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HOW FAR IS TOO FAR? NEW EVIDENCE ON ABORTION CLINIC CLOSURES, ACCESS, AND ABORTIONS

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ABSTRACT

We estimate the effects of abortion clinic closures on clinic access and on abortions using variation generated by Texas HB2, a "TRAP" law that shuttered nearly half of Texas' abortion clinics in late 2013. After demonstrating that pre-existing trends in abortion rates were unrelated to the changes in access caused by HB2, we implement a difference-in-differences research design to identify the effects of abortion access. Our results suggest a substantial and non-linear effect of distance to clinics. Increases from less than 50 miles to 50-100, 100-150, and 150-200 miles reduce abortion rates by 13, 24, and 40 percent, respectively, while additional increases in distance appear to have no additional effect. We also introduce a proxy for congestion that predicts additional reductions in abortion rates as fewer clinics serve more women.

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1 Introduction

In June of 2016, the United States Supreme Court issued its first major abortion ruling in a quarter century, striking down Texas HB2, an abortion law that had shuttered many of the clinics in the state and threatened to close all but a handful of those that remained (*Whole Woman's Health v. Hellerstedt*, 2016). This landmark case set a new precedent for evaluating abortion regulations against the "undue burden standard" established in *Planned Parenthood v. Casey* (1992). In particular, the decision in *Whole Women's Health v. Hellerstedt* stated that courts must "consider the burdens a law imposes on abortion access together with the benefits those laws confer" and highlighted an critical role for empirical evidence.

Quite notably, however, there is very little empirical evidence on the causal effects of targeted regulation of abortion provider (TRAP) laws and, more generally, on the causal effects of abortion clinic closures and access to abortion services. In this study we aim to fill these gaps in knowledge. Though this evidence comes too late to inform *Whole Women's Health v. Hellerstedt*, it comes at a key moment in the broader history of abortion provision in the United States as legislators continue to propose laws that make it more difficult for abortion clinics to operate and as clinics are "closing at a record pace" (Deprez, 2013). What happens if/when these laws are passed and enacted, forcing clinics to close? Or what if some other "supply-side" factor causes closures?

Texas' recent history offers an opportunity to learn the answer to these questions. Texas HB2, which was enacted in July 2013, required physicians at abortion clinics to have admitting privileges at a hospital within 30 miles of the facility and abortion facilities to meet the standards of an ambulatory surgical center. Unable to meet the first of these requirements, nearly half of the abortion clinics in Texas immediately closed when it began to be enforced on November 1, 2013 (Figure 1). On average this doubled a Texas resident's distance to her nearest clinic (including those in adjacent states), but those in some counties were affected more than others (Figure 2).

We treat this as a natural experiment, estimating difference-in-differences models of the causal effects of abortion-clinic access on abortions. To implement this research design, we construct a panel of data on abortion clinic operations from 2009 through 2015 in Texas and its neighboring states. After showing that the pre-existing trends in abortion rates (and other predictors of abortion rates) were unrelated to changes in access, we estimate the causal effects of different levels of access on abortion rates. We estimate that a 100 mile increase in distance to the nearest abortion clinic reduces abortion rates by 22 percent on average. We also find evidence of a non-linear relationship in which increases in distance have less effect in counties that already are more than 200 miles away from an abortion clinic. Relative to having an abortion clinic within 50 miles, abortion rates fall by 13 percent if the nearest clinic is 50-100 miles away, by 24 percent if the nearest clinic is 100-150 miles away, and by 40 percent if the nearest clinic is 150-200 miles away, from which point additional increases have little additional effect.

Distance to the nearest clinic, however, is not the only dimension of access. There is substantial anecdotal and survey evidence that as fewer clinics served larger regions in Texas, wait times increased (TPEP, 2015). We introduce a new proxy for congestion based on the population expected to be served by each clinic. Increasing congestion predicts additional reductions in abortion rate, though the statistical significance of this estimate is somewhat sensitive to the years of data used in the analysis.

To put the contribution of our work into context, it is important to note that U.S. legislators seeking to reduce abortions have historically attempted to do so through "demand-side policies" that directly target pregnant women seeking abortions, such as parental involvement and mandatory delay laws (Joyce, 2011), and that these sorts of policies have been studied extensively in prior work. "Supply-side policies" targeting abortion facilities are a more-recent phenomenon and thus have received far less attention from researchers. On the topic of supply-side policies, Grossman et al. (2017) have shown that Texas counties with the greatest change in distance-to-nearest-abortion-facility between 2012 and 2014 experienced the greatest reductions in residents obtaining abortions, and Lu and Slusky (2016b) have shown that closures of "women's health clinics"—which includes both family planning and abortion clinics—increased birth rates in Texas during an earlier time when family planning funding was substantially cut.[1] Because Grossman et al. (2017) is primarily descriptive and Lu and Slusky (2016b) are unable to distinguish between family planning clinics and abortion clinics and the context is such that their estimates likely reflect the effects of family planning clinic closures, we believe our study is the first to provide credible estimates of the causal effects of reduced access to abortion clinics, the first to demonstrate substantial nonlinearities in the effects of distance to such clinics, and the first to estimate the effects of congestion.

The remainder of this paper is organized as follows. In the next section, we provide a brief history of U.S. abortion legislation and Texas abortion legislation before describing Texas HB2 in detail. We then describe our data and research design in sections 3 and 4. We present the results of our analysis in Section 5 and then discuss these results in our conclusion.

2 Background

2.1 Abortion Legislation in the United States

Prior to 1973, when *Roe v. Wade* legalized abortion nationwide, abortion was largely regulated at the state level. From the 19th and through the mid-20th century, abortion regulations were restrictive and appear to have increased childbearing (Lahey, 2014). The regulatory trend shifted in the late 1960s. Between 1967 and 1972, 13 "reform states" liberalized their abortion laws and five "repeal states" and the District of Columbia made abortion legal under most circumstances (Myers, 2016). Researchers have exploited this variation in modern state policies, using quasi-experimental research designs to provide evidence that the legalization of abortion had strong effects on abortion and childbearing (Levine et al., 1999; Angrist and Evans, 2001; Ananat et al., 2007; Joyce et al., 2013; Myers, 2016).

The controversy over abortion did not subside after the sweeping national liberalization

[1] In related work, Lu and Slusky (2016a) also show that the closure of such clinics reduce preventative care.

of access; in fact, abortion regulation increased in many states as legislators sought to define the legal limits of access. For the first three decades following *Roe*, state abortion regulations were primarily focused on codifying when and under what circumstances women can obtain an abortion and what sources of funding are available (Guttmacher Institute, 2016a). From an economic standpoint, such policies can be classified as "demand-side regulations" because they focused on regulating the consumers of abortion: pregnant women. These laws include parental consent requirements, waiting periods, mandated counseling and ultrasounds, restrictions on the use of public funds, and bans of abortions later in pregnancy.

Beginning roughly a decade ago, regulatory efforts increasingly focused on abortion supply as states began enacting "targeted regulation of abortion providers" or "TRAP" laws that directly govern abortion facilities and providers. At present twenty-four states have enacted some version of these laws, though enforcement is enjoined in some states (Guttmacher Institute, 2016b). Eleven states have enacted laws requiring abortion providers to have admitting privileges at a local hospital or an alternative arrangement, such as an agreement with another physician who has admitting privileges. Seventeen states have requirements for facilities, such as specifying the sizes of procedure rooms or the minimum distance to the nearest hospital, or requiring transfer agreements with the nearest hospital. The most stringent facilities requirements mandate structural standards comparable to those for surgical centers (Guttmacher Institute, 2016b). While proponents of TRAP laws argue that they make abortion safer, critics have argued that they do no such thing, and that the true intention is to limit access to abortion by making it difficult or impossible for some clinics to continue operations.

2.2 Texas HB2 and its Aftermath

Texas HB2, which was enacted in July 2013, had two key provisions: (1) It required all abortion providers to obtain admitting privileges at a hospital located within 30 miles of the location at which an abortion was performed and (2) It required all abortion facilities to meet the standards of an ambulatory surgical center, regardless of whether they were providing surgical abortions or providing medication to induce abortions (Texas HB2, 2013). In addition to these provisions, HB2 also prohibited abortions after 20 weeks gestation and required physicians to follow FDA protocols for medication-induced abortions, which restricted the use of abortion pills to within 49 days post-fertilization and required that the medication be administered by a physician.[2] Proponents of the law argued that these requirements ensured the safety of abortion services and easy to access to a hospital in the event of complications (*Whole Woman's Health v. Hellerstedt*, 2016).

Obtaining admitting privileges can be lengthy process, as it takes time for hospitals review a doctor's education, licensure, training, board certification, and history of malpractice. Moreover, many hospitals require admitting doctors to meet a quota of admissions. After the enactment of HB2, a group of Texas abortion providers filed suit, challenging the enforcement of the admitting privileges requirement that was scheduled to take effect on October 29, 2013. A District Court ruled in their favor, concluding that admitting privileges "have no rational relationship to improved patient care" and that "the vast majority of abortion providers are unable to ever meet the threshold annual hospital admissions, because the nature of the physicians' low-risk abortion practice does not generally yield any admissions" (*Planned Parenthood of Greater Texas Surgical Health Services v. Abbott*, 2013b).[3] However, the State appealed the ruling and the Fifth Circuit Court of Appeals permitted the admitting privileges requirement to take effect on November 1, 2013 (*Planned Parenthood of Greater Texas Surgical Health Services v. Abbott*, 2013a). As a result, nearly half of Texas' abortion clinics shuttered their doors because they were unable to comply with the requirement (*Whole Woman's Health v. Hellerstedt*, 2016).

The second major restriction of HB2, the ambulatory surgical center requirement, required

[2]The FDA guidelines have since been revised (March 2016) to indicate that these pills can be used up to 70 days into a pregnancy and that the second abortion pill need not be administered by a physician. In particular, it states that the second pill can be taken at a "location appropriate for the patient."

[3]Henshaw (1999) estimates that 0.3 percent of abortion patients experience a complication that requires hospitalization. As a point of comparison, Callaghan et al. (2012) estimates that 1.3 percent of delivery hospitalizations involve a severe complication.

clinics to meet additional size, zoning, and equipment requirements to meet the licensure standards for ambulatory surgical centers. This requirement was scheduled to take effect on September 1, 2014, 10 months after the admitting privileges requirement, and threatened most of Texas' remaining clinics. At the time HB2 was passed, only 6 facilities in 4 cities—Austin, Fort Worth, Houston and San Antonio—met the standards of an ambulatory surgical center.[4] A group of abortion providers filed suit for a second time, challenging both the ambulatory surgical center requirement and also requesting relief from the admitting privileges requirement as applied to two specific clinics, Whole Woman's Health in McAllen and Reproductive Services in El Paso. In response the District Court enjoined enforcement of both provisions, but again the Fifth Circuit reversed, allowing the ambulatory surgical center requirement to go into effect on October 2, 2014. Two weeks later, the United States Supreme Court intervened, issuing an order blocking enforcement of the ambulatory surgical center requirement for all clinics and of the admitting privileges requirement for the clinics in McAllen and El Paso.

In June of 2016, the United States Supreme Court struck down these two provisions of Texas HB2, issuing a majority opinion that Texas had failed to demonstrate that they served a legitimate interest in regulating women's health and that they imposed an undue burden on access to abortion (*Whole Woman's Health v. Hellerstedt*, 2016). It remains to be seen whether the many clinics that closed as a result of this requirement will re-open or otherwise be replaced following the Supreme Court ruling. As of March 2017, only one clinic, Whole Woman's Health in Austin, has announced plans to do so (Tuma, 2017).

In the wake of the *Whole Woman's Health v. Hellerstedt* ruling, abortion opponents continue to focus on supply-side abortion restrictions. Many states with TRAP laws continue to enforce them (Guttmacher Institute, 2016b) and, two days after the Supreme Court struck down HB2, Texas legislators proposed new rules requiring that abortion providers bury or

[4]In response to the law, Planned Parenthood opened an additional facility in Dallas in the summer of 2014 at a cost of over 6 million dollars (Martin, 2014). Two additional ambulatory surgical centers opened the following year. Both were in San Antonio, where Planned Parenthood built a new surgical facility at a cost of 6.5 million dollars (Stoeltje, 2014a) and Alamo Women's Reproductive Services relocated to a surgical facility at a cost of 3 million dollars (Garcia-Ditta, 2015).

cremate fetal remains. Similar laws have been proposed in Indiana and Louisiana, and could add substantially to the cost of an abortion (Zavis, 2017).

As such, policy considerations in the future are likely to depend on knowing what happens when abortion clinics close. The remainder of this paper focuses on answering this question, using the Texas experience as a case study. One important part of this context is that Texas has a law requiring a 24-hour waiting period after a counseling session before an abortion can be performed. This law went into effect in 2011 and does not apply to women who live more than 100 miles from the clinic. We note that the effects of access to abortion clinics may interact with these laws in important ways that could make it difficult to extrapolate from the results of our analysis to other contexts. That said, Texas is not atypical in having such laws: 35 states have counseling requirements, 27 have waiting periods, and 24 hours is the most common waiting period (Guttmacher Institute, 2017).

3 Data

Table 1 summarizes the variables used in our analysis: measures of abortion access, abortion rates, and time-varying control variables measuring county demographics: age and racial composition (SEER, 2016) and unemployment (BLS, 2016).

3.1 Abortion access in Texas

To evaluate the effects of Texas HB2 on abortion-clinic access, we compile a database of abortion clinic operations in Texas and adjacent states based on a variety of sources including licensure data maintained by the Texas DSHS, clinic websites, judicial rulings, newspaper articles, and websites tracking clinic operations maintained by both advocacy and oppositional groups. Appendix B contains detailed information on abortion clinic operations in Texas. Figure 1 mentioned above, which shows quarterly trends in the number of clinics providing abortion services in Texas, is based on these data. Between July 18, 2013, when HB2 was enacted, and November 1, 2013 when its first major requirement went into effect, 18 of Texas' 42 abortion clinics shut their doors, many for good.[5]

We use the clinic operations database to construct two county-level measures of abortion access: distance to the nearest abortion provider and a measure of congestion we term the *average service population*. Distance to the nearest provider is calculated using the Stata *georoute* module (Weber and Péclat, 2016) to estimate the travel distance from the population centroid of each county (United States Census Bureau, 2016) to the nearest operating abortion clinic.[6] Figure 1 illustrates that the distance the average Texas woman had to travel to reach an abortion clinic increased from 21 miles in the quarter prior to HB2 to 44 miles in the quarter immediately after. The percentage of women who had to travel more than 100 miles (one-way) to reach a clinic increased from 5 to 15 percent.[7] Figure 2 mentioned above describes the spatial patterns of clinic closures occurring between Quarter 2 2013 and Quarter 4 2013 when HB2's first major requirement went into effect. The central-western region of Texas exhibits the largest increases in travel distances, in many cases in excess of 100 miles. Counties for which the nearest abortion clinic was located in a major city—Houston, Dallas, Fort Worth, San Antonio, Austin or El Paso—do not show any change because at least one clinic remained open in these places.

Access to abortion services, however, is not a function of distance alone. The number of physicians providing abortions in the state dropped from 48 to 28, largely due to an inability to obtain admitting privileges (TPEP, 2016), and one quarter of the clinics that remained open in November 2013 did so with a reduced staff (TPEP, 2013). As the number of clinics and providers shrank, wait times to obtain an abortion likely increased. The Texas

[5] Clinics are coded as "open" if they provided abortions for at least two out of three months in a given quarter. Hence, Figure 1 and the analysis that follow do not reflect the brief mass closures that occurred for two weeks in October 2014 when the surgical center requirement was enforced. The increase in average distance in the second quarter of 2014 is due to the closure of the sole clinic in Corpus Christi. For a few months, until the McAllen clinic re-opened in the third quarter of 2014, there was no abortion provider in south Texas.

[6] In the appendix, we also present alternative results using geodesic ("as the crow flies") distance calculated with the *geonear* module (Picard, 2010). These results are very similar to those using travel distance.

[7] These are population-weighted county averages using estimates of the populations of women aged 15-44 (SEER, 2016).

Policy Evaluation Project conducted monthly telephone surveys of clinic wait times in Texas, beginning after the admitting-privileges requirement went into effect. Though the timing of this effort precludes an analysis of the immediate effect of HB2, it does reveal that wait times hit three weeks in Austin, Dallas and Fort Worth clinics (TPEP, 2015). In Dallas, wait times remained fairly stable until July 2015, when the closure of a large abortion facility in Dallas caused them to increase from 2 to 20 days.

Ideally, we would like to measure wait times as an additional proxy for abortion access, but this is impossible because, to our knowledge, no data on wait times were collected prior to the implementation of HB2. We therefore propose an alternative measure of abortion access that captures the increasing patient loads faced by a reduced number of clinics. We call this variable the "average service population." To construct it, we first assign each county c in time period t to an "abortion service region" r according to the location of the closest city with an abortion clinic.[8] The average service population is the ratio of the population of women aged 15-44 in the service region to the number of clinics in the service region:

$$Average\ service\ population_{c,r,t} = \frac{\sum_{c \in r} population_{c,t}}{number\ of\ clinics_{r,t}}. \tag{1}$$

Figure 3 depicts the service region boundaries and average service populations for the second and fourth quarters of 2013, while Figure 4 summarizes the *change* in the average service population. The average service population rose during this period for two reasons: (1) As clinics closed in small cities, women had to travel to clinics that remained in larger cities, shrinking the number and expanding the sizes of service regions; and (2) As clinics closed in large cities, there were fewer providers of abortion services. In the immediate aftermath of

[8]To construct the ASP measure, we combine clinics that are in different counties but the same commuting zone. For instance, the city of Austin has abortion clinics in both Travis and Williamson counties; we use the population centroid of Travis county, the more populated of the two, to construct the Austin service region. Because they are in the same commuting zone, we additionally combine Shreveport and Bossier City, Louisiana (3 miles apart), Oklahoma City and Norman, Oklahoma (20 miles apart), Sugar Land and Houston, Texas (22 miles apart), Harlingen and McAllen, Texas (35 miles apart), and El Paso, Texas and Las Cruces, New Mexico (54 miles apart). We additionally combine Dallas and Fort Worth (33 miles apart), although they are not in the same commuting zone. The results are similar if we use a different rule, combining counties only if their population centroids are less than 25 miles apart.

HB2, the average service population increased across much of Texas, including by more than 200,000 in the Dallas-Fort Worth region where distances did not change when HB2 went into effect even though several clinics closed. Clinic closures during 2014 additionally increased ASP for many regions. For example, by the fourth quarter of 2014, 8 clinics in Houston served 29 counties, up from 10 clinics serving 14 counties in 2009. As a result, the average service population increased from 108,000 to 270,000 women of childbearing age per clinic.

3.2 Abortion Rates in Texas

We use publicly available data on Texas abortions by county of residence (TDSHS, 2017). To produce these data, the Texas DSHS combines in-state abortions, which providers are mandated to report, with information on out-of-state abortions it obtains via the State and Territorial Exchange of Vital Events (STEVE) system. To construct abortion rates, we use population denominators based on annual estimates of county populations by race, gender and age from SEER (2016).

The Texas abortion rates therefore account for interstate travel so far as the Texas DSHS is able to observe abortions to Texas residents occurring in other states. The state abortion reporting system is voluntary, and the information collected varies across states and over time. Texas and 43 other states, including neighboring Louisiana, Oklahoma and New Mexico, collect information on the residence of abortion patients (CDC, 2015). However, Louisiana did not begin recording state and county of residence for out-of-state residents until 2012, and these counts were not incorporated into the Texas abortion data until 2013.[9] Further complicating matters, although Oklahoma continues to collect information on state of residence, it ceased collecting county of residence in April 2012 (OSDH, 2013). Moreover,

[9] In email correspondence with the authors dated November 29, 2016, staff at the Louisiana Vital Records office advised that they began collecting information on state of residence in 2012, but cannot say when Texas began receiving this information. In email correspondence with the authors dated January 20, 2017, staff at the Texas DSHS report that they did not receive a variable reporting state of occurrence until 2014, and so cannot say when they began receiving the Louisiana data. They note that Louisiana is included in 2014. Looking at time trends, the authors observe a sharp increase in abortions in Texas counties on the Louisiana border in 2013, and infer that this is the year Louisiana abortions began to be included in the counts of abortions to Texas residents.

New Mexico ceased collecting information on state of residence for out-of-state patients in 2013.[10] Texas residents' abortions in New Mexico and Oklahoma cannot be assigned a county of residence after these dates.

The lack of complete reporting of out-of-state abortions is a potential concern because undercounting out-of-state travel to obtain abortions could cause us to overstate the effects of reduced access to clinics. That said, this is unlikely to be a major issue or to drive our main results. Out-of-state abortions were a small fraction of the total obtained by Texas residents before the policy change; they accounted for approximately 2 percent of the total in 2013.[11] We anticipate that Texas women traveled to neighboring states in increasing numbers following HB2 and address this issue in several ways. First, we can restrict our analysis to counties where it is unlikely for women to seek abortions out of state in any year. We do so by focusing our attention on counties for which the nearest abortion clinic is always in Texas. This amounts to excluding counties in the Texas Panhandle and Northeastern Texas. This robustness check yields estimated quite similar to our main results. Moreover, we also demonstrate that the estimated effects that we find are far too large to be explained by observed increases in abortions in New Mexico and Oklahoma, even under very conservative assumptions.

4 Empirical Strategy

We estimate the effects of access to abortion clinics using a generalized difference-in-differences design, which exploits within-county variation over time while controlling for aggregate time-varying shocks. The identifying assumption underlying this approach is that changes in abortion rates would have been the same across Texas counties in the absence of differential changes in access to abortion clinics. We provide empirical support for the validity of this

[10]We learned this in an April 25, 2017 email correspondence with staff at the New Mexico Bureau of Vital Records and Health Statistics.

[11]This estimate is based on a cross tabulation of abortion counts by state of residence and state of occurrence published by the CDC (2016). Louisiana counts do not appear to be incorporated into this table, so the authors added them to the out-of-state total using data supplied by the Louisiana Department of Health.

assumption in the next section.

Given the discrete nature of abortions, and because we encounter cells with zero abortions when looking at some subgroups, we operationalize this strategy with a Poisson model.[12] In particular, our approach to estimating the effect of changes in abortion access on the abortion rate corresponds to the following equation:

$$E[AR_{ct}|\boldsymbol{access_{ct}}, \alpha_c, \theta_t, \boldsymbol{X_{ct}}] = exp(\boldsymbol{\beta access_{ct}} + \alpha_c + \theta_t + \boldsymbol{\gamma X_{ct}}) \tag{2}$$

where AR_{ct} is the abortion rate for residents of county c in year t; $access_{ct}$ is a measure (or set of measures) of access to abortion clinics for residents of county c in year t; α_c are county fixed effects, which control both observed and unobserved county characteristics with time-invariant effects on abortion rates; θ_t are year fixed effects, which control for time-varying factors affecting abortion rates in all Texas counties in the same manner; and X_{ct} can include time-varying measures of county characteristics such as demographics and access to family-planning clinics. Because Poisson models are more typically thought of as considering counts, not rates, we note that this model can be expressed alternatively as estimating the natural log of the expected count of births while controlling for the relevant population and constraining its coefficient to be equal to one. All analyses allow errors to be correlated within counties over time when constructing standard-error estimates.

As we discussed above, we consider multiple measures of access to abortion clinics. To correspond with the abortion data, which is available for each year, our access measures are annual averages based on the quarterly data described in Section 3. We begin by considering the distance to the nearest clinic from the county centroid. In some sense, this allows us to provide an answer to the question: does distance-to-clinic matter to abortion rates? We then consider the degree to which different distances have different—potentially non-linear—

[12] Like linear models, the Poisson model is not subject to inconsistency caused by the incidental parameters problem associated with fixed effects. While the possibility of overdispersion is the main theoretical argument that might favor alternative models, overdispersion is corrected by calculating sandwiched standard errors (Cameron and Trivedi 2005). Moreover, the conditional fixed effects negative binomial model has been demonstrated to not be a true fixed effects model (Allison and Waterman 2002).

impacts by evaluating the effect of having the nearest clinic within 50–100 miles, 100–150 miles, 150–200 miles, or 200+ miles away (versus having a clinic within 50 miles) and by considering a polynomial in distance. This allows us to provide answers to the questions: at what point does distance become an important enough factor that it influences abortion rates? And how big is this impact for different distances? We also consider abortion-clinic congestion by evaluating the effects of the "average service population," which measures the number of people each clinic is expected to serve in each "service region" described previously. This allows us to determine the degree to which clinic closures affect abortion rates though congestion as well as distance. It is particularly relevant to understanding the effects in areas where the existence of multiple clinics is such that a closure does not have any meaningful impact on the distance a woman has to travel for an abortion but is expected to increase congestion.

5 Results

5.1 Establishing the Validity of the Research Design

The goal of our paper is to provide estimates of the *causal* effects of abortion-clinic access on abortions provided by medical professionals. The identifying assumption underlying our differences-in-difference strategy is that proportional changes in abortion rates would have been the same across Texas counties in the absence of differential changes in access to abortion clinics. This assumption implies that the changes in abortion rates for counties with small changes in access provide a good counterfactual for the changes in abortion rates that would have been observed for counties with larger changes in access if their access had changed similarly.

In order to assess the credibility of this identifying assumption, we categorize counties into four groups based on their changes in distance-to-nearest-clinic between the second quarter of 2013 (before HB2) and the fourth quarters of 2013 (after HB2). One group consists of counties with no increase in distance-to-nearest-clinic over this time period. The other three groups of counties are in terciles based on the amount that their distance-to-nearest-clinic increased over the same period. As we show in the upper panel of Figure 5, the average distance-to-nearest-clinic was flat at 19 miles from 2009–2013 for the first group of counties, before increasing to 26 miles in subsequent years. The trend is very similar for the lowest-tercile group with increases in distance-to-nearest-clinic in 2013: the average distance-to-nearest-clinic was flat at 22 miles miles from 2009–2012 before it increased slightly in subsequent years to 28 miles. For the middle-tercile group, the average distance-to-nearest-clinic was also flat at approximately 22 miles from 2009–2012 before it increased to an annual average of 50 miles in 2013 and 115 miles in 2014. For the upper-tercile group, the average distance-to-nearest-clinic was similarly flat at approximately 27 miles miles from 2009–2012 before it increased to an annual average of 77 miles in 2013 and 223 miles in 2014.

The main point we want to emphasize from the upper panel of Figure 5 is that distance-to-nearest-clinic was extremely flat for all four groups prior to 2013. As such, we can use pre-2013 years to evaluate the credibility of the common trends assumption. Towards this end, the lower panel of Figure 5 plots the log of the abortion rate over time for each of the four groups. Mirroring the national trend, this figure demonstrates that abortion rates were steady from 2009 to 2010 before falling from 2010 to 2013 for all four groups of Texas counties. More importantly, log abortion rates for the four groups track one another fairly closely over this period of time. That is, from 2009 to 2012, log abortion rates were changing very similarly for counties that would subsequently experience a major increase in distance-to-nearest-clinic and counties that would subsequently experience smaller (or no) increases. Our identification strategy assumes this would have continued to be the case in subsequent years in the absence of HB2.

In addition to providing support for the validity of our identification strategy, the lower panel of Figure 5 also provides some visual evidence of the effects of distance on abortion rates. In particular, counties experiencing the greatest increase in distance exhibit correspondingly greater decreases in abortion rates. Some readers may also note that distances decreased somewhat for the top two terciles between 2014 and 2015 and also that that there is a corresponding "rebound" in the abortion rate. This could be taken as further evidence that abortion rates respond to changes in distance to clinics. That said, the magnitude of the rebound in abortion rates is such that it could reflect that the effects of the earlier, larger, increases in distance are short lived. We explore this possibility in our econometric analysis Section 5.5.[13]

To provide further evidence in support of our research design, Appendix Figure A1 shows that the same main features of Figure 5—common pre-HB2 trends and evidence of an effect on counties with the greatest increases in distance-to-nearest-clinic—are also present if we focus on teenagers, women in their 20s, or women in their 30s. Moreover, Appendix Figure A2 presents similar plots for county demographics (race, ethnicity, age), the unemployment rate, and the number of family planning clinics. For the most part, these graphs indicate that the HB2-induced changes in distance-to-nearest-clinic were unrelated to trends in these county characteristics.[14] Moreover, there is no evidence in these figures that changes in demographic, unemployment rates, or family planning clinics could explain the large decline in abortions in 2014 for those counties with the greatest increase in distance-to-nearest-clinic.

[13]We have also investigated the counties underlying this variation in greater detail. They are all in South Texas. Prior to HB2, four cities in South Texas had licensed abortion clinics: San Antonio, Corpus Christi, McAllen, and Harlingen. The clinics in McAllen and Harlingen both closed on November 1, 2013 when the admitting privileges requirement went into effect, causing Corpus Christi– which is about 150 miles away from both locations– to become the nearest destination for women seeking abortions at a licensed clinic. The associated county-level abortion rates fell by 64 percent for McAllen and by 56 percent for Harlingen between 2012 and 2014. In June of 2014, the sole provider of abortion services in Corpus Christi– who commuted there from San Antonio to provide abortion services two days a month– announced that he was retiring for health reasons (Meyer, 2013; Stoeltje, 2014b). As a result, San Antonio became the closest abortion destination for women in McAllen, Harlingen and Corpus for three months, until September 2014 when the Fifth Circuit Court of Appeals carved out an exemption from the admitting-privileges requirement for the McAllen clinic, allowing it to re-open in September. When the McAllen clinic re-opened, abortion rates in McAllen and nearby Harlingen increased to nearly their pre-HB2 levels. Meanwhile, in Corpus Christi, where the part-time clinic had closed, abortion rates fell by 12 percent.

[14]The most notable aspect of these graphs is that the number of family planning clinics fell most in counties that experienced no increase in distance-to-nearest-clinic; however, the number of family clinics fell by roughly half for all groups of counties between 2011 and 2014.

5.2 The Causal Effects of Distance-to-Nearest-Clinic

Having provided evidence to support the key identifying assumption underlying our difference-in-differences research design, we now present estimates of the causal effects of access to abortion clinics that are based on this research design. We begin in Column 1 of Table 2 with estimates from the baseline model, controlling only for county fixed effects and year fixed effects. When we use distance-to-nearest-clinic (in hundreds of miles) as the measure of access (Panel A), the resulting estimate indicates that a 100 mile increase in the distance-to-nearest-clinic reduces the abortion rate in a given county by 16 percent percent.[15] This estimate is statistically significant at the one-percent level.

As we noted above, the effects of distance may not be linear, in which case the estimate reported in Panel A could be misleading. In order to investigate this possibility, in Panel B we consider distance-to-nearest-clinic across five categories: less than 50 miles (omitted), 50–100 miles, 100–150 miles, 150–200 miles, and 200 or more miles. Point estimates based on this alternative model imply that having the nearest abortion clinic 50–100 miles away, as opposed to less than 50 miles away, reduces abortion by a statistically-significant 13 percent. The estimated effects of greater distances indicate that a distance of 50–100 miles reduces abortion rates by 29 percent, a distance of 100-150 miles reduces abortion rates by 44 percent, and a distance of 200 or more miles to the nearest abortion clinic reduces abortion rates by 37 percent, where all estimated effects are relative to having a clinic within 50 miles. The estimated effects of being 150–200 miles versus greater than 200 miles from the nearest clinic are not statistically distinguishable from one another.

Across columns 2 through 4 of Table 2, we consider the robustness of these estimates to the inclusion of time-varying county control variables. Specifically, Column 2 presents the estimate based on a model that additionally controls for demographics (race, ethnicity, age). This leads to slightly larger estimates of the effects of distance-to-nearest-clinic, whether measured in 100s of miles or in different distance categories. Column 3 presents estimates

[15] Percent effects are calculated as $(e^{\beta} - 1) \times 100\%$.

that additionally control for economic conditions using the unemployment rate. The inclusion of this control variable also has no impact on the estimated effects.

Finally, Column 4 presents estimates based on a model that additionally controls for access to family planning services. Our approach to controlling for family planning follows Packham (2016) who evaluates the effects of Texas' decision to cut funding to family planning clinics by two-thirds in 2012. In particular, we control for whether a county had a publicly funded family planning clinic prior to the funding cut interacted with the time period after the funding cut occurred (post-2012). The inclusion of this control variable has little impact on the estimate or its precision. The linear estimate suggests that a 100 mile increase in distance causes a 23 percent reduction in the abortion rate. The specifications with dichotomous measures in Panel B suggest that, relative to having a clinic within 50 miles, increasing distance to 50-100 miles reduces the abortion rate by 16 percent, increasing distance to 100-150 miles by 30 percent, increasing distance to 150-200 miles by 45 percent, and increasing distance to 200 or more miles also by 45 percent. In Appendix Table A1 we show that alternative approaches to controlling for access to family planning produce similar results. In particular, the estimates are nearly identical if we control for family planning support using the variable just described, with a variable indicating that the county had a family planning clinic in the given year, with a variable for the number of family planning clinics in the county in the given year, or with a variable for the number of family planning clinics per capita in the county in the given year.

Figure 7 presents estimated percent changes in the abortion rate controlling for the same set of control variables as in Column 4 of Table 2 with with a cubic specification of the distance-to-nearest clinic. The estimated average percent effects are extremely similar to those for the spline specifications in Panel B, and again show large effects of increasing distance from a base of 0 to 150 miles. There seems to be little additional effect of increasing distance beyond 200 miles.

Appendix Figure A3 and Table A2 presents alternative estimates of the results in Figure 7 and Table 2, using geodesic ("as the crow flies") distances rather than travel distances. The estimated effects of increases in geodesic distance tend to be larger in magnitude, but the differences are small and we regard them as substantially the same. Comparing the results in Column 4 of Panel A of Tables 2 and A2, for instance, the abortion rate is estimated to decrease by by 23 percent ($p < 0.001$) for a 100 mile increase in travel distance or by 27 percent ($p < 0.001$) for a 100 mile increase in geodesic distance.

5.3 Congestion

We now consider the degree to which abortion-clinic closures may also affect abortion rates through congestion effects, using the "average service population" measure described in detail above. In order for us to be able to separately identify the effects of this measure of access and the distance measures evaluated in the previous section, there must be independent variation across these two measures. As we noted in Section 3, such variation is expected because closures in areas where some clinics remained open increase congestion without affecting distance-to-nearest-clinic whereas closures in areas where no clinics remained open increase both congestion and distance-to-nearest-clinic. This is evident from a comparison of figures 2 and 4, which depicted changes in the two measures across different Texas counties. We also illustrate this point in Figure 6, which plots county-level changes in the average service population against county-level changes in distance-to-nearest-clinic. There is a positive relationship between changes to these measures of abortion-clinic access but the relationship is not strong and there is substantial independent variation.

Table 3 presents the results from our models that simultaneously evaluate the effects of distance-to-nearest-clinic and our measure of congestion. Across all of the specifications, the estimates routinely indicate that increases in congestion reduces abortion rates. Specifically, the estimates imply that a 100,000 person increase in the average service population reduces a county's abortion rate by 7 percent.[16]

We also note that the estimated effects of distance-to-nearest clinic are slightly smaller

[16] A 100,000 person increase is about 1.5 standard deviations based on the 2009 distribution.

in Table 3 relative to those reported in Table 2. Given the positive relationship between the distance and congestion variables shown in Figure 6, this is not surprising. Intuitively, it implies some of the reductions in abortion rates we previously attributed to increased distance based on Table 2 should instead be attributed to increased congestion. Nonetheless, the estimated effects of distance remain large and statistically significant, and continue to demonstrate substantial non-linearities. They imply that, relative to having an abortion clinic less than 50 miles away, having a clinic 50–100 miles away reduces abortions by 13 percent, having a clinic 100–150 miles away reduces abortions by 24 percent, and having a clinic 150–200 miles away reduces abortions by 45 percent. As in Table 2, the estimated effects of being 150–200 miles versus more than 200 miles away from the nearest clinic are not statistically distinguishable from one another.

5.4 Analysis Using Different Regions

As previously discussed, abortion surveillance practices changed in neighboring states between 2012 and 2013: Oklahoma ceased tracking county of residence in 2012; New Mexico ceased tracking county and state of residence in 2013; and Louisiana began tracking state and county of residence in 2013. In this subsection, we continue to address the question of whether these changes in reporting might drive some of the observed effects.

The total number of abortions to Texas women in neighboring states that have nearby abortion clinics is a small fraction of the total. In 2014, the Texas DSHS reported 53,882 abortions to Texas residents. This total includes abortions obtained in Louisiana, but not 136 abortions provided to Texas women in Oklahoma (OSDH, 2015), or 1,156 abortions provided to out-of-state residents in New Mexico.[17] Even if one assumes that all of the abortions provided to out-of-state residents in New Mexico were provided to women from Texas, the three neighboring states still only account for 3.9 percent of abortions obtained by Texas women.

[17]The total number of abortions provided to out-of-state residents in New Mexico was provided to the authors by the New Mexico Bureau of Vital Records and Health Statistics.

Moreover, based on our estimated models, if access to abortion clinics had remained at pre-HB2 levels, Texas women would have had 122,678 legal abortions in 2014–2015 rather than the 107,830 observed in the abortion surveillance data.[18] All of this estimated increase cannot be explained by the 267 abortions Texas women obtained in Oklahoma and the 2,585 abortions out-of-state women obtained in New Mexico during this two year period.

To additionally explore whether the estimated effects of access are in part picking up unobserved interstate travel to obtain abortions, we test the sensitivity of our main results to the exclusion of counties where such travel is most likely. In our first such test, we eliminate the entire Texas Panhandle region from the sample because this region includes counties for which New Mexico or Oklahoma abortion clinics were the nearest abortion destination in the later years in the sample.[19] Our second test eliminates all counties in Texas for which an out-of-state clinic is ever the closest destination for an abortion during the study period. This rule causes us to eliminate 56 out of Texas' 254 counties, all of them in the Panhandle region and Northeastern Texas. Because these counties are primarily rural, they account for only 5.4 percent of the population of women of childbearing age. Estimates based on these restricted samples are presented in Columns 2-3 of Table 4. They are quite similar to the estimates produced using the full sample (Column 1), indicating that unobserved interstate travel to obtain abortions a significant driver of our main results.

5.5 Analysis Using Different Time Windows

In this subsection, we consider estimates that rely on different time windows for the analysis. We do so with three main objectives. First, we want to verify that our estimates are robust to focusing on a narrower window of time around around HB2's enactment. Our main results use data from 2009–2015, and thus use variation in access generated by closures induced by HB2 in addition variation in access generated to closures (and openings) taking place at other

[18]This estimate is based on our measures of abortion-clinic access in 2012 and the results of the estimated model whose coefficients are shown in Table 3, Panel B, Column 4.

[19]More specifically, we identify the Panhandle as counties in Texas Public Health Region 1 as defined by the Texas DSHS.

times. We would be less confident in the validity of these estimates if they are not robust to an approach that restricts the degree to which the latter source of variation contributes to the estimates. Our second objective is to consider the robustness of the estimates to using years in which we consistently have data on abortions occurring in Louisiana, which are included beginning in 2013. Our third and final objective is to examine whether the estimates differ if we focus on "later post-HB2 years" in order to speak to whether the immediate and longer-run effects differ.

The results of these analyses are shown in Columns 4-6 of Table 4. Columns 4 and 5 focus on a narrower window around HB2 than our main analyses. Specifically, Column 4 reports estimates that use data from 2012 to 2014, while Column 5 reports estimates based on data from 2012 and 2015, omitting the year most clinics closed and the subsequent year. The estimates in each of these columns continue to indicate significant effects of increasing distance. That said, the estimates are smaller in magnitude when 2015 is the only post-HB2 year included in the analysis (Column 5), which does suggest that the immediate effects of increases in distance may be larger than the effects after a period of time, as individuals and clinics learn and make adjustments. We also note that the estimated effects of congestion—as measured by the average service population—are smaller in magnitude and less precise in some of these columns.

Finally, Column 6 reports estimates that solely use data from 2013 through 2015, which corresponds to the set of years in which abortions taking place in Louisiana are reported in the data. The variation across these three years is driven in part by the fact that 2013 is only partially affected by the closures precipitated by HB2 and also in part by subsequent clinic openings. The estimated effects of distance based on this variation are quite similar to our main results; however, the estimated effect of the average service population is again weaker as it was in Columns 4 and 5.

5.6 Heterogeneity by Age, Race, and Ethnicity

Because of differences in preferences, transportation, and income, reducing access to abortion clinics may have different effects across age, race, and ethnicity. We examine this possibility in Table 5. After reproducing the estimates based on the full set of data, this table reports estimates for different age/race/ethnicity groups in subsequent columns. The major takeaway from this table is that the overall effects are not driven by any specific subgroup defined by age, race, or ethnicity. All groups save for the (small) population of Texas women of "other" racial and ethnic identities exhibit substantial responsiveness to abortion access. In general, a combination of similar point estimates and imprecise estimates when looking at subgroups makes it such that we cannot rule out that the effects are the same across most of the subgroups we can consider.

The exception is Hispanic women, for whom the estimated effect of distance in the linear model (Panel A) is more than twice as large as that for non-Hispanic whites. Panel B suggests that this is driven by much greater sensitivity among Hispanic women to additional distance increases beyond 100 miles.

5.7 Heterogeneity by distance to the Mexican border

As access to abortion clinics decreased in Texas, substantial anecdotal evidence suggests that many women sought to self-induce abortions by accessing an abortafacient sold over-the-counter at Mexican pharmacies under the brand name Cytotec (Eckholm, 2013; Hellerstein, 2014).

The FDA protocol for medical abortions requires the administration of two drugs: Mifepristone, which blocks the effects of progesterone, and Misoprostol, which induces uterine contractions. Taken together, this combination is more than 95 percent effective in the first trimester (Kahn et al., 2000). Taken alone, Misoprostol is about 90 percent effective (von Hertzen et al., 2007), and the World Health Organization recommends that it be used alone in environments in which mifepristone is not avialable (WHO, 2012). Misoprostol also is marketed for the treatment of ulcers, and it is sold under the brand name Cytotec in many countries. While Cytotec is a prescription medication in the United States, in Mexico it is available over-the-counter at pharmacies.

In 2008-2009, 1.2 percent of patients at abortion clinics reported that they had used Misoprostol on their own to self-induce abortion at some point in the past Jones (2011). Rates may be higher in Texas because women can more easily travel to Mexico to obtain the drug. In 2012, prior to the enactment of HB2, 7 percent of Texas abortion patients reported that they had tried to "do something" on their own to end the pregnancy (Grossman et al., 2014). The number was higher– about 12 percent– for women living near the Mexican border. In 2014, the Texas Policy Evaluation Project surveyed 779 Texas women; 2 percent reported attempting to self-induce an abortion and 4 percent reported knowing someone else who had done so (TPEP, 2015b).

Ideally, we would be able to evaluate the effects of abortion-clinic access on self-induced abortions as well those that are provided at clinics in order to measure the degree to which women substitute the former for the latter. However, these self-induced abortions take place out of sight of public health authorities tracking legal abortions in licensed facilities, which makes a rigorous analysis along these lines impossible. That said, the fact that we find larger effects of abortion-clinic access for Hispanic women, for whom travel to Mexico may be more straightforward and less costly, provides some suggestive evidence that this sort of substitution may have been widespread.

As another approach to investigating this issue, we can stratify our analysis to separately consider the effects of clinic access on counties close to the Mexican border and those that are farther way. We do so using data on the locations of border crossings between Texas and Mexico, calculating the travel distance from each Texas county to the nearest border crossing, and then separately analyzing counties less than 100 miles from a border crossing and those more than 100 miles from such a crossing.[20] Of Texas' 254 counties, 26 counties accounting for

[20] We obtained the geographic coordinates of border crossings from the Texas Department of Transportation (TXDOT, 2017), limiting the analysis to crossings that can be accessed by pedestrians or private vehicles.

11 percent of Texas' population of women of childbearing age are located within 100 miles of a Mexican border crossing. Because these counties afford relatively limited variation in clinic operations, we simply estimate the effects of (linear) travel distance to the nearest abortion clinic and its interaction with an indicator for being less than 100 miles from the Mexican border, while controlling fully for county and year fixed effects, demographics, economic conditions, and access to family planning services; we do not also attempt to estimate the effects of congestion or to estimate models with a series of distance indicators.

The results of this analysis are shown in Table 6. They indicate that there are heterogeneous effects of decreasing access to abortion clinics across these two groups of counties. For women living in counties that are more than 100 miles from the nearest border crossing, a 100 mile increase in distance to an abortion clinic is estimated to reduce the abortion rate by 18 percent.For women living less than 100 miles from the Mexican border, abortion rates fall by 48 percent. The larger magnitude effect for counties near the Mexican border is observed across all population subgroups, though the estimates are not statistically significant for the (small) population of women in the "other" racial and ethnic category. These results provide further suggestive evidence that substitution to self-induced abortion may have been widespread. That said, we do have to acknowledge that other differences could explain why we there are larger effects of access to abortion clinics on abortions obtained at clinics for women residing in counties near Mexico. One especially notable difference is that counties near the Mexican border have relatively high poverty rates.

6 Discussion and Conclusion

The results of our empirical analysis demonstrate that decreases in TRAP-law-induced reductions in access to abortion clinics can have sizable effects. For women living within 200 miles of an abortion clinic, we document substantial and statistically significant effects of increasing distance to abortion providers. This finding that even small increases in distance have significant effects is is notable in light of previous Supreme Court opinions suggesting that travel up to 150 miles not be considered an undue burden.[21] Moreover, our estimates also suggest that increased travel distances is not the only burden imposed by clinic closures. Most of the specifications indicate that as fewer clinics serve larger regions, abortion rates decline.

Based on our estimated models, if access to abortion clinics had remained at pre-HB2 levels, Texas women would have had nearly 15,000 more abortions in 2014-2015 than were actually observed. We hope that future research can address what explains these "missing" abortions. It is possible that some women responded to the reduction in access to abortion facilities by decreasing risky sexual behaviors and, as a result, unintended pregnancies. To the extent that such compensations do not completely explain the reduction in abortions, one would expect that the "missing" abortions correspond to an increase in births and/or an increase in self-induced abortions outside of licensed abortion facilities. At present, an analysis of the effect of HB2 on births must wait for the release of 2015 natality statistics by the Texas DSHS.[22] And though there is anecdotal evidence suggesting that many Texas women did resort to "do-it-yourself abortions" by obtaining misoprostol over-the-counter in Mexico (Hellerstein, 2014; TPEP, 2015b), data limitations will likely make it difficult to investigate this sort of behavior in any systematic fashion. However, our findings do suggest that the demand for legal abortions is particularly elastic among Hispanics and near the Mexican border, which is consistent with this anecdotal evidence.

[21] See Justice Alito's dissenting opinion in *Whole Woman's Health v. Hellerstedt* (2016), with reference to *Planned Parenthood v. Casey* (1992).

[22] We applied through NAPHSIS to obtain restricted-use "all county" national vital statistics files that would allow us to observe Texas births by county of residence. Our application was deemed to require special approval from Texas vital statistics officials who have not been responsive.

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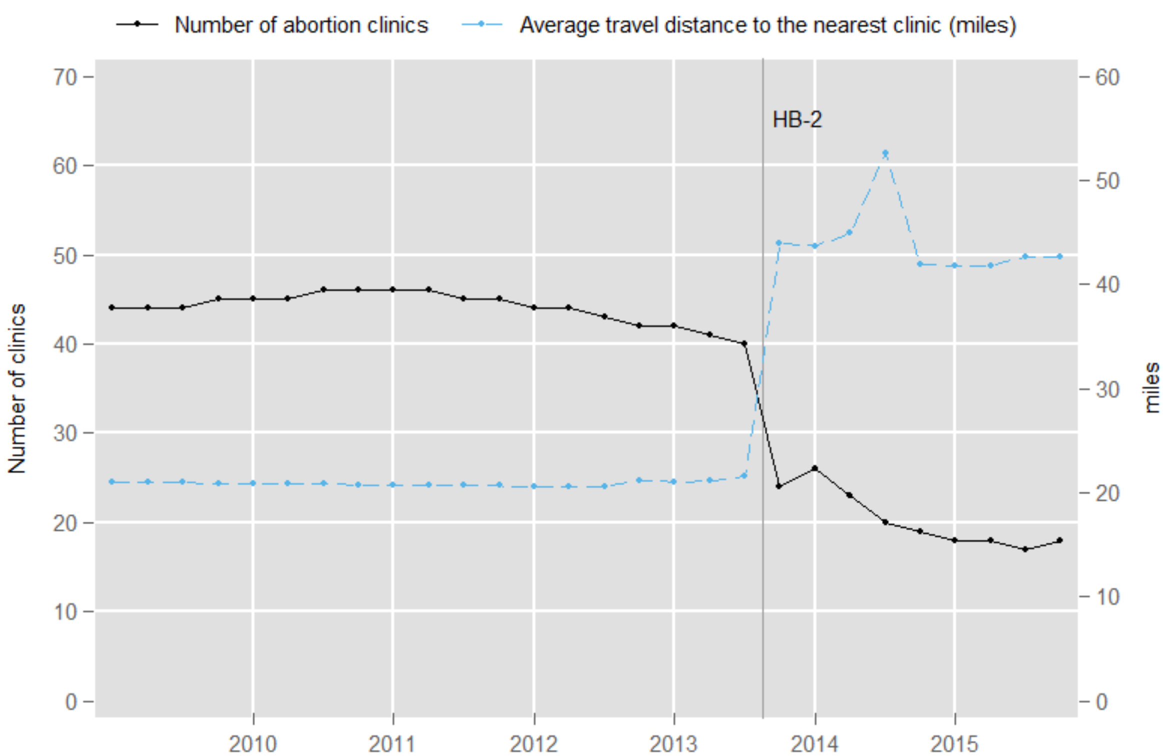
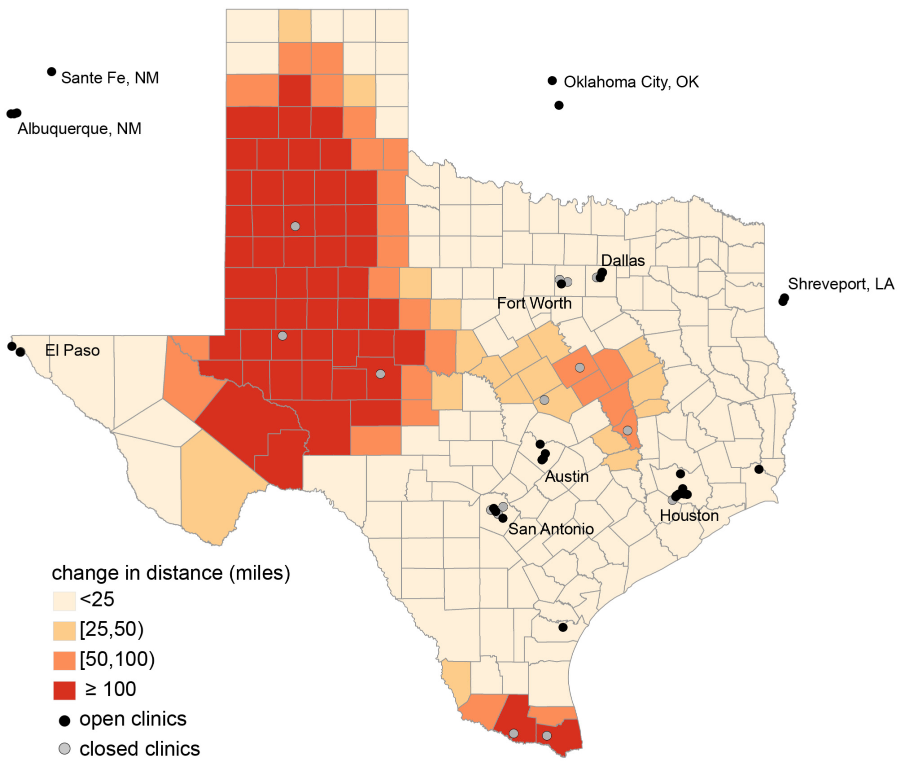
Figure 1
Abortion Clinics and Residents' Average Distance to Abortion Clinics, Texas 2009-2015



Notes: Distances are population-weighted average travel distances from county population centroids to the geographic coordinates of the nearest open abortion facility. Facility operations are measured quarterly, and a facility is considered "open" if it provided surgical or medical abortions for at least 2 months in a given quarter. Sources: The clinic operations data were compiled by the authors, annual county-level population estimates were obtained from SEER (2016), and geographic coordinates of county population centroids were obtained from the United States Census Bureau (2016).

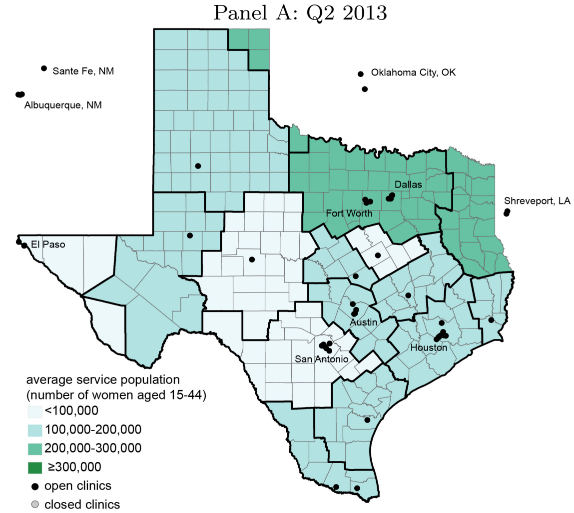
Figure 2
Change in distance to the nearest abortion clinic, Q2 2013 to Q4 2013



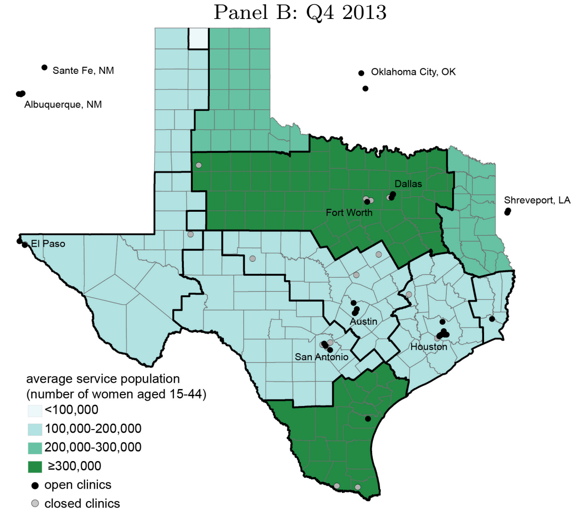
Notes: County-level change in the average distances to the nearest open abortion facility measured in Quarter 2 2013 and Quarter 4 2013. Distances are the estimated travel distances from county population centroids to the geographic coordinates of the nearest open abortion facility. A facility is considered "open" if it provided surgical or medical abortions for at least 2 months in a given quarter. Sources: The clinic operations data were compiled by the authors, annual county-level population estimates were obtained from SEER (2016), and geographic coordinates of county population centroids were obtained from the United States Census Bureau (2016).

Figure 3
Service Regions and Average Service Populations, Q2 2013 and Q4 2013

Panel A: Q2 2013

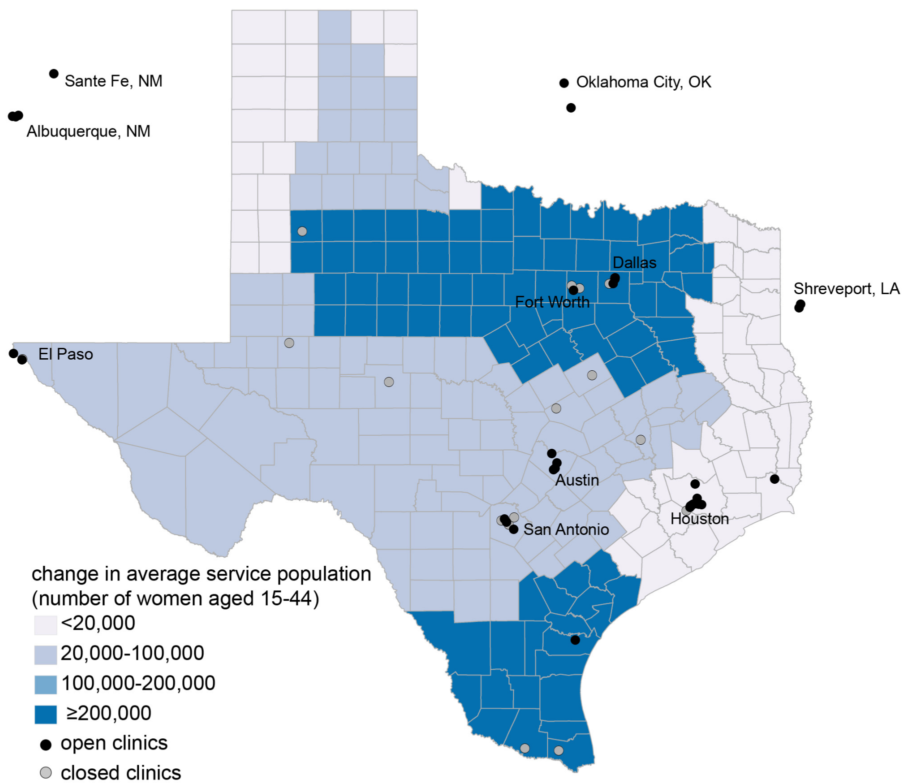


Panel B: Q4 2013



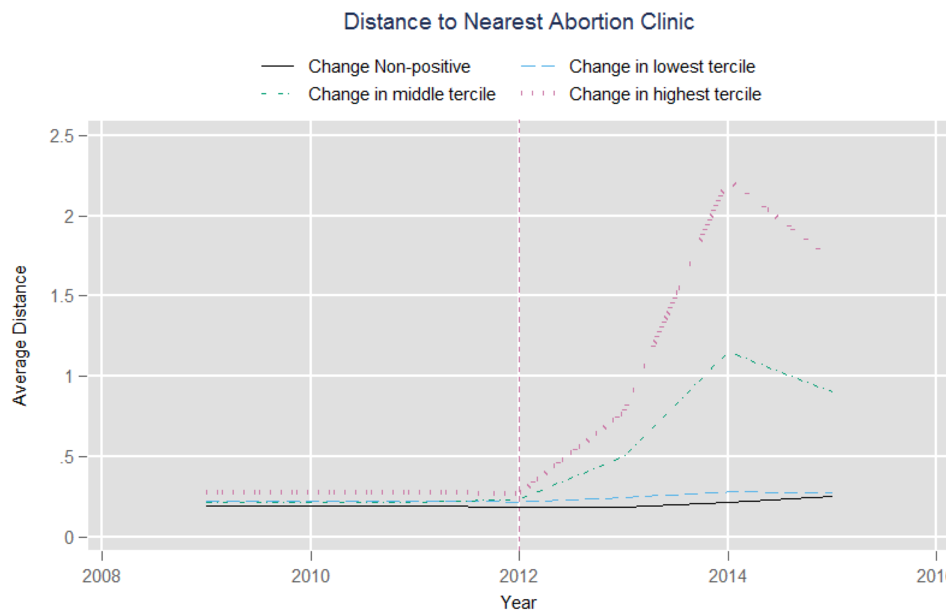
Notes: Service regions are defined annually by spatial proximity to the nearest city with an abortion clinic. These are delineated by heavy boundary lines. The Average Service Population is the total population of women aged 15 to 44 divided by the number of clinics in each service region.

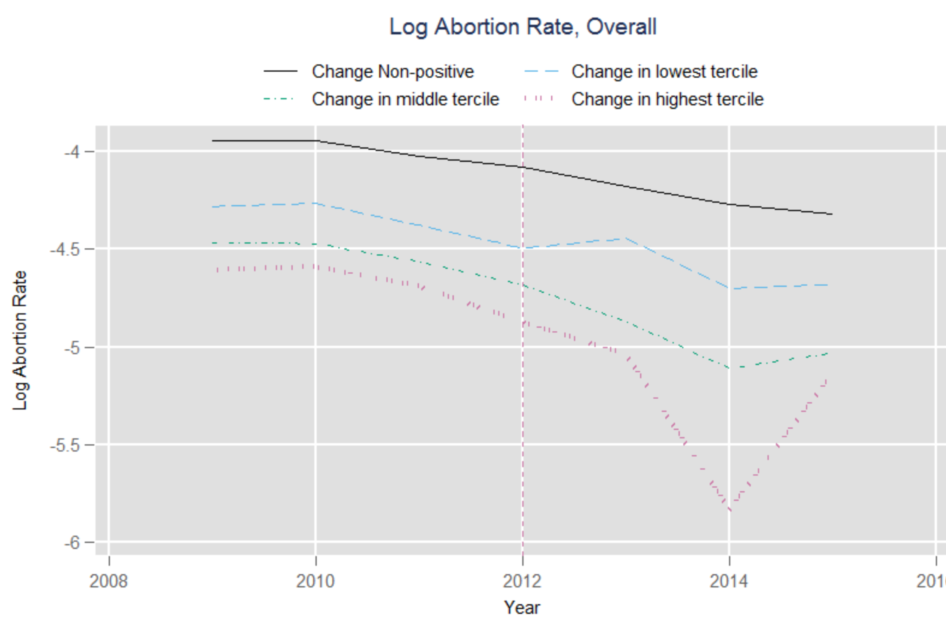
Figure 4
Change in *Average Service Population*, Q2 2013 to Q4 2013



Notes: County-level change in the average service population in Quarter 2 2013 and Quarter 4 2013. The average service population associated with a county in a given year is based on the population (women aged 15-44) and the number of clinics in its abortion service region in that year. Service regions are defined annually by spatial proximity to the nearest city with an abortion clinic. Sources: The clinic operations data were compiled by the authors, annual county-level population estimates were obtained from SEER (2016), and geographic coordinates of county population centroids were obtained from the United States Census Bureau (2016).

Figure 5
Trends in distance and abortion rates across treatment intensity groups,
where treatment intensity is the change in distance to nearest clinic Q2 2013 to Q4 2013

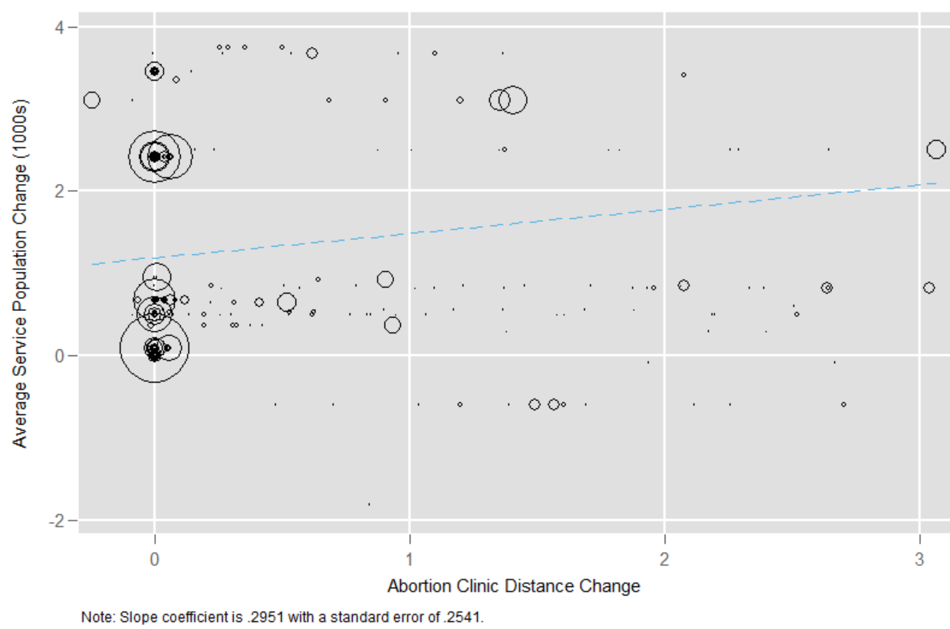




Notes: See Figure 3 for definitions and sources. The vertical line highlights the final year of data before HB2 was enacted.

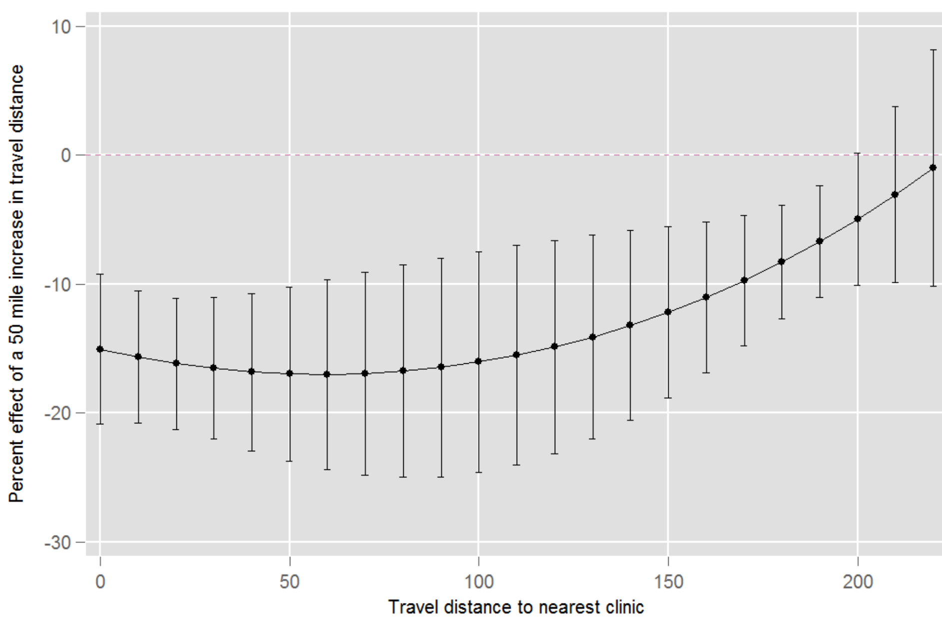
Figure 6

Independent Variation in Average Service Population Measure of Access to Abortion



Notes: Population-weighted linear regression of the change in Average service population on the change in distance to the nearest abortion provider. Changes are calculated between Q2 2013 to Q4 2013. See previous figures for additional definitions and sources.

Figure 7
Estimated percent effect of a 50 mile increase in distance on abortion rates
Fixed effects Poisson model with cubic specification of distance



Notes: Estimated average percent effects and 95 percent confidence intervals are plotted over distance. Estimates are based on a Poisson model with a cubic specification of travel distance to the nearest abortion clinic as well as county and year fixed effects and demographic, unemployment, and family planning access controls.

Table 1
Summary Statistics

Variable	2009 to 2015 mean	2009 to 2015 s.d.	2012 mean	2012 s.d.	2014 mean	2014 s.d.
Abortion rate (per 1,000 women)						
Total	11.68	5.05	11.78	4.98	9.46	4.32
Age 15 to 19	7.21	3.49	6.58	2.81	5.72	2.64
Age 20 to 29	20.22	8.64	20.35	8.34	16.36	7.44
Age 30 to 39	9.33	4.11	9.70	4.29	7.70	3.57
White	8.71	3.62	8.84	3.66	7.09	2.78
Black	22.68	10.36	22.65	11.86	19.32	6.50
Hispanic	10.71	4.65	10.78	4.29	8.28	4.29
Other	14.46	8.03	14.94	7.30	11.56	5.43
Measures of abortion access						
Distance (100s of miles)	0.29	0.49	0.21	0.34	0.46	0.70
I(distance<50 miles)	0.82	0.38	0.87	0.33	0.71	0.45
I(50< Distance $\leq$ 100)	0.10	0.30	0.08	0.27	0.14	0.35
I(100< Distance $\leq$ 150)	0.04	0.20	0.03	0.17	0.06	0.25
I(150< Distance $\leq$ 200)	0.02	0.14	0.02	0.12	0.03	0.17
I(200 < Distance)	0.02	0.13	<0.01	0.04	0.05	0.22
Average Service Population (100,000s)	1.89	0.94	1.45	0.48	2.53	0.72
Race						
White	40.04	19.02	40.05	19.04	39.20	18.65
Black	13.05	8.39	13.02	8.38	13.19	8.37
Hispanic	41.35	21.44	41.40	21.46	41.73	21.17
Other	5.56	3.93	5.53	3.89	5.88	4.14
Age distribution						
15 to 19	16.72	2.01	16.60	1.96	16.41	1.94
20 to 29	34.03	3.90	34.08	4.03	34.20	3.72
30 to 39	33.10	2.73	32.97	2.71	33.15	2.61
40 to 44	16.15	1.90	16.34	1.94	16.25	1.88
Economic conditions						
Unemployment rate	6.59	1.96	6.77	1.41	5.17	1.22

Notes: Population-weighted summary statistics calculated for Texas counties (n=254) for the pooled sample period (2009-2015) and individually for 2012 (the year prior to HB-2) and 2014 (the year after HB-2). Sources: Authors' compilation of clinic operations, annual county-level population estimates from SEER (2016), abortions by county of residence from the Texas DSHS (2017), geographic coordinates of county population centroids from the United States Census Bureau (2016), and unemployment rates from the BLS (2016).

Table 2
Estimated Effects of Distance to an Abortion Clinic on Abortion Rates

	(1)	(2)	(3)	(4)
Panel A: Continuous Measure				
Distance (100s miles)	-0.214***	-0.253***	-0.261***	-0.261***
	(0.051)	(0.052)	(0.052)	(0.052)
Panel B: Dichotomous Measures				
I(50< Distance $\leq$ 100)	-0.140***	-0.182***	-0.184***	-0.184***
	(0.040)	(0.034)	(0.033)	(0.034)
I(100 < Distance $\leq$ 150)	-0.348***	-0.352***	-0.356***	-0.356***
	(0.132)	(0.117)	(0.115)	(0.115)
I(150 < Distance $\leq$ 200)	-0.583***	-0.584***	-0.592***	-0.591***
	(0.113)	(0.088)	(0.085)	(0.085)
I(200 < Distance)	-0.465***	-0.574***	-0.590***	-0.589***
	(0.083)	(0.094)	(0.092)	(0.092)
County FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Demographic Controls	no	yes	yes	yes
Unemployment Rate	no	no	yes	yes
Family Planning Access Controls	no	no	no	yes

Notes: Estimates are based on a Poisson model with county and year fixed effects. Rates are based on county-level populations of women aged 15 to 44. Standard errors (in parentheses) allow errors to be correlated within counties over time. Outcomes are county-level annual abortion counts from 2009 through 2015.

Table 3
Estimated Effects of Distance to an Abortion Clinic and ASP on Abortion Rates

	(1)	(2)	(3)	(4)
Panel A: Continuous Measure				
Distance (100s miles)	-0.199***	-0.236***	-0.244***	-0.243***
	(0.042)	(0.046)	(0.046)	(0.046)
Average Service Population (100,000s)	-0.075**	-0.074***	-0.073***	-0.073***
	(0.037)	(0.026)	(0.024)	(0.024)
Panel B: Dichotomous Measures				
I(50$<$ Distance $\leq$ 100)	-0.108***	-0.143***	-0.145***	-0.144***
	(0.037)	(0.036)	(0.034)	(0.035)
I(100 $<$ Distance $\leq$ 150)	-0.284**	-0.281**	-0.286**	-0.285**
	(0.124)	(0.116)	(0.115)	(0.115)
I(150 $<$ Distance $\leq$ 200)	-0.516***	-0.510***	-0.518***	-0.516***
	(0.105)	(0.087)	(0.084)	(0.084)
I(200 $<$ Distance)	-0.479***	-0.578***	-0.593***	-0.592***
	(0.087)	(0.095)	(0.094)	(0.095)
Average Service Population (100,000s)	-0.069*	-0.071***	-0.071***	-0.071***
	(0.038)	(0.028)	(0.026)	(0.026)
County FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Demographic Controls	no	yes	yes	yes
Unemployment Rate	no	no	yes	yes
Family Planning Access Controls	no	no	no	yes

Notes: See Table 2. Additionally note that the average service population associated with a county in a given year is based on the population (women aged 15-44) and the number of clinics in its abortion service region in that year. Service regions are defined annually by spatial proximity to the nearest city with an abortion clinic.

Table 4
Sensitivity Analysis to Years and Regions Included

	Full Sample	Counties excluded: Panhandle	Counties excluded: Out-of-State Travel	Years included: 2012–2014	Years included: 2012, 2015	Years included: 2013–2015
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Continuous Measure						
Distance (100s miles)	-0.243***	-0.251***	-0.223***	-0.303***	-0.161***	-0.220***
	(0.046)	(0.051)	(0.043)	(0.050)	(0.029)	(0.073)
Average Service Population (100,000s)	-0.073***	-0.080***	-0.072***	-0.036	-0.057**	-0.039**
	(0.024)	(0.025)	(0.027)	(0.059)	(0.028)	(0.020)
Panel B: Dichotomous Measures						
$I(50 < \text{Distance} \leq 100)$	-0.144***	-0.139***	-0.152***	-0.107**	-0.101**	-0.101**
	(0.035)	(0.034)	(0.035)	(0.044)	(0.050)	(0.051)
$I(100 < \text{Distance} \leq 150)$	-0.285**	-0.335***	-0.342***	-0.387***	-0.147**	-0.341**
	(0.115)	(0.122)	(0.123)	(0.149)	(0.073)	(0.163)
$I(150 < \text{Distance} \leq 200)$	-0.516***	-0.501***	-0.565***	-0.383***	-0.404***	-0.372***
	(0.084)	(0.090)	(0.076)	(0.089)	(0.148)	(0.104)
$I(200 < \text{Distance})$	-0.592***	-0.466***	-0.457***	-0.755***	-0.456***	-0.446***
	(0.095)	(0.065)	(0.049)	(0.134)	(0.071)	(0.099)
Average Service Population (100,000s)	-0.071***	-0.075***	-0.061**	-0.043	-0.063**	-0.034*
	(0.026)	(0.027)	(0.028)	(0.061)	(0.031)	(0.020)

Notes: See notes to Table 3. All columns control for county fixed effects, year fixed effects, demographics, the unemployment rate, an indicator for the presence of a family planning clinic in the county, and this indicator's interaction with post-2012. In Column 3, the excluded counties are those for which an out-of-state abortion clinic is the nearest abortion destination at any point in the sample period.

Table 5
Estimated Effects of Distance to an Abortion Clinic and ASP on Abortion Rates
By Age, Race, and Ethnicity

	All (1)	Age 15-19 (2)	Age 20-29 (3)	Age 30-39 (4)	White (5)	Hispanic (6)	Black (7)	Other (8)
Panel A: Continuous Measure								
Distance (100s miles)	-0.243***	-0.199***	-0.244***	-0.259***	-0.141***	-0.367***	-0.221***	0.028
	(0.046)	(0.046)	(0.044)	(0.053)	(0.021)	(0.067)	(0.058)	(0.062)
Average Service Population (100,000s)	-0.073***	-0.119***	-0.073***	-0.067**	-0.061***	-0.029	-0.072*	-0.181**
	(0.024)	(0.023)	(0.024)	(0.028)	(0.022)	(0.040)	(0.037)	(0.076)
Panel B: Dichotomous Measures								
I(50< Distance ≤ 100)	-0.144***	-0.118**	-0.129***	-0.191***	-0.142***	-0.172***	-0.110**	0.026
	(0.035)	(0.052)	(0.036)	(0.042)	(0.042)	(0.054)	(0.055)	(0.109)
I(100 < Distance ≤ 150)	-0.285**	-0.234*	-0.318***	-0.295**	-0.072	-0.419***	-0.299***	0.205
	(0.115)	(0.130)	(0.107)	(0.128)	(0.048)	(0.153)	(0.091)	(0.184)
I(150 < Distance ≤ 200)	-0.516***	-0.437***	-0.477***	-0.558***	-0.331***	-0.540***	-0.554***	-0.175
	(0.084)	(0.159)	(0.088)	(0.093)	(0.083)	(0.094)	(0.191)	(0.234)
I(200 < Distance)	-0.592***	-0.490***	-0.578***	-0.632***	-0.346***	-0.904***	-0.585***	0.038
	(0.095)	(0.100)	(0.084)	(0.111)	(0.050)	(0.161)	(0.153)	(0.175)
Average Service Population (100,000s)	-0.071***	-0.116***	-0.071***	-0.063**	-0.061**	-0.036	-0.073*	-0.194**
	(0.026)	(0.025)	(0.027)	(0.030)	(0.025)	(0.045)	(0.040)	(0.085)

Notes: See notes to Table 3. All columns control for county fixed effects, year fixed effects, demographics, the unemployment rate, an indicator for the presence of a family planning clinic in the county, and this indicator's interaction with post-2012.

Table 6
Estimated Effects of Distance to an Abortion Clinic on Abortion Rates
Interaction with Distance to the nearest Mexican Border Crossing

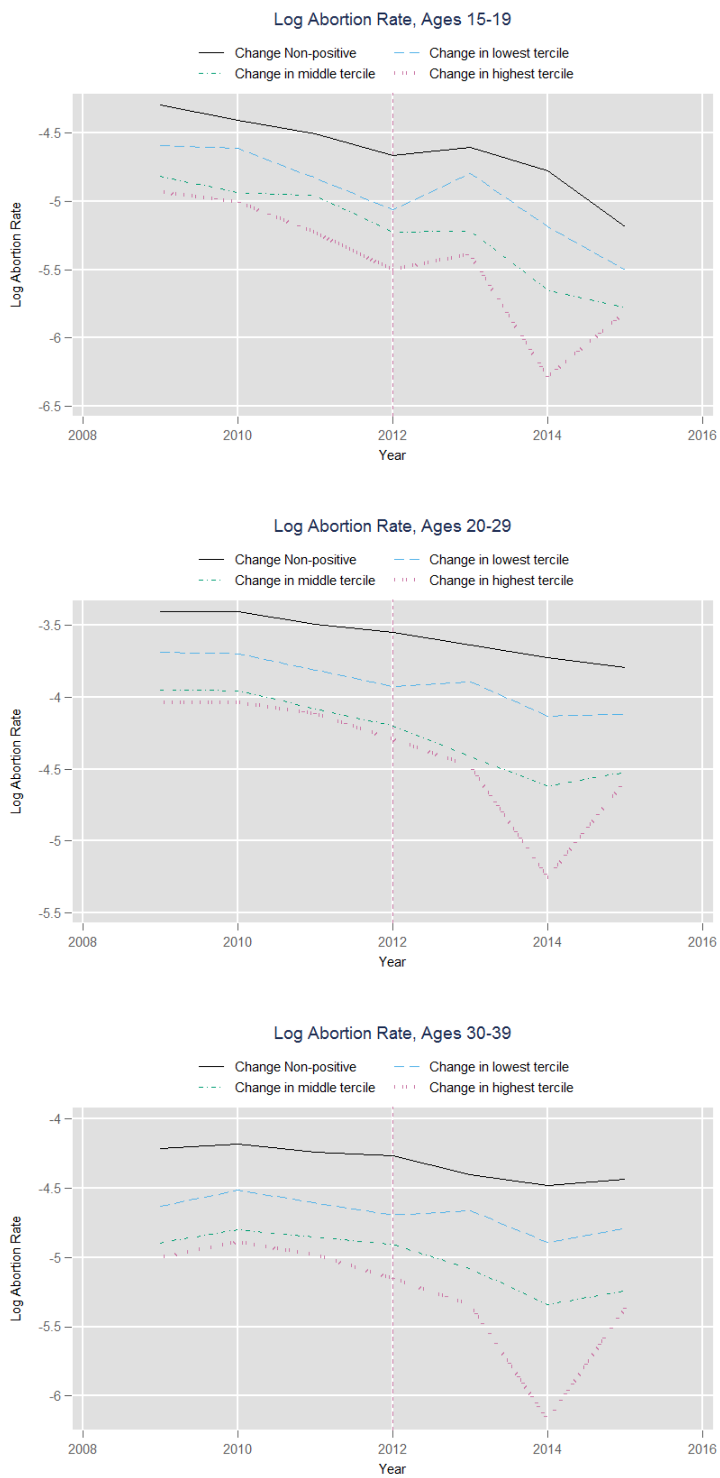
	All (1)	Age 15-19 (2)	Age 20-29 (3)	Age 30-39 (4)	White (5)	Hispanic (6)	Black (7)	Other (8)
Panel A: Continuous Measure								
Distance (100s miles)	-0.197***	-0.152***	-0.199***	-0.213***	-0.141***	-0.281***	-0.227***	0.038
	(0.027)	(0.031)	(0.024)	(0.036)	(0.021)	(0.041)	(0.061)	(0.062)
Distance × I(<100 miles to Mexican border)	-0.453***	-0.499***	-0.459***	-0.427***	-0.186**	-0.359***	-0.485**	-0.317
	(0.042)	(0.056)	(0.041)	(0.071)	(0.091)	(0.059)	(0.192)	(0.227)

Notes: Distance to the Mexican border is calculated as travel distance between county population centroids and the nearest Mexican border crossings that can be used by pedestrians and/or private vehicles. All columns control for county fixed effects, year fixed effects, demographics, the unemployment rate, an indicator for the presence of a family planning clinic in the county, and this indicator's interaction with post-2012.

APPENDIX A: FIGURES AND TABLES

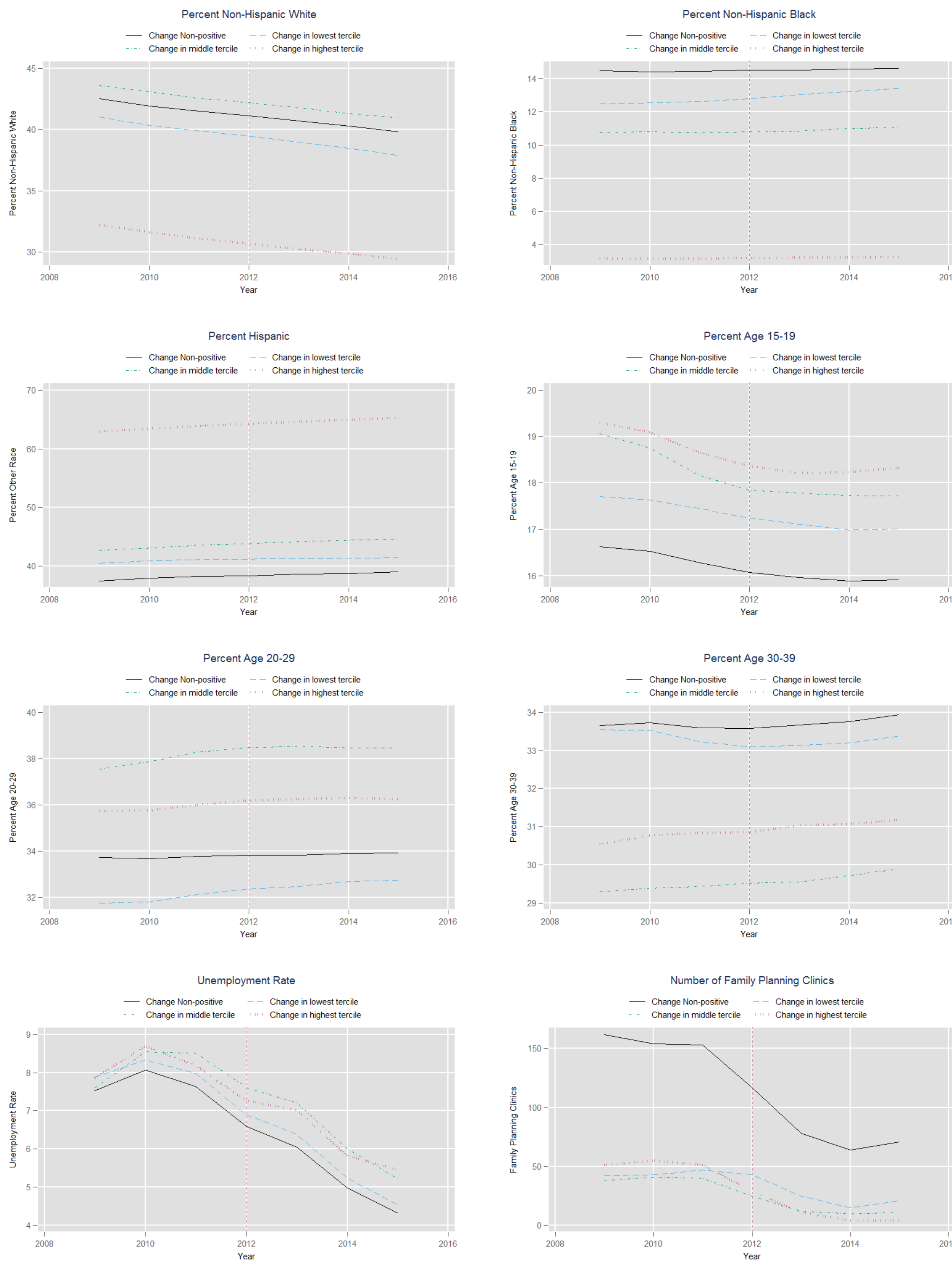
Figure A1

(Appendix) Trends in distance and abortion rates *by age* across treatment intensity groups, where treatment intensity is the change in distance to nearest clinic Q2 2013 to Q4 2013



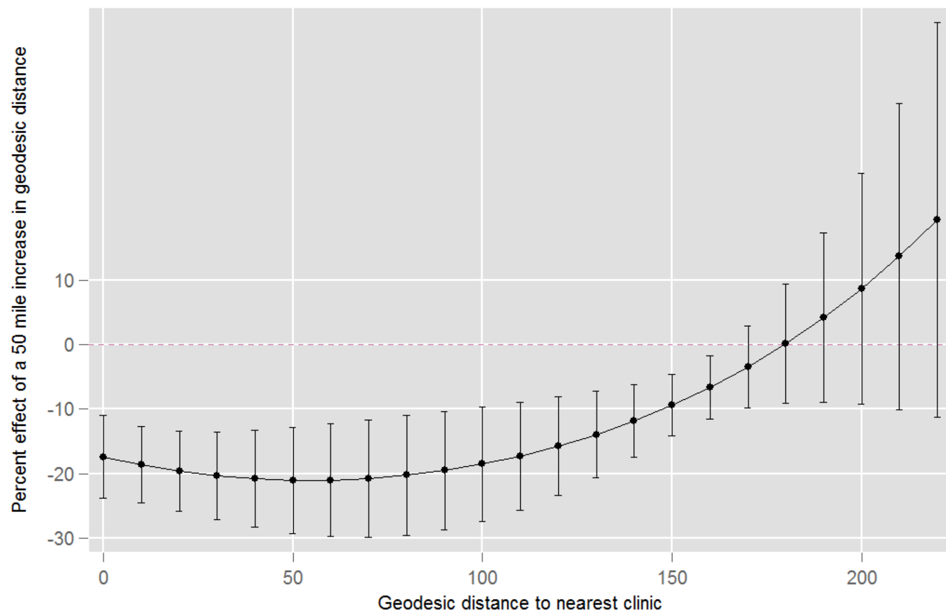
Notes: See Figure 5.

Figure A2
(Appendix) Trends in covariates across treatment intensity groups, where treatment intensity is the change in distance to nearest clinic Q2 2013 to Q4 2013



Notes: See Figure 5.

Figure A3
(Appendix) Sensitivity of Figure 7 results to using geodesic distance rather than travel distance



Notes: Estimated average percent effects and 95 percent confidence intervals of a 50 mile increase in geodesic distance. See notes to Figure 7.

Table A1
(Appendix) Sensitivity of Table 2 Results to alternate Family Planning Controls
Estimated Effects of Distance to an Abortion Clinic on Abortion Rates

	(1)	(2)	(3)	(4)
Panel A: Continuous Measure				
Distance (100s miles)	-0.261***	-0.255***	-0.258***	-0.254***
	(0.052)	(0.054)	(0.052)	(0.052)
Panel B: Dichotomous Measures				
I(50< Distance ≤ 100)	-0.184***	-0.178***	-0.188***	-0.182***
	(0.034)	(0.035)	(0.034)	(0.034)
I(100 < Distance ≤ 150)	-0.356***	-0.353***	-0.355***	-0.348***
	(0.115)	(0.117)	(0.113)	(0.115)
I(150 < Distance ≤ 200)	-0.591***	-0.587***	-0.593***	-0.575***
	(0.085)	(0.088)	(0.086)	(0.087)
I(200 < Distance)	-0.589***	-0.569***	-0.579***	-0.571***
	(0.092)	(0.094)	(0.091)	(0.089)
1(family planning clinic in county in 2010) × 1(post-2011)	yes	no	no	no
1(family planning clinic in county)	no	yes	no	no
# of family planning clinics	no	no	yes	no
# of family planning clinics per capita	no	no	no	yes

Notes: Re-estimation of Table 2, Column 3 using alternate controls for access to publicly-funded family-planning clinics. All columns control for county fixed effects, year fixed effects, demographics, and the unemployment rate. See notes to Table 2.

Table A2
(Appendix) Sensitivity of Table 2 Results to using Geodesic Distance
Estimated Effects of Distance to an Abortion Clinic on Abortion Rates

	(1)	(2)	(3)	(4)
Panel A: Continuous Measure				
Distance (100s miles)	-0.255***	-0.301***	-0.309***	-0.309***
	(0.061)	(0.063)	(0.063)	(0.063)
Panel B: Dichotomous Measures				
I(50$<$ Distance $\leq$ 100)	-0.151***	-0.197***	-0.197***	-0.196***
	(0.033)	(0.031)	(0.031)	(0.031)
I(100 $<$ Distance $\leq$ 150)	-0.462***	-0.454***	-0.461***	-0.460***
	(0.131)	(0.111)	(0.108)	(0.109)
I(150 $<$ Distance $\leq$ 200)	-0.261***	-0.348***	-0.354***	-0.353***
	(0.095)	(0.087)	(0.086)	(0.086)
I(200 $<$ Distance)	-0.487***	-0.594***	-0.609***	-0.608***
	(0.092)	(0.102)	(0.101)	(0.101)
County FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Demographic Controls	no	yes	yes	yes
Unemployment Rate	no	no	yes	yes
Family Planning Access Controls	no	no	no	yes

Notes: Re-estimation of Table 2 using estimated geodesic distance rather than travel distance. See notes to Table 2.

APPENDIX B: Abortion clinic operations in Texas and neighboring states, January 2009 through March 2017

Clinic	City	State	Dates providing abortion services
Planned Parenthood Choice	Abilene	TX	<2009-11/6/2012
Austin Womens Health Center (Brookside)	Austin	TX	<2009-present
International Health Care Solution	Austin	TX	<2009-8/31/2014
Planned Parenthood South Austin Clinic	Austin	TX	<2009-present
Whole Woman's Health Austin	Austin	TX	<2009-7/14/2014; 4/2017-present
Whole Woman's Health Beaumont	Beaumont	TX	<2009-3/11/2014
Planned Parenthood Center for Choice (Bryan)	Bryan	TX	<2009-8/31/2013
Coastal Birth Control Center	Corpus Christi	TX	<2009-6/10/2014
Fairmount Center	Dallas	TX	<2009-10/2009
North Park Medical Group/AAA Healthcare Systems	Dallas	TX	<2009-11/1/2013; 2/2017-present
Planned Parenthood Dallas/South Dallas Surgical Health Services Ctr	Dallas	TX	7/1/2014-present
Planned Parenthood of Greater Texas Surgical Health Services	Dallas	TX	<2009-6/2014
Routh St. Women's Clinic	Dallas	TX	<2009-6/15/2015
Southwestern Women's Surgery Center	Dallas	TX	9/2009-present
The Women's Center (Abortion Advantage)	Dallas	TX	<2009-11/1/2013; 2/2014-12/2014
Hilltop Women's Reproductive Center (Abortion Advisers Agency)	El Paso	TX	<2009-present
Reproductive Services	El Paso	TX	<2009-11/1/2013; 1/2014-4/2014; 9/24/2015-present
Planned Parenthood of Greater Texas Star Clinic/Southwest Fort Worth Health Center	Fort Worth	TX	5/2013-11/1/2013; 1/13/2014-present

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Clinic	City	State	Dates providing abortion services
West Side Clinic	Fort Worth	TX	<2009-11/1/2013
Whole Woman's Health Ft. Worth	Fort Worth	TX	<2009-11/1/2013; 12/6/2013-present
Planned Parenthood of Greater Texas Henderson Clinic	Forth Worth	TX	<2009-4/2013
Harlingen Reproductive	Harlingen	TX	<2009-11/1/2013
A Affordable Women's Medical Center	Houston	TX	<2009-2/7/2014
AAA Concerned Women's Center (Abortion Hotline)	Houston	TX	<2009-10/1/2014
Aalto Women's Center	Houston	TX	<2009-3/13/2014
Aaron women's center/Women's Pavilion	Houston	TX	<2009-8/7/2014
Crescent City Women's Center	Houston	TX	<2009-12/30/2011
Houston Women's Clinic	Houston	TX	<2009-present
Planned Parenthood Center for Choice (Gulf Freeway)	Houston	TX	11/15/2010-present
Planned Parenthood of Southest Texas	Houston	TX	<2009-1/14/2010
Suburban Women's Clinic (Medical Center) of NW Houston	Houston	TX	<2009-present
Suburban Women's Clinic of SW Houston	Houston	TX	<2009-present
Texas Ambulatory Surgery Center	Houston	TX	<2009-present
Women's Center of Houston	Houston	TX	10/4/2013-present
Killeen Women's Health Center	Killeen	TX	<2009-11/1/2013
Planned Parenthood Women's Health Center	Lubbock	TX	<2009-11/1/2013
Whole Woman's Health- McAllen	McAllen	TX	<2009-11/1/2013; 9/2014-present
Planned Parenthood Choice	Midland	TX	<2009-8/31/2013

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Clinic	City	State	Dates providing abortion services
Planned Parenthood Choice	San Angelo	TX	<2009-8/31/2013
A Woman's Choice Quality Health Center	San Antonio	TX	<2009-10/5/2011
Alamo Women's Clinic/ Alamo Women's Reproductive Services Clinic	San Antonio	TX	6/2015-present
Alamo Women's Reproductive Services Clinic	San Antonio	TX	<2009-5/2015
All Women's Medical Center	San Antonio	TX	<2009-8/6/2013
New Women's Clinic	San Antonio	TX	<2009-11/1/13
Planned Parenthood Babcock Sexual Healthcare	San Antonio	TX	<2009-5/2015
Planned Parenthood Bandera Clinic	San Antonio	TX	<2009-11/1/2013
Planned Parenthood Medical Center	San Antonio	TX	6/2015-present
Planned Parenthood Northeast Clinic	San Antonio	TX	<2009-11/1/2013
Reproductive Services	San Antonio	TX	<2009-7/7/2012
Whole Woman's Health San Antonio	San Antonio	TX	8/2/2010-present
Planned Parenthood Center for Choice	Stafford	TX	<2009-10/1/2013
KNS Medical PLLC INC	Sugar Land	TX	<2009-3/27/2013
Planned Parenthood of Central Texas	Waco	TX	1/1/2012-8/2013; 5/2017-present
Planned Parenthood Waco	Waco	TX	<2009-12/31/2011
Alamosa Planned Parenthood	Alamosa	CO	2009-present
Bossier City Medical Suite	Bossier City	LA	<2009-present
Hope Medical Group for Women	Shreveport	LA	<2009-present
Planned Parenthood Albuquerque Surgical Center	Albuquerque	NM	<2009-present

Continued on next page

Clinic	City	State	Dates providing abortion services
Southwestern Women's Options	Albuquerque	NM	1/2009-present
University of New Mexico Center for Reproductive Health	Albuquerque	NM	<2009-3/25/2014
University of New Mexico Center for Reproductive Health	Albuquerque	NM	4/1/2014-present
Whole Woman's Health	Las Cruces	NM	9/15/2014-present
Planned Parenthood Santa Fe Health Center	Santa Fe	NM	<2009-present
Hilltop Women's Reproductive Clinic	Santa Teresa	NM	<2009-present
Abortion Surgery Center	Norman	OK	<2009-present
Outpatient Services for Women	Oklahoma City	OK	<2009-12/2014
Trust Women South Wind Women's Center	Oklahoma City	OK	7/2016-present

Author-constructed panel of abortion clinic operations in Texas and neighboring states. Clinics are identified based on licensure data from the Texas DSHS. To identify dates of operation, we use licensure dates supplemented with accounts of clinic operations in the judicial record, news reports and on websites including Fund Texas Choice. A clinic in a neighboring state is listed only if it is the closest destination for at least one Texas county in one quarter in our dataset. "Present" is as of May 4, 2017.