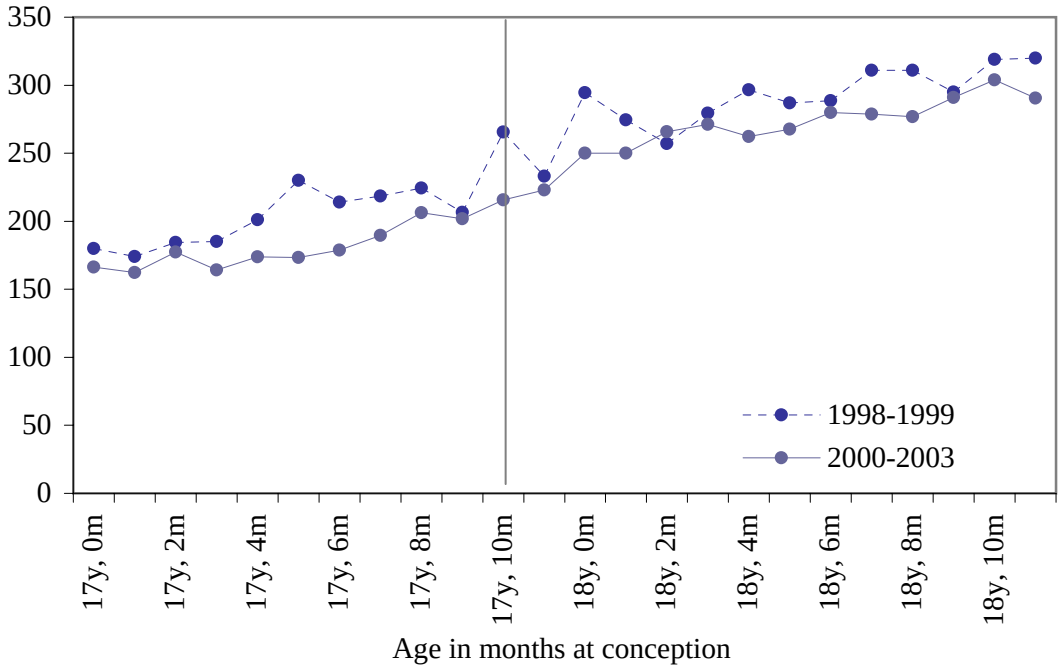


Figure 17. Average yearly number of pregnancies to black non-Hispanic teens ages 17 and 18 years, by year of conception (1998-1999 vs. 2000-2003) and age in months at the time of conception; Texas residents



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Chapter II. Behavioral responses to parental involvement laws: the case of the delay in the timing of abortion until age 18

1. Introduction

Laws requiring parental involvement in minors' abortion decision, commonly referred to as parental involvement laws, can influence young teens' reproductive behavior, for example by inducing them to avoid an unwanted pregnancy, or by making it more likely that a pregnant minor carries an unwanted pregnancy to term. These kinds of changes in minors' behavior will alter their abortion, birth and pregnancy rates, a focus of numerous studies on the evaluation parental involvement laws. Relatively few studies, however, evaluate the effect of these laws on the timing of abortion by pregnant minors, a possible behavioral response with potential health consequences. Abortions performed later in the gestation, especially after the first trimester are surgically more demanding and carry a higher risk of complication. Furthermore, fewer clinics provide such services and the cost of abortion rises substantially the later in pregnancy the termination occurs (Finer and Henshaw 2003). If parental involvement laws cause a delay in abortion among minors, it can potentially increase their exposure to the risks associated with late-term abortions, as well as increase the financial burden of obtaining an abortion.

Parental involvement laws can induce minors to delay an abortion longer than they would have in absence of the law. Minors who do not want to involve their parents are forced to search for alternatives such as a judicial bypass or to make arrangements to travel out of state for an abortion, all of which can extend the time a minor remains pregnant. Minors may also delay the involvement of their parents by putting off the abortion out of embarrassment or fear of punishment. This kind of behavior, if present is

likely to occur in various degrees across minors of all ages. Additionally, the law may induce some minors to delay the abortion until they turn 18 in order to circumvent parental involvement. The latter alternative is only possible for minors who are relatively close to their 18th birthday at the time of conception.

The few studies of abortion delay in association with parental involvement laws analyze changes in mean gestational age or the proportion of second-trimester abortions among all minors. The evidence presented by these studies is mixed. Some report an increase in the likelihood of a late-term abortion (post first-trimester or post 8 weeks of gestation) in response to a parental involvement law (Ellertson 1997; Rogers et al. 1991; Bitler and Zavodny 2001; Joyce and Kaesnter 2001). While others argue that the increased likelihood of second-trimester abortion associated with the law is not the result of an increase in the incidence of late abortions, rather it is due to a greater decline in the number of abortions performed early in the gestation (Rogers et al. 1991).

Two aspects of the effect of parental involvement laws on the timing of abortion have been overlooked in the literature. First, any effect of these laws that only applies to a subgroup of teens, such as the delay by older 17-year-olds until their 18th birthday, is most likely lost in an analysis that combines minors of all ages. Second, the delay in the timing of abortion until age 18 will by definition increase the mean gestational age of abortions that are obtained at age 18. This may potentially bias estimates of the law on the timing of abortion, as measured by mean gestational age, the proportion of second-trimester abortions or the second-trimester abortion rate, if changes in the outcomes of 18-19 year-olds serves as the counterfactual.

In this study we analyze the delay in the timing of abortion by minors associated with Texas's parental notification requirement, which took effect in January of 2000. We contribute to the literature in several ways. First, we focus our analysis on the delay by older 17-year-olds until age 18, a behavior that received little attention in the literature on parental involvement laws. We are able to distinguish this behavior from a general increase in gestational age due to other causes of delay. Second, we identify which teens are subject to the law from the point of conception and not based on their age at the time of abortion, as was done in all previous work, and thereby we reduce the bias that results from classifying teens who become pregnant at age 17 but abort at age 18 as unaffected by the law. Finally, with an estimate of teens' age in months, we can define our treatment and control groups so that they are only a few months apart in age, and thereby enhance the internal validity of the study design.

We use individual-level data from abortion certificates from Texas with reported date of birth and date of the procedure. Using this information and a clinical estimate of gestational age in weeks, we calculate teen's age at the time of conception as well as at the time of abortion. With this information, we identify which group of minors is most likely to respond to the law by delaying the abortion until age 18, and whether this behavior is associated with any of the teen's characteristics available to us from the abortion certificates. We perform several tests to ensure that the observed increase in the likelihood of obtaining the abortion at age 18 among pregnant 17-year-olds is indeed motivated by the effort to circumvent the parental notification requirement. Next, we evaluate whether the law is associated with an increase in second-trimester abortions among teens who delay. This is an important measure of whether or not the law led to an

increase in the number of teens exposed to the risks associated with late-term abortions. We also argue that the prevalence of this behavior can serve as a test of whether minors take account of the law when making decisions regarding their reproductive behavior, such as sexual activity and contraceptive use. Given that post first-trimester abortions are surgically more demanding, significantly more expensive and carry a higher risk of complication, if minors have the potential to adjust their behavior to the law, we should observe a decline in the delay in the timing of abortion over time.

Our findings reveal that the increased likelihood of delaying the abortion until age 18 by pregnant 17-year-olds associated with Texas's parental notification law was concentrated among minors who were about three to four months away from their 18th birthday at the time of conception. This delay comes at a cost of an increased likelihood of a second-trimester abortion among teens ages 17 years and 8-9 months at the time of conception. We found no change in the probability of late-term abortion associated with Texas's law among the younger and older 17-year-olds. This behavior was also not significantly related to race, marital status or history of previous pregnancies. While the incidence of late abortions actually declined in response to the law among teens ages 17 years and 7 months at the time of conception, we have evidence suggesting that the law increased the incidence of late abortions among teens ages 17 years and 8-9 months at the time of conception, although, this latter result is not statistically significant. Finally, we show evidence that the delay in the timing of abortion by older 17 year-olds persists even 4 years after the introduction of the Texas's law, suggesting that there may be relatively little feedback from the enforcement of the law and teen sexual activity and contraceptive use.

2. Background and literature review

The most common research design used for the evaluation of parental involvement laws and the timing of abortion by minors is a difference-in-differences analysis where the pre- to –post law change in the measures of delay among minors ages 17 or less are compared to the changes in the outcomes among older teens ages 18-19 or the outcomes of all women ages 18 and above (18-44). All studies but one use individual-level data from selected states, since there is no one source of abortion data for all states by patients' age and length of gestation (Ellertson 1997; Joyce and Kaestner 2001; Rogers et al. 1991; Henshaw 1995; Rogers 1997). One study uses data from all states by weeks of gestation compiled by the CDC, and evaluates the association between parental involvement laws and the timing of abortion by women of all ages (Bitler and Zavodny 2001).

The standard measures of the timing of abortion employed in this literature are mean gestational age, the proportion of abortions that occur after the 12th week of gestation (often referred to as post-first-trimester or second-trimester abortions), and the post first-trimester abortion rate. All studies on this subject employ one or more of these measures, however, the measures differ in their capacity to detect delay or an increase in the exposure to the risks associated with second-trimester abortions. As has been documented in numerous studies, parental involvement laws tend to reduce minors' abortion rate,[1] which can also lead to compositional changes, such as a rise in the percent of second-trimester abortions, or a rise in mean gestational age, neither of which necessarily implies an increased delay in the timing of abortion. For example, there

[1] See for example Rogers et al. (1991), Haas-Wilson (1996), Ellertson (1997), Levine (2003).

could be a decline in early abortions and a decline or no change in late abortions, but as long as the decline in early abortions is proportionally greater, the proportion of second-trimester abortions and mean gestational age will rise. This could occur, for example, if minors who would have had early terminations in absence of the law respond to the law by increasing the use of contraception and thereby avoiding an unwanted pregnancy, while minors having late abortions do not change their behavior. Therefore a finding of a rise in mean gestational age or an increase in the percent of abortions performed in the second trimester with a simultaneous decline in the abortion rate cannot be interpreted as evidence of delay. Yet there are studies that rely only on these outcomes in their evaluation of the effect of parental involvement laws on abortion timing (Ellertson 1997; Henshaw 1995). A more appropriate measure of delay and increased exposure to the risk of late abortions associated with parental involvement laws is the change in the second-trimester abortion rate (Joyce and Kaestner 2001; Rogers 1991; Bitler and Zavodny 2001).

The evidence on the effect of parental involvement laws on the timing of abortion is not conclusive. Some studies show no change in the proportion of abortions that are performed in the second-trimester (Ellertson, 1997). Others show some evidence of a rise, however, in most cases not statistically significant (Henshaw, 1995; Joyce and Kaestner, 2001). A significant increase in the percent of second-trimester abortions was documented in the case of Minnesota, but it was the result of a greater decline in the rate of early abortions compared to the rate of second-trimester abortions, indicating no increase in exposure to the risks of late abortions (Rogers et al. 1991). In fact, no studies that evaluated the effect of parental involvement laws on the rate of second-trimester

abortion found a significant increase (Rogers et. al.1991; Joyce and Kaestner 2001). Researchers found some evidence that the laws increased mean gestational age among minors. Henshaw (1995) found a marginally significant increase of 3 days among minors in Mississippi. Similarly, Joyce and Kaestner (2001) found that Mississippi's parental involvement law was associated with an increase of about half a week in mean gestational age at the time of abortion. However, since both Henshaw (1995) and Joyce and Kaestner (2001) found a reduction in the total abortion rate among minors and either did not evaluate (Henshaw, 1995), or found no significant change in the rate of post first-trimester abortions (Joyce and Kaestner 2001), it is not at all clear that the rise in mean gestational age is linked to an increased likelihood of delay.

While the interpretation of the estimates based on the different measures of delay is not always clear, even studies that employ a thorough analysis of all measures are limited in their ability to infer a causal interpretation. The difference-in-differences approach employed in most studies relies on the appropriateness of the counterfactual for a causal inference. Yet, as was discussed in more detail in Chapter I of this essay, it is unlikely that the behavior of older teens and older women is representative of minors' behavior in absence of the law. As is evident from studies that use more than one comparison group, changes in the outcomes in the two control groups (e.g. 18-19, 20-24 and 20-44) from before to after the law went into effect are often different, suggesting differing trends over time (Rogers et. al., 1991; Ellertson, 1997). There is no reason to believe that the trend between minors and any of the two control groups would have been the same in absence of the law, yet no study controls for the possibility of differing trends between minors and older women. The evaluation of the effect of parental involvement

laws on delay is further complicated by the additional assumption that compositional changes in abortions would have been the same between minors and older women. There is evidence of the contrary in the evaluation of Minnesota's law by Rogers et al (1991). The authors show a statistically different decline in the early abortion rate of 18-19 year-olds compared to the early abortion rate of 20-44 year-olds, while no significant difference in the decline in the late abortion rate between the two groups. This suggests a difference in the compositional change in abortions between the two control groups. Again, no reason to believe that the compositional change between minors and any of the control groups would have been the same.

All studies evaluating the delay in the timing of abortion associated with parental involvement laws look for overall shifts in the outcomes of all minors, and therefore do not take into account the possibility that the laws' impact is not homogenous across all ages. Minors of different ages may respond to the law differently. For example, survey data suggests that older minors are less likely to talk to their parents about their intention to get an abortion, as a result they are more likely to be affected by a parental involvement law compared to younger minors (Henshaw and Kost, 1992). At the same time, mean gestational age at the time of abortion is generally greater at younger ages, which may make it less feasible for younger minors to further delay the abortion in response to a parental involvement law. And lastly, some minors for whom delaying the abortion until age 18 is feasible, may do so in order to avoid a parental notification or consent requirement. As a result, these minors may respond differently to a parental involvement law compared to their younger counterparts. While it is important to learn

the overall impact of the law on all minors, an evaluation that groups all minors together may conceal the negative impact of the law if it only applies to a subgroup of teens.

In this study, we address some of the limitations of previous work. We evaluate the effect of Texas's parental notification requirement on the timing of abortion, by focusing on the behavior of older minors, specifically the likelihood of delaying the abortion until age 18. The advantage of focusing on the behavior of older minors is that we can use the behavior of teens who are only a few months apart in age but unexposed to the law from the point of conception as the counterfactual. This way we minimize the unobserved differences between the treatment and control groups, as well as the possible differences in trends between the two groups over time. Furthermore, while previous studies were unable to establish a relationship between parental involvement laws and abortion timing, researchers have overlooked the incentive to delay until age 18. Any rise in gestational age or the percent of abortions performed in the second-trimester among this subgroup is most likely lost in an analysis based on all minors. Since we focus our analysis on pregnant 17-year-olds who delay the abortion until after their 18th birthday, from here on whenever we mention *delay,* we are referring to this specific form of delay as opposed to a delay for other reasons that could apply to minors of all ages.

3. Data

We use individual-level data from induced termination of pregnancy (ITOP) certificates for the years 1997 to 2003 from the Texas Department of State Health Services (TDSHS). Abortion data from Texas are noteworthy in that they contain the patient's exact date of birth as well as the date of the procedure. With patients' date of

birth, the exact date of the event and the clinician's estimate of gestational age in weeks, we are able to estimate teens' age in weeks at the time of conception and at the time of abortion, thus enabling us to identify which teens delayed the abortion until age 18. We define our pre-law sample as abortions that were conceived between August 1, 1997 and July 31, 1999. Minors who conceived between August 1, 1999 and December 31, 1999 could be exposed to the law given the time that may elapse between pregnancy recognition and pregnancy resolution. For simplicity, from here on we refer to this period as 1998-1999. We include all abortions conceived between January 1, 2000 and December 31, 2003 as the post-law events. We limit all analysis to Texas residents. A more detailed description of the Texas abortion data is available in Chapter I.

4. Methods and results

We begin our analyses by evaluating the persistence of the delay in the timing of abortion during the four years after introduction of Texas's law. We then identify which age group is most likely to respond to the law by delaying the abortion, and how long they are willing to postpone the abortion in order to avoid compliance with the law. We perform several tests to confirm that the increased delay is in fact the result of an effort to get around the parental involvement requirement, and not the result of a general increase in mean gestational age in response to the law. Finally, we evaluate whether Texas's law is associated with an increase in the incidence of second-trimester of abortion among teens who delay the abortion until age 18.

4.1 Delay in the timing of abortion over time

As we argued in Chapter I, the delay in the timing of abortion by some 17 year-olds until after their 18th birthday, spuriously reduces the number of abortions that are performed at ages less than 18 and increases the number of abortions obtained at age 18. Since there is a limit to how late in the gestation an abortion can be performed, the closer a teen is to her 18th birthday at the time of conception, the easier it is to delay. At the same time we expect that teens whose goal is to circumvent the law would not delay the abortion any further than necessary, and would schedule the abortion soon after turning 18. Therefore, in a plot of abortions by age in months at the time of the procedure, there should be decline as age approaches 18, and an increase at age 18, where the increase should occur within a few weeks of turning 18. This pattern in the age-profile of abortions was evident in Figure 1 of Chapter I, which shows a plot of abortions by age in months for the first year after Texas' parental involvement law was introduced.

In this section, we begin the analysis of abortion delay with an examination of its persistence over time during the four years after the introduction of the law (2000-2003). We compare the age-profile of the pre-law period (1998-1999) to the post-law profile in order to verify that no similar pattern of delay exists before the law went into effect. As noted previously, if teens adjust their sexual behavior to the law over time, we should observe a decline in the tendency to delay since fewer teens should be "surprised" by the law as time goes on. If teens do not respond to the law until after they become pregnant, indicating that there is no learning mechanism, then the pattern of abortion delay should persist over time.

In Figures 1a-1e we present a scatter plot of the number of abortions by age in months at the time of abortion for the pre-law period 1998-1999, and separately for each year after the law (2000-2003). We fit a trend line through the series, where we allow the trend to differ for ages less than 18 and greater than 18, and allow for a discontinuity at age 18 years and 0 months. We also allow the trend to vary for every year. The predicted values shown in the figure come from a cubic specification. We determined that a third-order polynomial is sufficient to pick up the non-linearity in the series as well as accommodates the changes in the age-profile generated by the law. We limited the sample of abortions to those obtained by teens between the ages of 17 years and 0 months and 18 years and 11 months (a period of 12 months from 18 years and 0 months on both sides) because our objective was to evaluate changes in the age profile around the threshold of 18 years and 0 months. Estimating the age profile based on data for all teens would obscure the changes in the trend just below and above the relevant age cutoff.

The first noticeable difference in the age profile between the pre- and post-law periods is the size of the gap at age 18 years and 0 months. While this gap is exaggerated by the apparent dip in the number of abortions below and rise in the number of abortions above the age cutoff, even in the case of no delay there would most likely be a gap in the series at this age simply because the law reduced the number of abortions among minors compared to older teens. Therefore, for our purposes here, we do not emphasize the size of the gap, rather we focus on the shape of the age profile of abortions just below and above the threshold of 18 years and 0 months. The observed patterns in the number of abortions in the years 2000-2003 in Figures 1b-1e are all consistent with a delay in the timing of abortion. All series pertaining to the post-law period show a dip in the number

of abortions as age approaches 18, and a sharp rise in the number of abortions at exactly age 18 years and 0 months. In contrast, our results for the before-law period of 1998-1999 give no indication for such behavior (Figure 1a); there is no pattern of a decline before age 18 and a corresponding rise at 18 years and 0 months. The patterns depicted in the figures for all after-law years are very similar with no sign of subsiding over time, suggesting that the delay in the timing of abortion by older 17-year-olds associated with Texas's parental involvement law persists even four years after its introduction.

4.2 Identifying teens who delay

In this section, we evaluate how long pregnant minors are willing to wait in order to schedule the abortion after they turn 18, by examining which group of 17 year-olds exhibits this behavior. We begin by comparing the proportion of abortions that were obtained at age 18 among teens who conceived at ages 17 years and 5 to 11 months, between the pre- and post-law periods. We do this by age in weeks at the time of conception, since the proportion that obtains the abortion at 18 rises with age, and our goal is to reveal the age at which this proportion begins to rise faster in the post-law compared to the pre-law period. We exclude from this analysis minors younger than 17 years and 5 months, since in our data they all terminate their pregnancy before turning 18 in both periods.

The results of this exercise are presented in Figure 2a, where we plot the probability that a 17-year-old obtains the abortion at age 18, by age in weeks at the time of conception (along the horizontal axis), separately for 1998-1999 and 2000-2003. In 1998-1999, the period before Texas's law went into effect, minors had no incentive to wait until 18 to schedule the abortion, thus the series pertaining to the pre-law period

represents the natural age profile of this outcome in absence of the law. As revealed by the series for both periods, a very small proportion (close to zero) of minors ages 17 years and 5-6 months delay the abortion until 18. At around age 17 years and 7 months this proportion begins to rise and rises continuously until about age 17 years and 10 months, at which point nearly 100 percent of minors have the abortion at 18. When comparing the proportion who abort at 18 between the before-law and after-law periods, the evidence points to an increase among teens who conceive at ages 17 years and 8-9 months. There is no noticeable difference among minors ages 17 years and 5-6 months, and 17 years and 10-11 months.

To evaluate whether the changes from the pre- to post-law period are statistically significant, we perform a simple t-test of a difference in the proportions. In order to increase precision, we perform this analysis by age in months rather than by age in weeks. The difference in the proportions is calculated as:

$$D^m = \frac{A^m_{18,After}}{A^m_{17,After}} - \frac{A^m_{18,Before}}{A^m_{17,Before}},$$

where $A^m_{18,Before}$ and $A^m_{18,After}$ are the number of abortions that occurred at age 18 among teens who conceived at age 17 years and m months (m = 6, 7…11) in the before and after-law periods, respectively. $A^m_{17,Before}$ and $A^m_{17,After}$ represent the total number of abortions that were conceived at ages 17 years and m months in the before and after-law periods, respectively.

Estimates of D^m along with the 95 percent confidence interval for minors ages 17 years and 6-11 months are presented in Figure 2b. The results confirm that among teens who conceived at ages 17 years and 8 months and 17 years and 9 months the likelihood

of delaying the abortion until age 18 increased after the law by 5 ($p<0.01$) and 10 ($p<0.01$) percentage points, respectively. The proportion of younger teens, those ages 17 years and 6 to 7 months, that delayed the abortion until 18 did not change significantly. The same holds for teens ages 17 years and 10-11 months. These results are not surprising, since for the younger age group the wait is much less feasible, as it would entail having the abortion late in the second trimester, possibly in the third trimester. The opposite is true for the older age group. The great majority of them, close to 100 percent, are 18 at the time of abortion even in the pre-law years (Figure 2a). Therefore, it is not surprising that we found no increase in delay associated with the law among this group.

4.2.1 Robustness Checks

In this section we perform several tests to ensure that the observed increase in the likelihood of obtaining the abortion at age 18 among a subgroup of pregnant 17-year-olds is indeed motivated by the effort to circumvent the parental notification requirement. Findings similar to those presented in Figure 2b could for example be caused by a general increase in gestational age in response to the law by all 17 year-olds, or if there is some psychological benefit to minors in having the abortion at an older age and this is somehow affected by the law. First, we evaluate whether there is evidence of a similar behavior among 16-year-olds. We repeat the same analysis as that presented in Figures 2a and 2b for 16-year-olds and evaluate the change in the proportion who terminate the pregnancy at age 17. While 16-year-old minors are also subject to the law, the increase in the likelihood of delay in order to circumvent the law only applies to older 17-year-olds. Therefore, we should find no such pattern of delay for this younger group. A similar finding of delay until age 17 among 16-year-olds would suggest that our earlier

findings for the case of minors ages 17 years and 8-9 months who delay until 18 cannot be attributed to an effort to avoid parental notification. On the other hand, if we find no evidence of a delay among older 16-year-olds, this would provide support to our interpretation of our findings for 17 year-olds.

Second, we analyze the increase in the probability of second-trimester abortion associated with Texas's law among all 17-year-olds. Again, if our interpretation of findings in Figure 2b is correct, then we should only find an increase in the probability of second-trimester abortions among minors ages 17 years and 8-9 months. There should be no such increase among the older and younger 17 year-olds. A finding of the contrary would suggest that the observed increase in the proportion who obtain the abortion at age 18 is the result of a general increase in gestational age, and would invalidate our argument that the increased delay of the abortion among teens ages 17 years and 8-9 months is the result of an effort to circumvent Texas's parental notification requirement.

4.2.1.1 Results of the analysis of 16-year-olds who delay until age 17

Figures 3a and 3b show the results for the proportion of 16-year-olds who abort at age 17 by age in weeks at the time of conception, separately for the pre and post-law periods. The analysis is limited to minors who conceived at age 16 years and 6-11 months. The series in Figure 3a take on the same general shape as the series pertaining to 17-year-olds in Figure 2a. However, in the case of 16-year-olds we see no visible sign of an increase in the proportion that aborts at age 17. This is confirmed in Figure 3b, which is the equivalent of Figure 2b for 16-year-olds. In all cases but one, the pre- to post-law change in the proportion who abort at age 17 is negative, indicating that mean gestational age decreased after the law. In three out of the six cases the decline is statistically

significant ($p<0.05$). Among minors ages 16 years and 9 months there was an increase of 0.1 percentage points, but not statistically significant. Note that based on this analysis we cannot conclude that the law reduced mean gestational age among 16-year-olds, since we lack an appropriate comparison group. The purpose of this exercise was to show that the increase in the proportion who abort at age 18 among those who conceive at age 17 was not a result of a general increase in the likelihood of delay.

4.2.1.1 Probability of second-trimester abortion associated with Texas's law

We use logistic regression to analyze the effect of the law on the increased odds of second-trimester abortion among all 17-year-olds. Our basic regression is as follows:

(1) $$P_{it} = \alpha_0 + \beta E_i + \alpha Y_t + \gamma (E_i * Y_t) + \mathbf{X}\boldsymbol{\pi} + e_{it} \ ,$$

where P_{it} is the conditional probability that teen *i* who conceived in year *t* and chose to abort, obtained the procedure later than 12 weeks gestation; Y_t is a dichotomous indicator of the years after the law (2000-2003); E_i is a dichotomous indicator for minors subject to the law during pregnancy; $E_i * Y_t$ is the interaction of year and age; **X** is a vector of characteristics that includes indicators for race/ethnicity, previous live births, previous induced abortions, marital status at the time of abortion and health service region of residence.[2] We estimate the effect of the law separately for teens ages 17 years and 0-5 months, 17 years and 6-7 months, 17 years and 8-9 months and 17 years and 10-11 months, since our goal is to identify a differential impact of the law among these groups. We use the outcomes of teens ages 18 years and 1-3 months as the counterfactual. Since our earlier results confirm that minors ages 17 years and 10-11 months are in effect not

[2] Texas is divided into 11 health service regions. For a map go to: http://www.dshs.state.tx.us/regions/stregctymap.pdf.

subject to the law by the time they seek an abortion, in a separate specification, we treat this group as unexposed to the law and estimate the law's impact on the younger 17-year-olds using changes in the outcomes of teens ages 17 years and 10-11 months as the counterfactual. The advantage of using this group for comparison is that they are closer in age to the treatment group and therefore are less likely to differ in unobserved characteristics.

As a first approximation, in Figure 4 we show the proportion of abortions obtained after 12 weeks gestation by age in months at conception for all 17 year-olds. One series pertains to the period four years after the enactment of Texas's law (2000-2003) and the other to the period two years prior (1998-1999). The plots in Figure 4 seem consistent with our argument. There is a sharp jump in the proportion of late abortions in the post-law years among minors who are 17 years and 8 - 9 months at conception. At the same time, there is no obvious increase in the probability of second-trimester abortions among the younger and older age groups in the post-law compared to the pre-law period.

The results from equation *(1)* are presented in Table 1. Whether we use teens ages 18 years and 1-3 months or teens ages 17 years and 10-11 months as the comparison group, we find a statistically significant increase in the odds of second-trimester abortions among teens ages 17 years and 8-9 months at conception. The adjusted odds of an abortion after 12 weeks increased by 35 percent (OR=1.35; $p<0.01$) among this group relative to those ages 18 years and 1-3 months and 51 percent (OR=1.50; $p<0.01$) relative to teens ages 17 years and 10-11 months. In contrast, we find no statistically significant change in the odds of second-trimester abortion associated with the law for younger 17

year-olds, regardless of how we define the comparison group. Similarly, we find no significant change in the odds of second-trimester abortion among teens ages 18 years and 1-3 months relative to teens ages 17 years and 10-11 months.

The finding that the law only increased the likelihood of second-trimester abortion among teens ages 17 years and 8-9 months at conception, combined with our results from the previous section that shows no evidence that pregnant 16-year-olds delay the abortion until age 17, confirms that the increase in the proportion who obtain the abortion at age 18 among teens ages 17 years and 8-9 months is the result of a delay in the timing of abortion in order to circumvent the law.

Our findings have important implications. Minors who conceive at age 17 years and 8-9 months have to wait 2-4 months (depending on their exact age) if they want to schedule the abortion after their 18th birthday. This implies that most of these abortions occur well in the second trimester. In fact our data revealed that all minors of ages 17 years and 8 months that delay until 18 have their abortion after the 12th week of gestation. The mean gestational age at the time of abortion is 18.2 weeks for this group, as opposed to 8.4 weeks among teens of the same age who have their abortion before they turn 18. Among teens ages 17 years and 9 months at the time of conception who delay, 50 percent are in the second trimester by the time the abortion is performed. For them the mean gestational age is 13.3 weeks, compared to 7.5 weeks among those in the same age group who do not delay.[3]

[3] Author's tabulation of the Texas abortion data.

4.2.2 Differential impact of the law by teens' characteristics

To test whether the likelihood of delaying the abortion among minors of ages 17 years and 8-9 months, varies by teens' characteristics, we estimated a series of linear probability models adjusted for race, parity, previous terminations and marital status. Specifically, using the sample of teens who conceived at ages 17 years and 8-9 months, we estimate the following regression model:

(2) $P_{it} = \alpha_0 + \beta E_i + \alpha Y_t + (X * Y)\gamma + \mathbf{X}\boldsymbol{\pi} + e_{it}$,

where P_{it} equals one if teen i in period t terminates the pregnancy at age 18; Y is a dummy indicator for the after-law period (2000-2003), and **X** includes a set of indicators for teens' race, marital status, previous abortions, and previous births. The interactions of Y with the indicators of teens' characteristics identify the differential impact of the law by these characteristics.

The estimates from equation *(2)* are presented in Table 2. The adjusted likelihood that a pregnant minor of age 17 years and 8-9 months who chooses an abortion, delays the procedure until age 18, was 11 percentage points higher in 2000-2003 compared to 1998-1999 ($p<0.01$; Table 2, column 1). There is also evidence that the likelihood of delay varies by race, parity and marital status. In general, during our sample period of 1997-2003, Black non-Hispanic teens were about 5.6 percentage points more likely to delay the abortion compared to white non-Hispanics ($p<0.05$); teens with one or more previous birth were about 4.8 percentage points more likely to delay compared to those with no previous births ($p<0.05$); and married teens were about 8.2 percentage points less likely to delay compared to their single counterparts ($p<0.1$) (Table 2, column 1). In the last four columns of Table 4 we allow for interactions between the post-law period and

teens' characteristics, such as race, parity, previous induced abortions and marital status. We find no evidence that the law had a differential impact by any of the observed characteristics; none of the interactions are statistically significant. It should be noted that the higher likelihood of delay among Black non-Hispanic minors most likely reflects the fact that in general mean gestational age at the time of abortion is higher among this group compared to white non-Hispanics. When it comes to delaying the abortion in order to circumvent the law, the results suggest no differential impact by race.

4.3 The law's impact on the incidence of late abortions

An important question is whether the delay in the timing of abortion in response to Texas's parental notification requirement led to more late-term abortions among teens who delay. It is clear from our results that the delay in the timing of abortion greatly increased the mean gestational age as well as the proportion of abortions that are performed in the second-trimester. However, as we showed in Chapter I, the law is associated with a reduction in total abortions among this group; therefore, it is possible that the prevalence of late-term abortion also declined. In such a case it can be argued that while the law induced certain teens to delay their abortion, the combined effect of a reduction in the total number of abortions and the delay in the timing of abortion did not lead to more minors being exposed to the risks of late-term abortion.

We evaluate this statement by analyzing the effect of the law on the number of abortions by length of gestation. Since the medical literature typically links the increased risk of abortions to those performed after the 12^{th} week of gestation (second-trimester or later), we use this threshold for our analysis. As discussed earlier, the most common approach in the literature on parental involvement laws is to take the difference in the

post-first trimester abortion rate among minors from before to after the law and compare that to the difference in the post-first trimester abortion rate among older teens or adult women. We move away from this approach for two reasons. First, we are only interested in the outcomes of minors ages 17 years and 8-9 months at the time of conception. It is unlikely that we could detect any increase in post first-trimester abortions caused by a delay in the timing of abortion by older 17 year-olds if we performed the analysis on minors ages 15-17. Second, we want to narrow the differences between our treatment and control group, therefore, rather than using the outcomes of 18-19 year-olds as the counterfactual, as was done in previous work, we define our control group so that there is only a few months difference in age between those exposed and unexposed to the law.

We exploit changes in the age profile of post-first trimester abortions that can be attributed to the law. Our approach assumes that in absence of a parental notification requirement, the number of abortions rises continuously with age and the relationship can be described by the following regression model:

(3) $A_m = \alpha + \phi(m) + \varepsilon_m$,

where A is the number of abortions for teens of age m in months. The function $\phi(\cdot)$ captures the age-profile and should be smooth with no abrupt changes. If the law led to a change in the number of late-term abortions among teens ages 17 years and 8-9 months compared to teens ages 17 years and 10 months, we expect there to be a discontinuity at this age. An additional discontinuity in the age profile is likely at age 17 years and 7 months. We use teens ages 17 years and 10 months as the comparison group because this is the youngest group of teens who are in effect not subject to the law.

Our basic regression model for the age-profile of late abortions assuming a linear specification of $\phi(\cdot)$ can be expressed as:

$$
\begin{aligned}
A_m = {} & \beta_0 + \beta_1 AgeLT17{,}7_m + \beta_2 Age17{,}8\_9_m + \beta_3 Trend + \beta_4 Trend * AgeLT17{,}10 \\
& + \beta_5 After + \beta_7 AgeLT17{,}7 * After *_m + \beta_8 Age17{,}8\_9 * After_m + \beta_9 Trend * After \\
& + \beta_{10} Trend * AgeLT17{,}10 * After + \varepsilon_m ,
\end{aligned} \tag{4}
$$

where A_m refers to the number of post first-trimester abortions to teens of age *m*; *AgeLT17,7* is a dichotomous indicator for ages less than or equal to 17 years and 7 months; *Age17,8_9* is a dichotomous indicator for ages 17 years and 8-9 months. The omitted age category is those ages 17 years and 10 months and older. The *Trend* term controls for a linear age-profile and is defined as 0 at age 17 years and 10 months. We also include an additional interaction term *Trend*AgeLT17,10*, in order to allow the slope of the age profile to vary for ages less than 17 years and 10 months and greater. While we do not expect the slopes to differ in the pre-law period, it is important to allow them to differ in the after-law period. If the effect of the law on late-term abortions were homogeneous across all minors, there would be no change in the slope for the younger age-group, however if the effect is not homogeneous, it will change the shape of the age-profile and therefore we need to allow for a differential trend. *After* is a dummy representing the post-law period (2000-2003). By including a full set of interactions with the after-law dummy we allow all parameters to vary between the pre and post-law periods.

We identify the effect of the law on the post first-trimester abortions of teens ages 17 years and 8-9 months and those ages 17 years and 7 months with the following difference-in-differences in the expected values:

$DD_{17y,8\text{-}9m}$ = E[A | After, Age 17y,8-9m] - [A | After, Age 17y,10m]

$$-\{[A \mid \text{Before, Age 17y,8-9m}] - [A \mid \text{Before, Age 17y,10m}]\}$$

$$DD_{17y,7m} = E[A \mid \text{After, Age 17y,7m}] - [A \mid \text{After, Age 17y,10m}]$$

$$-\{[A \mid \text{Before, Age 17y,7m}] - [A \mid \text{Before, Age 17y,10m}]\}.$$

$DD_{17y,8\text{-}9m}$ and $DD_{17y,7m}$ represent the effect of the law on the late abortions of teens ages 17 years and 8-9 months, and 17 years and 7 months, respectively, using changes in the outcomes of teens 17 years and 10 months as the counterfactual. Evidence from Chapter I and the previous section of this chapter indicates that total abortions fell and the probability of late-term abortion did not change among minors ages 17 years and 7 months and younger, therefore we expect that $DD_{17y,7m}$ will be less than 0. Furthermore, we have evidence that the probability of late-term abortion increased after the law among teens ages 17 years and 8-9 months, for them the sign of $DD_{17y,8\text{-}9m}$ will depend on whether or not the delay in the timing of abortion outweighs the reduction in the total number of abortions.

In Figures 5a and 5b we give hypothetical examples of the possible impacts of the law and what they mean for the sign and magnitude of the difference-in-difference estimates. In both, Figures 5a and 5b we assume that the after-law late abortions were reduced for teens ages 17 years and 7 months and younger, so that $DD_{17y,7m}<0$. In the example given in Figure 5a, the delay in the timing of abortion led to more late abortions among teens ages 17 years and 8-9 months compared to those ages 17 years and 7 months, but the level of late-term abortions is not above of what would have been expected in absence of the law. In this case $DD_{17y,8\text{-}9m} < 0$, indicating that the decline in the total number of abortions in response to the law dominates the increase in the probability of late-abortions. The alternative scenario, one in which the law increased the

incidence of late-term abortions, is presented in Figure 5b. Here the number of late-term abortions among teens ages 17 years and 8-9 months is above the level of abortions among teens ages 17 years and 10 months, and therefore is higher than that expected without the law, $DD_{17y,8\text{-}9m} > 0$.

Another interesting question that can be answered from the estimates of equation (4) is how much higher is the number of late-term abortions among teens ages 17 years and 8-9 months in the after-law period compared to the level that would have occurred had there been no delay in the timing of abortion. The answer to this is given by:

$$DD'_{17y,8\text{-}9m} = E[A \mid \text{After, Age 17y,8-9m}] - [A \mid \text{After, Age 17y,7m}] - \{[A \mid \text{Before, Age 17y,8-9m}] - [A \mid \text{Before, Age 17y,7m}]\}.$$

In other words, the number of late abortions in the after-law period would have been lower by the size of $DD'_{17y,8\text{-}9m}$ if minors ages 17 years and 8-9 months had not responded to the law by delaying the abortion.

The magnitude of the difference-in-differences estimates will depend on how we define the $\phi(\cdot)$ function. As a robustness check we present estimates for various polynomial specifications such as linear, quadratic and cubic. We also limit the analysis to teens who are within 12 months of the age cutoff of 17 years and 10 months on either side. The age-profile changes as we move further away from this threshold and therefore the data for the younger and older teens are not good predictors of the trend around the threshold.

Table 3 presents the estimates of $DD_{17y,7m}$, $DD_{17y,8\text{-}9m}$, and $DD'_{17y,8\text{-}9m}$ for the models with different specifications of $\phi(\cdot)$ in each column. The first three columns of Table 3 show the results for the linear, quadratic and cubic specifications, respectively,

for the outcome defined as the number of late abortions in levels. The last three columns of the table have the results for the log of late-term abortions. Estimates of $DD_{17y,7m}$ range between -3.69 and -6.30, indicating that the law reduced the number of post first-trimester abortions among teens ages 17 years and 7 months compared to those ages 17 years and 10 months by an average of 4 to 6 abortions per year, although the results are not statistically significant. In relative terms, as given by the estimates from the model of log abortions, these effects translate into a decline of 16-22 percent. Only the estimate from the linear model of log abortions is statistically significant (-0.22; $p<0.1$).

We found the opposite effects for teens ages 17 years and 8-9 months at conception. All estimates of $DD_{17y,8-9m}$ are positive, indicating that the average number of late abortions increased after the law relative to teens ages 17 years and 10 months. The estimates range between 6.52 and 9.37, however none are statistically significant. The same is true for the estimates from the model of log abortions. All indicate an increase in late abortions among teens ages 17 years and 8-9 months. The estimates range between 12 and 18 percent, again none are statistically significant. Finally, the estimates of $DD'_{17y,8-9m}$ suggest that the number of late abortions among teens ages 17 years and 8-9 months after the law are on average higher by about 13 abortions per year compared to the level that would have occurred after the law had there been no delay in the timing of abortion. In relative terms this translates into an increase of about 32 to 35 percent, as indicated by the results in logs. These results are statistically significant for all specifications (linear, quadratic or cubic), as well as for both outcomes, late abortions and the log of late abortions.

To get a sense of how well each model fits the data it is useful to examine the graphical presentation of the results. In Figures 6a and 6b we plot the predicted values from the regression model of late abortions using the linear specification of $\Phi(\cdot)$, along with the actual data for the post- and pre-law periods, respectively. In figures 7a and 7b we do the same for the model with the quadratic specification. Figures 8a-8b and 9a-9b show the results from the models of the log of late abortions. All figures indicate that late abortions trend upward with age. But more importantly, the figures pertaining to the post-law period (Figures 6a,7a, 8a, and 9a) give evidence of an abrupt increase in late abortions at age 17 years and 8-9 months compared to the level at age 17 years and 10 months and 17 years and 7 months. The pattern depicted in these figures is consistent with the case presented in Figure 5b. Late abortions fell among minors for whom delay is not feasible (those ages 17 years and 7 months or less), however it increased above the level that would have been expected in absence of the law among teens for whom delay until age 18 was plausible (those ages 17 years and 8-9 months at conception). This is even more evident from Figure 10, where we plot the predicted values from the pre-law period against the predicted values from the post-law period from the model of late abortions, assuming a linear age profile. The predicted level of late-term abortions among teens who delay did not seem to change between 1998-1999 and 2000-2003, while it declined among all other age groups. Teens ages 17 years and 7 months seem to have experienced the greatest decline. The figures present a strong indication that the law led to more late abortions among teens who delay, even though a statistical significance of the results could not be established.

5. Conclusion

Previous studies that evaluate the effect of parental involvement laws on the second-trimester abortion rate of minors found no evidence of an increase. However, prior research has been unable to account for a delay in the timing of abortion until age 18 for the specific purpose of avoiding compliance with the law. We performed an extensive analysis of this behavior, and our findings have important policy implications. We identified teens ages 17 years and 8-9 months as the group most likely to exhibit such behavior in response to Texas's parental notification statute. We could not establish whether the tendency to delay in response to the law varied by any of the available characteristics of teens, such as race, marital status, previous abortions or previous live births. The delay in the timing of abortion by minors ages 17 years and 8-9 months led to an increase in the likelihood that the abortion occurred in the second-trimester. We found no association between the law and the probability of second-trimester abortion among younger 17 year-olds for whom delaying the abortion until age 18 is not feasible. We have evidence to suggest that the law led to an increase in the number of late abortions among teens who delay, thereby increasing the exposure to the risk of late-term abortions among this group, although this finding is not statistically significant. Finally, the delay in the timing of abortion seems to persist even four years after the introduction of the law, in spite of the greater risk of complications and the higher monetary cost associated with second-trimester abortions, suggesting that there is little feedback from the enforcement of the law and teen sexual activity and contraceptive use.

Table 1. Adjusted odds of second-trimester abortion associated with Texas's parental notification law among 17-year-olds and a sub-group of 18-year-olds

	Model 1		Model 2	
	OR	**s.e.(logOR)**	**OR**	**s.e.(logOR)**
17 years, 0-5 months	0.98	(0.099)	1.09	(0.115)
17 years, 6-7 months	0.95	(0.129)	1.06	(0.142)
17 years, 8-9 months	1.35*	(0.123)	1.51*	(0.136)
17 years, 10-11 months	0.89	(0.121)	1.00	---
18 years, 1-3 months	1.00	---	1.12	(0.121)
Obs.	23,351		23,351	

#The odds ratios were estimated by logistic regression based on equation *(1)* in the text, and were obtained from the coefficients of the interaction between the indicator after enforcement of the law and age at the time of conception. The odds ratios were adjusted for race or ethnic background, age at the time of conception, marital status, previous induced abortions, previous live births, health service region of residence, and the years after enforcement of the law. The reference age category is 18 years and 1-3 months in Model 1, and 17 years and 10-11 months in Model 2. The analysis includes abortions that were conceived in the periods from August 1, 1997, to July 31, 1999, and from January 1, 2000, to December 31, 2003.
* $p<0.01$

Table 2. Adjusted differences in the probability of delay between 1998-1999 and 2000-2003 among teens who were 17 years and 8-9 months old at the time of conception, for all, and by teens' characteristics[a]

	All	Race	Parity	Previous terminations	Marital status
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Years 2000-2003	0.106 ***	0.123 ***	0.113 ***	0.096 ***	0.108 ***
	(0.018)	(0.027)	(0.020)	(0.020)	(0.019)
Race:					
Black Non-Hispanics	0.056 **	0.069 *	0.056 **	0.056 **	0.056 **
	(0.025)	(0.040)	(0.025)	(0.025)	(0.025)
Hispanics	0.026	0.058 *	0.026	0.027	0.026
	(0.020)	(0.033)	(0.020)	(0.020)	(0.020)
Other	0.067	0.000	0.066	0.067	0.066
	(0.052)	(0.081)	(0.052)	(0.052)	(0.052)
Previous terminations:					
1+ previous terminations	0.039	0.038	0.039	-0.001	0.039
	(0.025)	(0.025)	(0.025)	(0.039)	(0.025)
Previous births:					
1+ previous births	0.048 **	0.048 **	0.069 *	0.047 **	0.047 **
	(0.023)	(0.023)	(0.036)	(0.023)	(0.023)
Marital status:					
Married	-0.082 *	-0.079 *	-0.080 *	-0.082 *	-0.052
	(0.042)	(0.042)	(0.042)	(0.042)	(0.076)
Interaction terms:					
Years 2000-2003 × Black-NH	---	-0.021	---	---	---
		(0.051)			
Years 2000-2003 × Hispanic	---	-0.05	---	---	---
		(0.041)			
Years 2000-2003 × Other	---	0.113	---	---	---
		(0.106)			
Years 2000-2003 × 1+ prev. birth	---		-0.035	---	---
			(0.046)		
Years 2000-2003 × 1+ prev. term.	---		---	0.067	---
				(0.050)	
Years 2000-2003 × married	---		---	---	-0.043
					(0.090)
R-squared	0.020	0.021	0.020	0.021	0.020
Observations	2,518	2,518	2,518	2,518	2,518

[a]All results are from linear probability models. The dependent variable is a dichotomous indicator that equals 1 for teens who are 18 at the time of abortion among those 17 years and 8 to 9 months at the time of conception. Each column represents a separate regression. The omitted categories are years 1998-1999, white non-Hispanics, no previous terminations, no previous births, single.
*** significant at 1%; ** significant at 5%; * significant at 10%.

Table 3. Estimates of the effect of Texas's law on post first-trimester abortions for teens ages 17 years and 7 months and 17 years and 8-9 months[a]

	Dependent variable : Number of late abortions			Dependent variable : Ln(Late abortions)		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
17y,7m vs. 17y,10m	-6.30	-5.67	-3.69	-0.22*	-0.20	-0.16
	(5.07)	(6.78)	(7.49)	(0.13)	(0.17)	(0.19)
17y,8-9m vs. 17y,10m	7.18	6.52	9.37	0.13	0.12	0.18
	(5.66)	(6.56)	(7.23)	(0.15)	(0.17)	(0.19)
17y,8-9m vs. 17y,7m	13.5**	12.2*	13.1*	0.35**	0.32*	0.34**
	(5.83)	(6.64)	(6.73)	(0.15)	(0.17)	(0.17)
R-squared	0.643	0.634	0.632	0.652	0.646	0.641
Obs.	144	144	144	144	144	144

[a]Estimates are from equation *(2)* from the text. The sample is aggregated by year and age in months. The pre- and post-law periods are 1998-1999 and 2000-2003, respectively. Three different models are presented using two different outcomes: number of late abortions and the log of late abortions. Linear, Quadratic and Cubic subheadings refer to models with a 1st, 2nd and 3rd order polynomial specification. The age profile for those less than 17 years and 10 months is allowed to differ from the age profile for older ages. All regressions are based on the sample of teens within 12 months of age 17 years and 10 months on either side. Standard errors are in parenthesis.

** significant at 5%; * significant at 10%.

Figure 1a. Average yearly number of abortions by patients' age in months at the time of abortion; Conception years 1998-1999

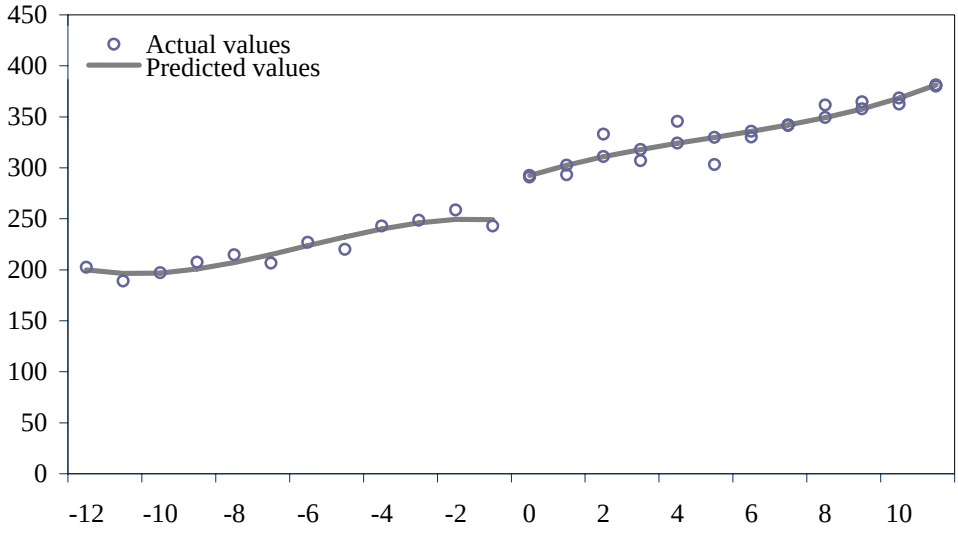


Figure 1b. Average yearly number of abortions by patients' age in months at the time of abortion; Conception year 2000

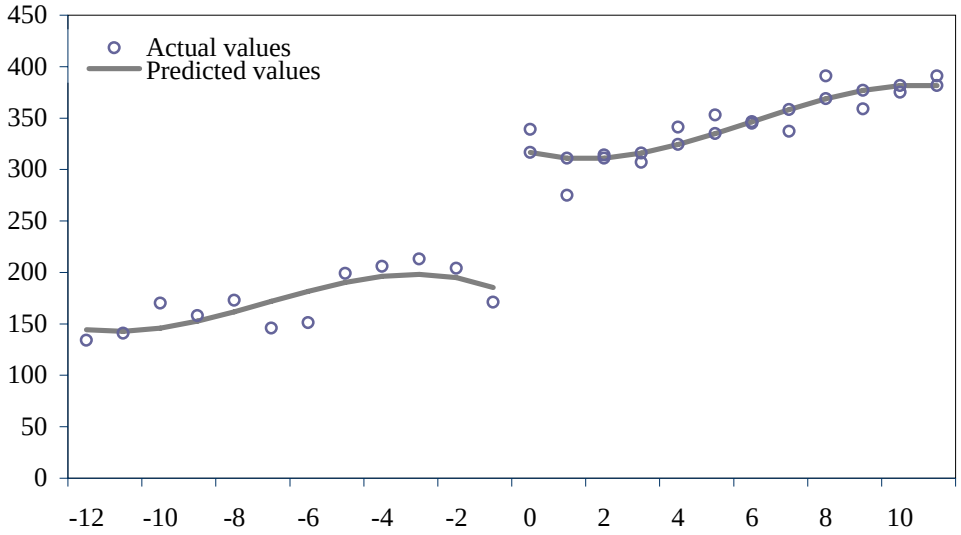


Figure 1c. Average yearly number of abortions by patients' age in months at the time of abortion; Conception year 2001

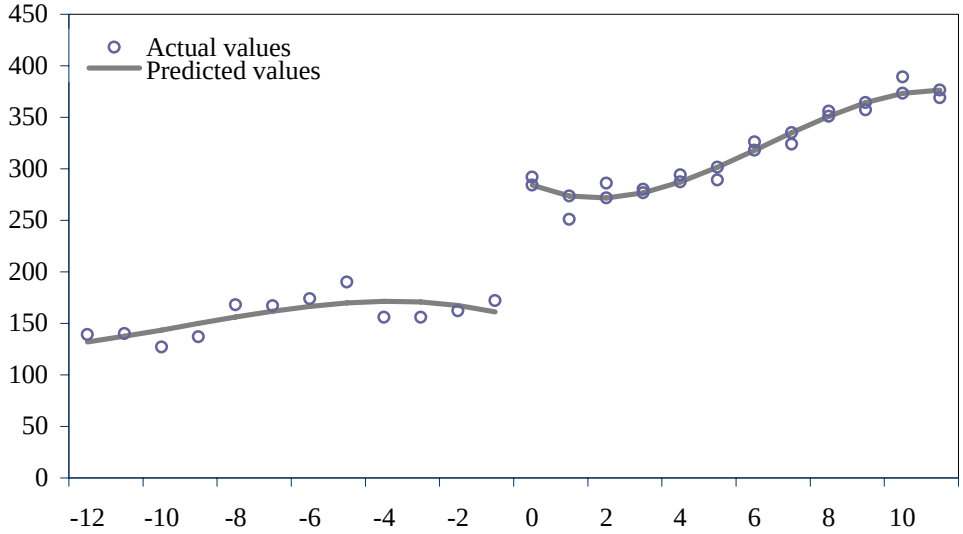


Figure 1d. Average yearly number of abortions by patients' age in months at the time of abortion; Conception year 2002

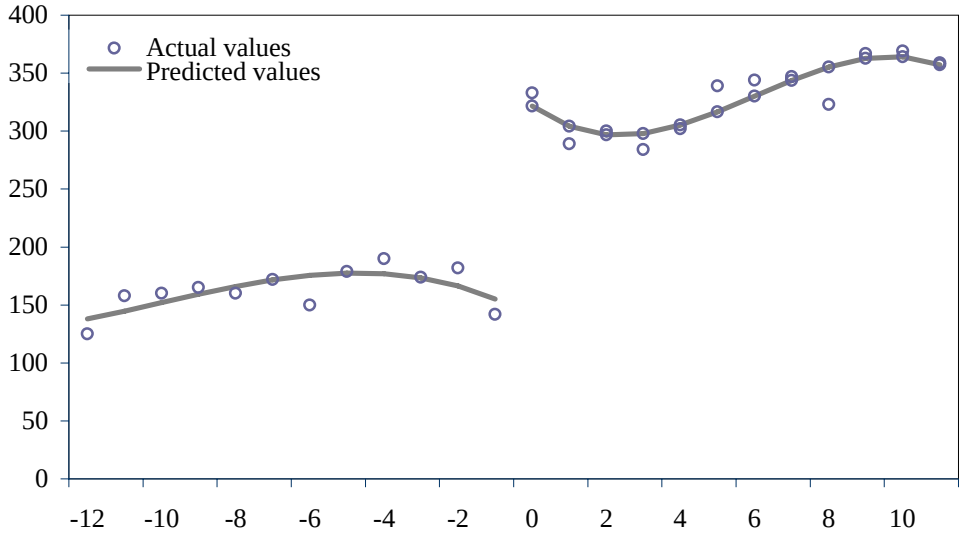


Figure 1e. Average yearly number of abortions by patients' age in months at the time of abortion; Conception year 2003

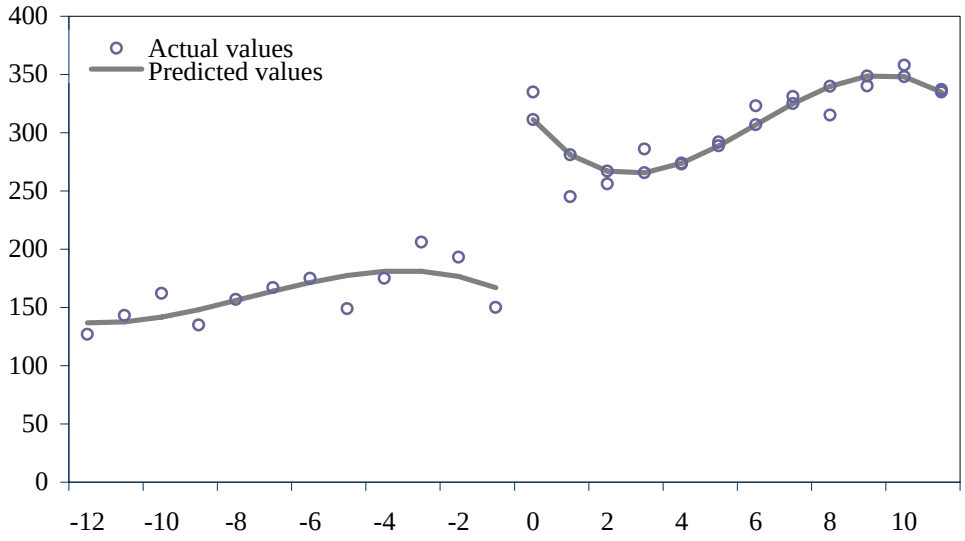


Figure 2a. Proportion of abortions that were obtained at age 18, among teens who were between 17 years and 5-11 months of age at the time of conception; Texas residents

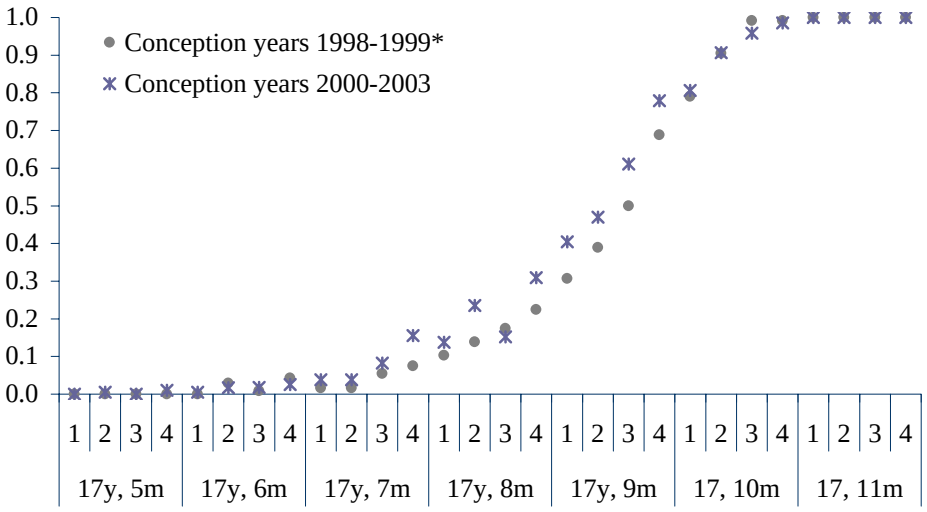


Figure 2b. Change in the proportion of abortions that were obtained at age 18 between 1998-1999 and 2000-2003 among teens who conceived at ages 17 years and 6 - 11 months, by age in months at the time of conception; Texas residents

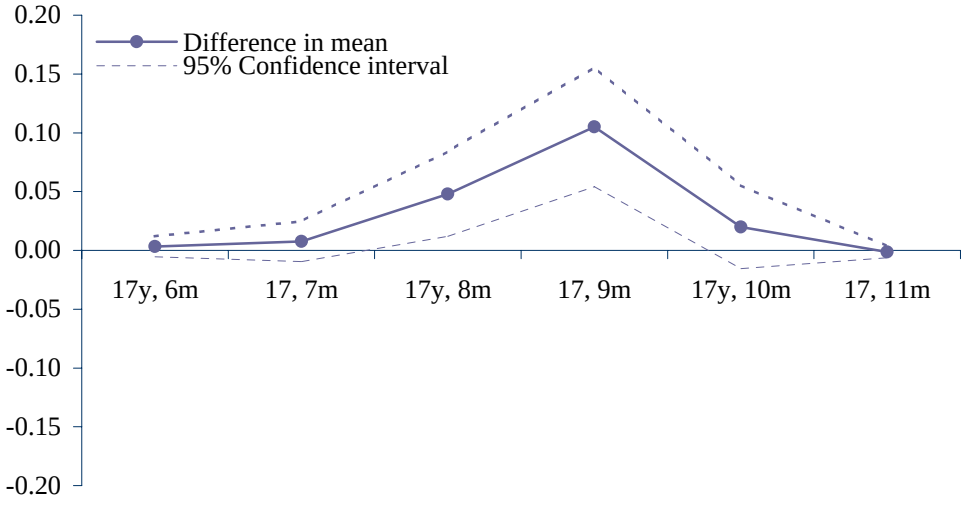


Figure 3a. Proportion of abortions that were obtained at age 17, among teens who were between 16 years and 5-11 months of age at the time of conception; Texas residents

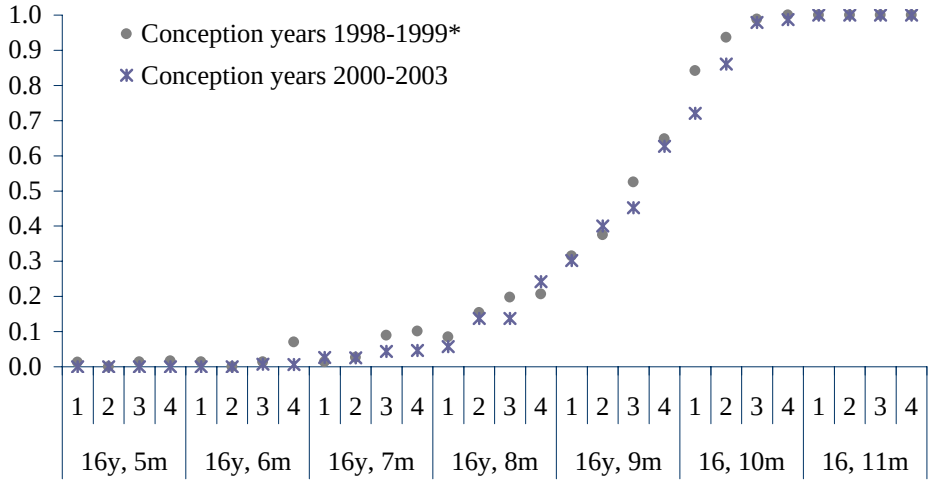


Figure 3b. Change in the proportion of abortions that were obtained at age 17 between 1998-1999 and 2000-2003 among teens who conceived at ages 16 years and 6 - 11 months, by age in months at the time of conception; Texas residents

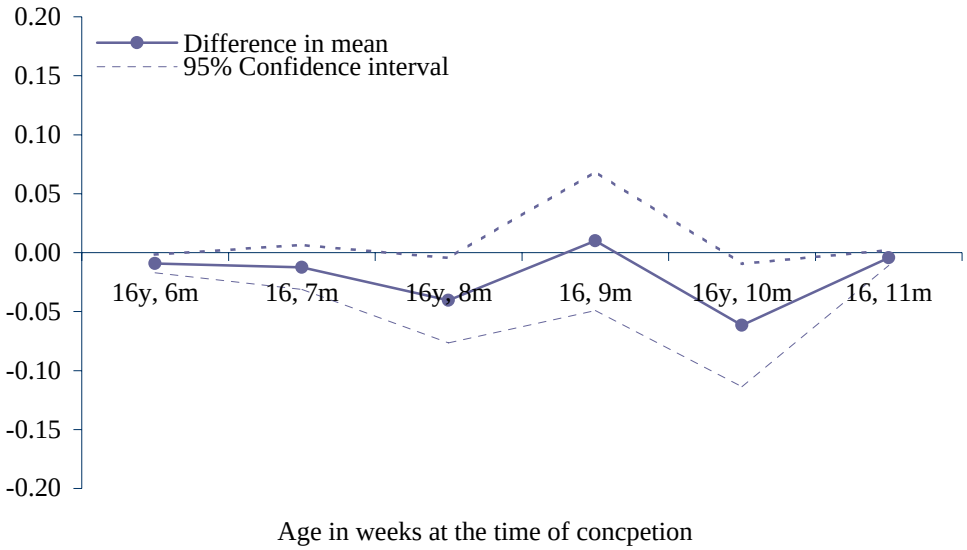


Figure 4. Percent of abortions with gestational age greater than 12 weeks, by age in months at conception and year of conception (1998-1999 vs. 2000-2003); Texas residents

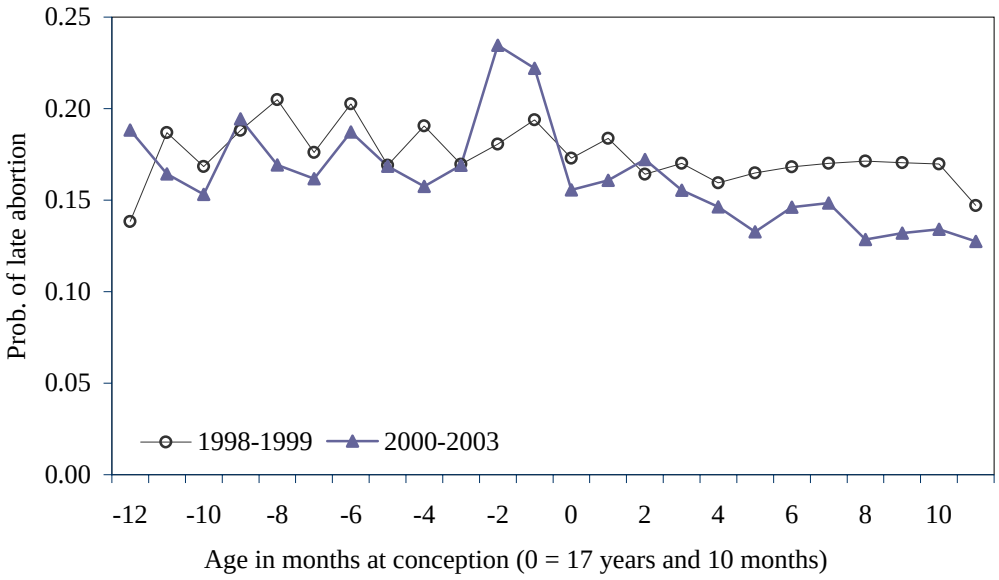


Figure 5a. Case 1 - A hypothetical example of the after-law age profile of second-trimester abortions if the law did not cause an increase in the number of second-trimester abortions among teens who delay

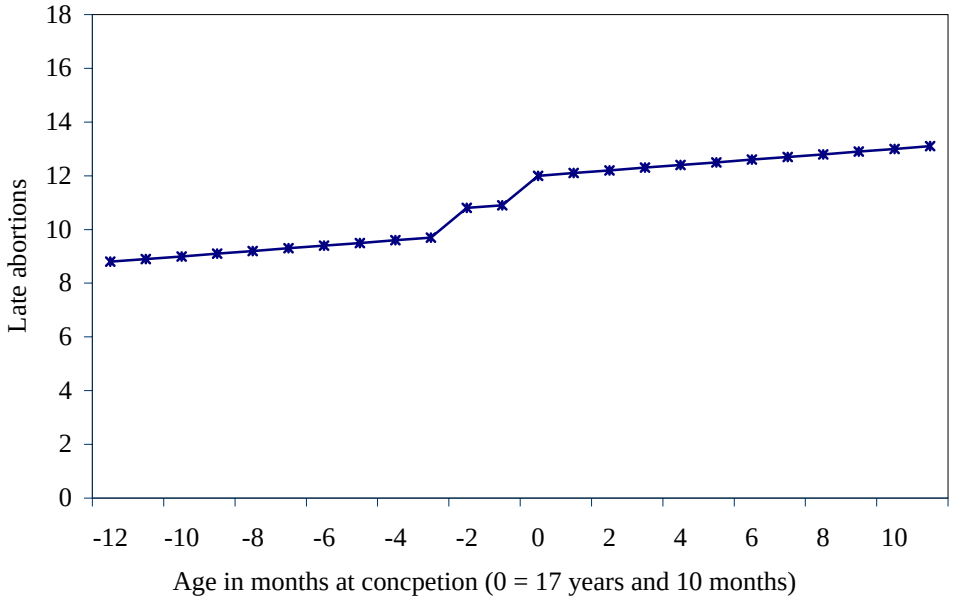


Figure 5b. Case 2 - A hypothetical example of the after-law age profile of second-trimester abortions if the law increased the number of second-trimester abortions among teens who delay

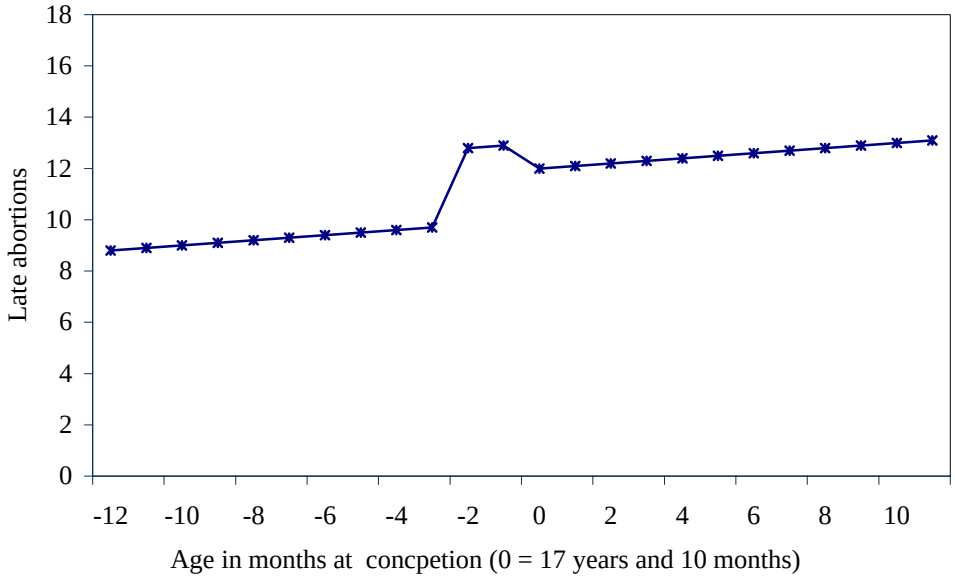


Figure 6a. Yearly number of late abortions by age in months at the time of conception along with the predicted values from a linear specification of Φ(.); Conception years 2000-2003 (post-law)

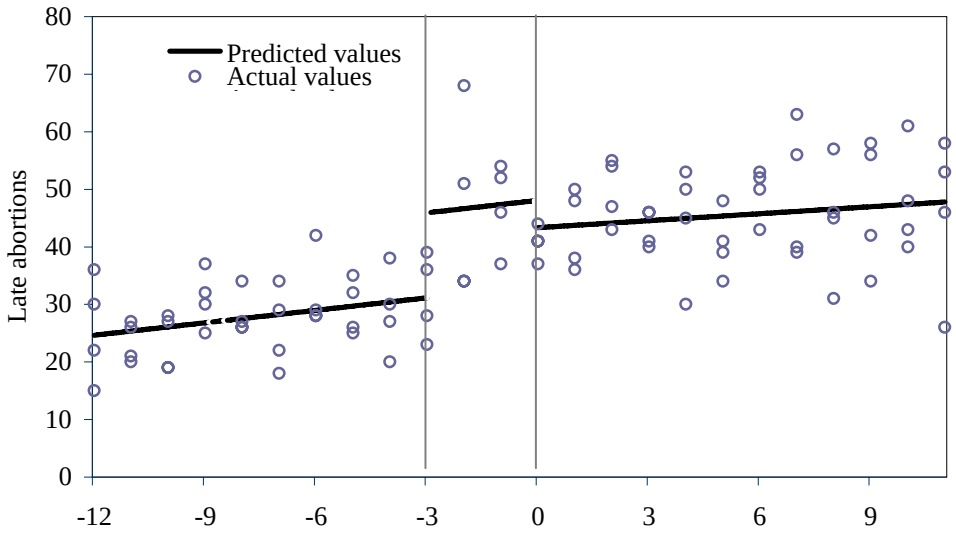


Figure 6b. Yearly number of late abortions by age in months at the time of conception along with the predicted values from a linear specification of Φ(.); Conception years 1998-1999 (pre-law)

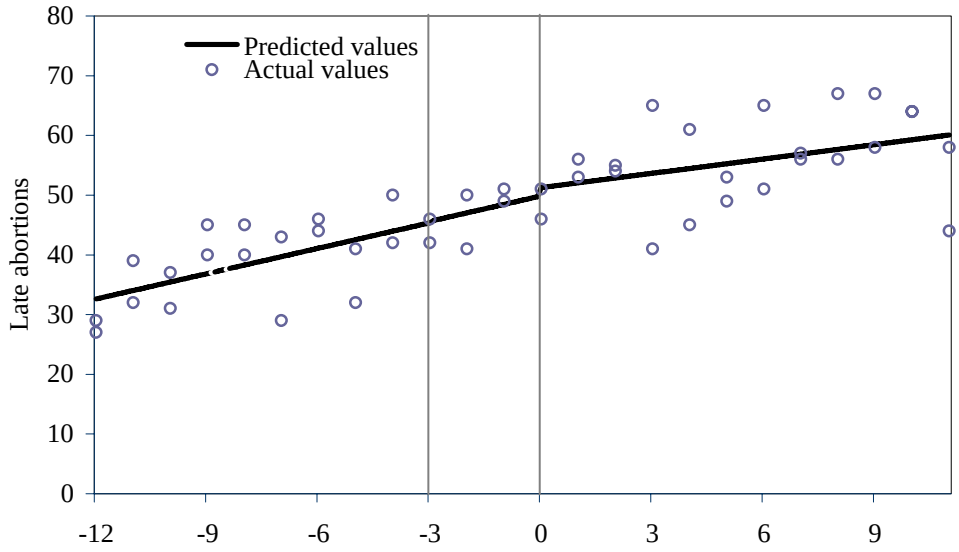


Figure 7a. Yearly number of late abortions by age in months at the time of conception along with the predicted values from a quadratic specification of Φ(.); Conception years 2000-2003 (post-law)

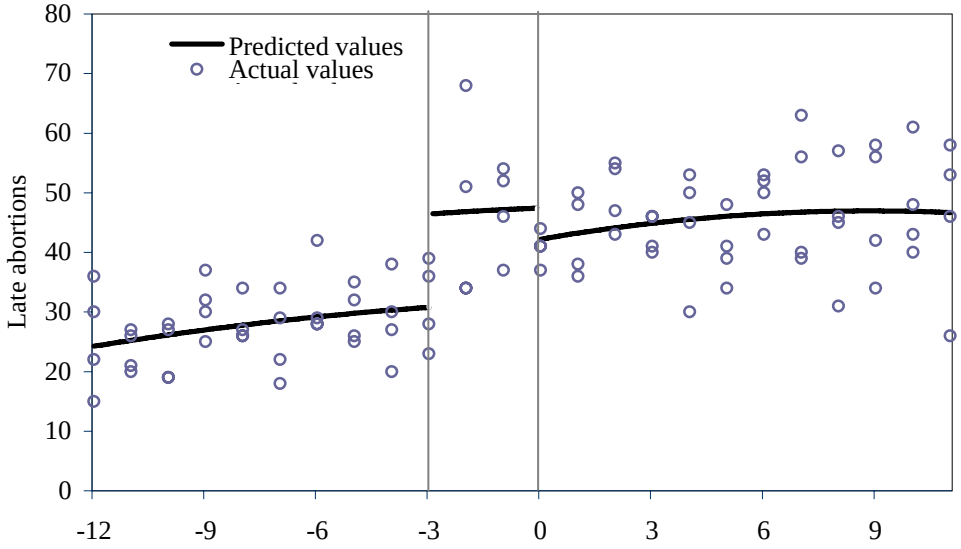


Figure 7b. Yearly number of late abortions by age in months at the time of conception along with the predicted values from a quadratic specification of Φ(.); Conception years 1998-1999 (pre-law)

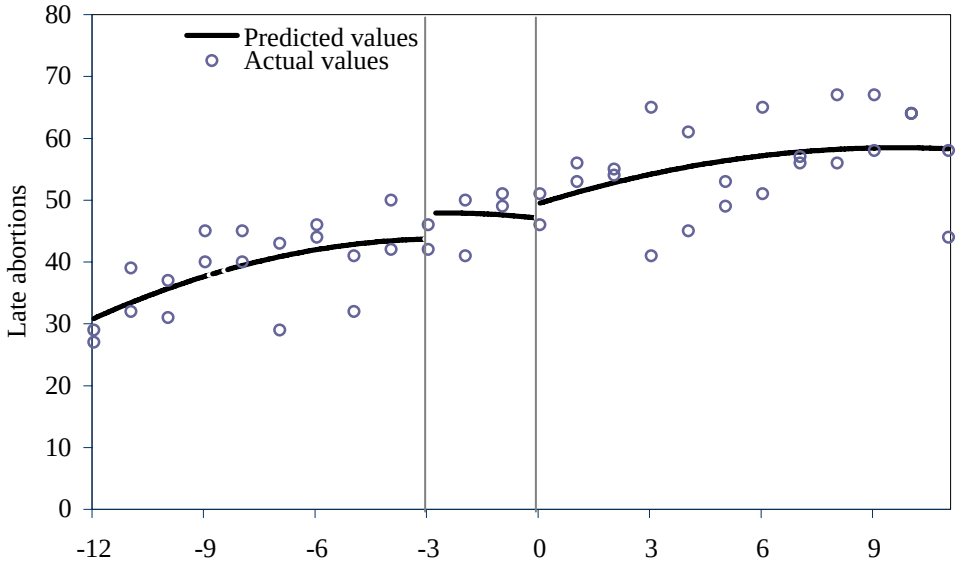


Figure 8a. Log of yearly number of late abortions by age in months at the time of conception along with the predicted values from a linear specification of Φ(.); Conception years 2000-2003 (post-law)

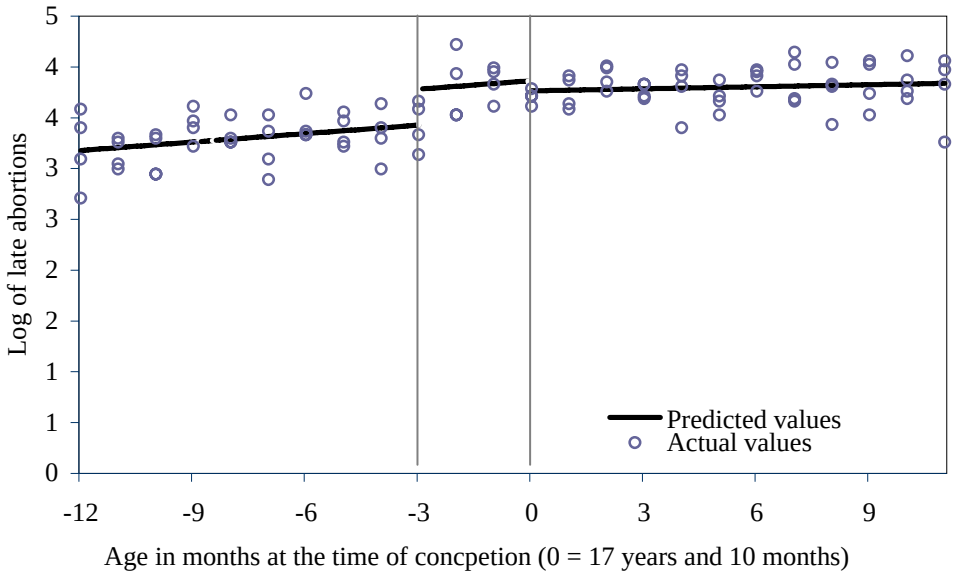


Figure 8b. Log of yearly number of late abortions by age in months at the time of conception along with the predicted values from a linear specification of Φ(.); Conception years 1998-1999 (pre-law)

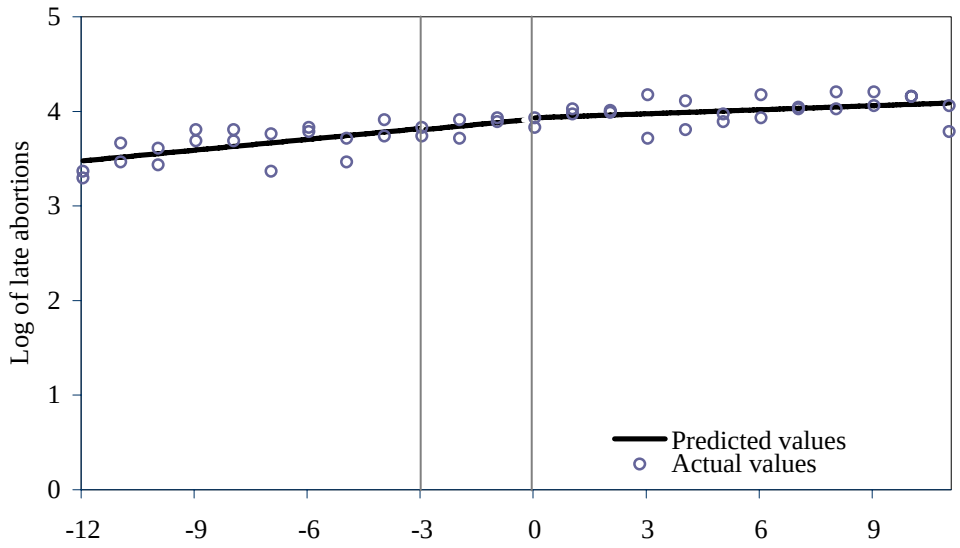


Figure 9a. Log of yearly number of late abortions by age in months at the time of conception along with the predicted values from a quadratic specification of Φ(.); Conception years 2000-2003 (post-law)

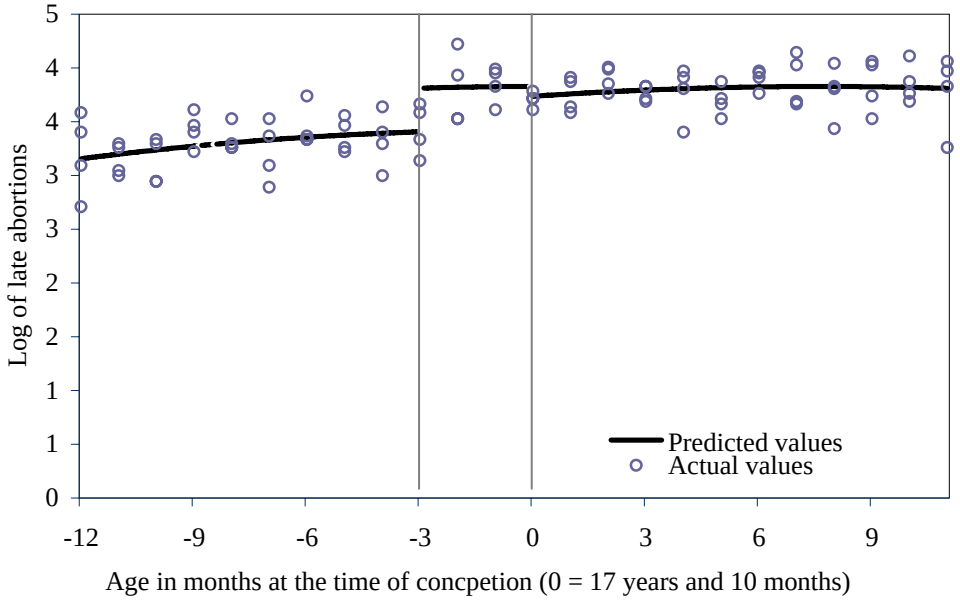


Figure 9b. Log of yearly number of late abortions by age in months at the time of conception along with the predicted values from a quadratic specification of Φ(.); Conception years 1998-1999 (pre-law)

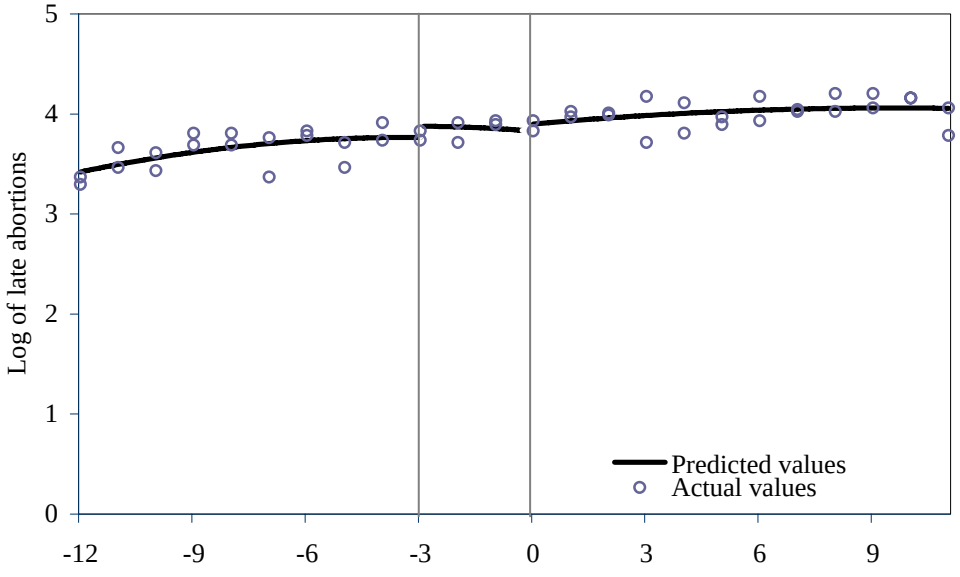
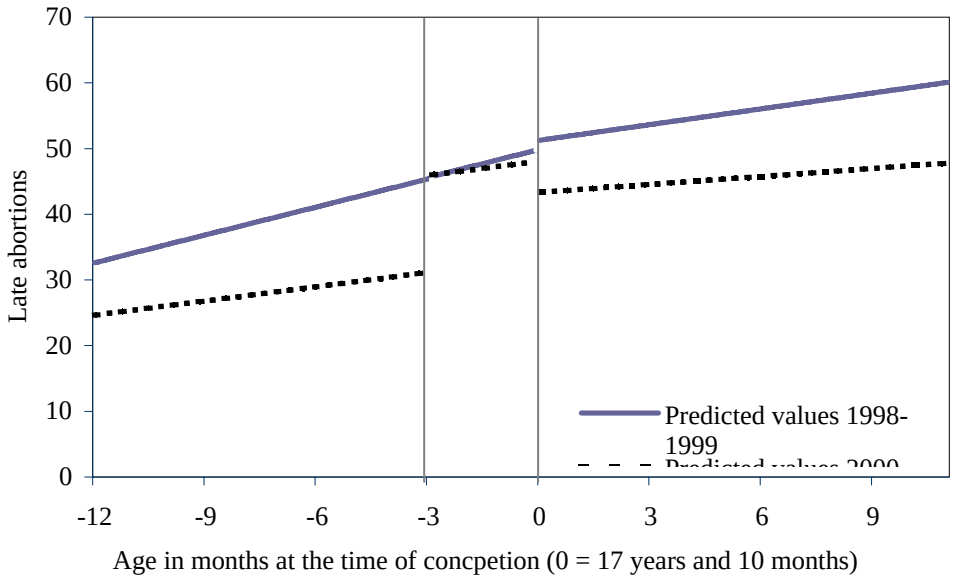


Figure 10. Predicted values for late abortions using the linear specification of *Φ(.)* separately for the before and after-law periods



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