New Evidence on the Effects of Mandatory Waiting Periods for Abortion
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ABSTRACT

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1 Introduction

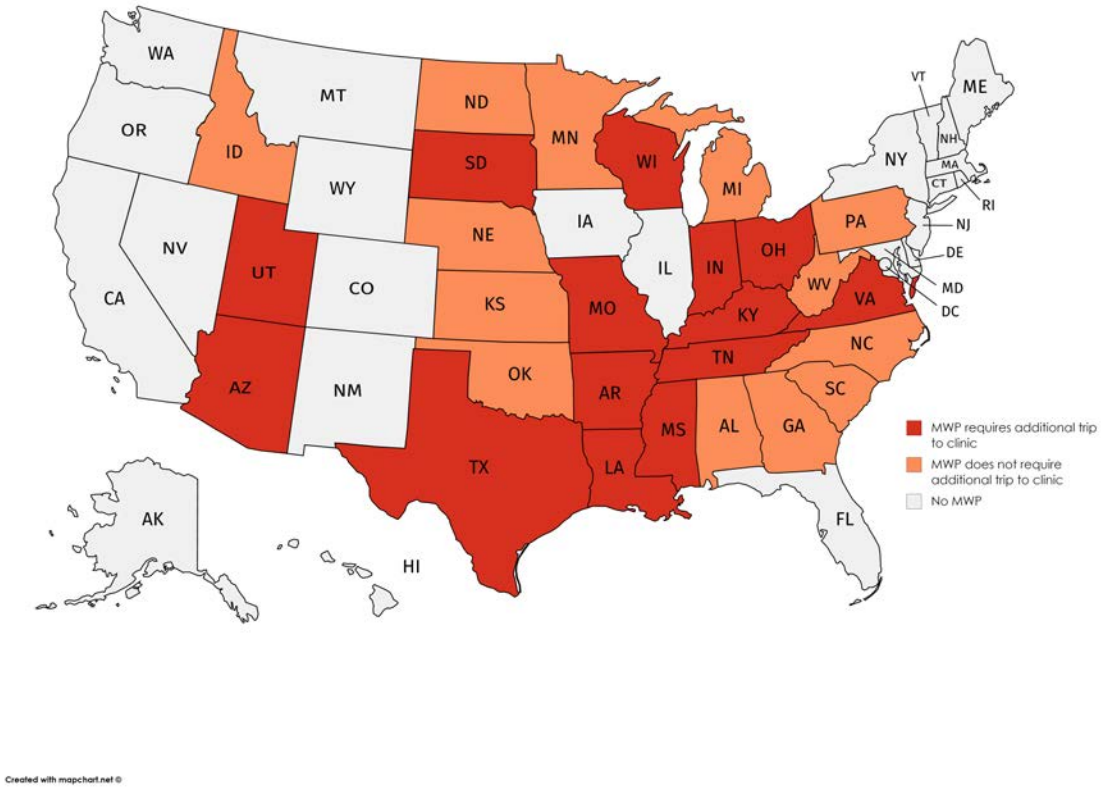
Currently, 27 states (shown in Figure 1) require women to wait 18-to-72 hours between pre-abortion consultation and the actual procedure. Fourteen of these states require women to make an additional trip to the facility so that this consultation can be done in person (Guttmacher Institute, 2019a). Proponents of mandatory waiting periods (MWPs) argue that they ensure women receive information about pregnancy and abortion and that they have ample time to weigh their options before deciding to terminate a pregnancy. Others have argued that women requesting abortion are already making informed decisions without the MWP; therefore, these laws impose an unnecessary burden that has the potential to delay or prevent women from accessing abortion care. In particular, women may have difficulty making arrangements for transportation, time off work, child care, or paying for any additional costs associated with the consultation appointment.[1] In addition, requiring a separate consultation appointment for all women seeking an abortion may present logistical challenges for providers thereby reducing the number of women they can serve—as a result, women may experience difficulties obtaining an appointment from their preferred provider.[2]

Together, these issues suggest that a MWP may cause delays for women seeking abortions because of: (i) the mandatory wait time after their first appointment; (ii) any additional wait time for appointments due to capacity constraints at facilities; (iii) and any extra time it takes them to make arrangements for another trip to a facility. Any such delays are particularly important because they can limit the types of procedures available which depend on gestational age, and because monetary costs and health risks tend to be higher

[1] See Lupfer and Silber (1981); Althaus and Henshaw (1994); Karasek et al. (2016); Roberts et al. (2016); Sanders et al. (2016); White et al. (2016).

[2] For women requesting an abortion at the end of their first trimester, the MWP could represent an additional burden because they may be in their second trimester by the time they can get an abortion. Consequently, they might not be able to have their preferred type of abortion (Roberts et al. 2016), since medical abortion is less effective after the first trimester. They are also likely to be referred to another clinic or to face difficulties finding an abortion provider because fewer providers are available for women at later stages of pregnancy (Drey et al., 2006; Jones and Jerman, 2014). This could prevent them from terminating their pregnancies.

Figure 1
Mandatory waiting periods for abortion, 2019



Source: The map shows the mandatory waiting period in each state as of August 19th, 2019. The map was created by the authors using information on *Counseling and Waiting Periods for Abortion* from the Guttmacher Institute.

as gestational age increases.[3] The same set of issues suggest that a MWP may *prevent* some women from obtaining abortions if: (ii) they are unable to make arrangements for an additional trip; (ii) the delays push them beyond the maximum gestational age for an abortion; or (iii) the consultation and/or waiting period changes beliefs or preferences. On the other hand, such effects could be mitigated to some degree if forward-looking women who know they are pregnant and know they may want an abortion begin to make arrangements

[3]The counseling visit may represent 11 percent of the actual cost of the abortion and 9 percent of the total cost of the two appointments (Roberts et al., 2016). Procedures performed after 12 weeks of pregnancy pose higher risks of medical complications and mortality than abortions performed earlier (Althaus and Henshaw, 1994; Drey et al. 2006). The type of procedure used to interrupt pregnancy depends on the stage of pregnancy. Medical abortion is most effective within the first nine weeks of gestation (UCLA Obstetrics and Gynecology), and its success rate decreases as gestational age increases (Rorbye et al., 2004). If a woman delays abortion, she becomes more likely to require a surgical abortion which can be more than twice as expensive as a medical abortion (Jones and Jerman, 2014; Roberts et al., 2016).

more quickly in anticipation of these obstacles. It is also possible that barriers to abortion access could change other behaviors that mitigate the risk of pregnancy, such as the use of contraception, but prior work has found minimal evidence of such effects (Fischer et al., 2018).

Ultimately, understanding the effects of MWPs on abortion timing and abortion rates requires careful empirical analysis. Notably, a 2009 review of the evidence found just seven studies of the impacts of MWPs on abortion rates and/or abortion timing, and only four of these used approaches that are typically thought to be credible for identifying causal effects (Joyce et al., 2009). Those four studies focused on the effects of MWPs in early-adopting states through the mid-1990s. To our knowledge, no new papers estimating the causal effects of MWPs have been written since. Thus, the evidence base arguably has become dated.

More recent evidence on the effects of MWPs is particularly important because these effects may be different in today's context, given the major changes in the landscape for women seeking an abortion. One major change is that the number of abortion providers has declined dramatically in many states. Thus, a restriction requiring women to make a second trip to a clinic may involve more travel today than it would have in the past. Another key difference is that the nearest out-of-state provider likely would not have had a MWP for women in early-adopting states. Today it is less likely that a woman can avoid the MWP by driving to her nearest out-of-state provider; most states have a MWP, and these states are clustered geographically (as shown in Figure 1). These two features of the current landscape imply that many women would have to travel farther today to avoid their states' MWP laws than in years past. While these factors suggest that MWPs may have a greater impact today, it is possible that their effects may be smaller, perhaps because of changes in access to transportation, improved information on navigating the process of obtaining an abortion, or for other reasons. Regardless, given the massive changes in the abortion landscape since the 1990s, including a surge in legislation since 2011,[4] we believe it is important to expand

[4]States passed more abortion restrictions from 2011–2013 than in the entire previous decade (205 versus 189). See Guttmacher Institute (2014).

on the existing base of knowledge by documenting the effects of MWPs enacted in recent years.

Towards this end, we evaluate the effect of Tennessee's MWP, which went into effect in 2015 and requires women to wait at least 48 hours after getting in-person counseling from a physician before they can obtain an abortion. With the enactment of this law, Tennessee joined its neighboring states with similar laws on the books. To evaluate causal effects, we use both a difference-in-differences approach and a synthetic control design comparing changes over time for residents of Tennessee to changes over time in two sets of comparison states. We focus on the share of women obtaining abortions in the second trimester of their pregnancy and on abortion rates.

Our difference-in-differences and synthetic-control estimates indicate that Tennessee's MWP caused a 48–73 percent increase in the share of abortions obtained in the second trimester, completely or almost completely closing the pre-existing gap between women residing Tennessee and women living in the comparison states. We highlight the statistical significance of this estimate through permutation tests indicating that no state in the comparison group experienced such a large increase relative to other states. Our analyses of the second-trimester abortion rate indicate that the MWP increased the number of number women having such abortions, though these estimates are not always statistically significant at conventional levels. Our analysis of the overall abortion rate yields suggestive evidence of reductions caused by the MWP though these analyses should be viewed with more caution because of limited statistical power.

Motivated by our findings indicating that Tennessee's MWP led to significant delays in abortion, we provide a number of back-of-the-envelope calculations of the additional monetary costs of the MWP to provide these findings some additional context. We conservatively estimate that the additional consultation appointment increased women's monetary costs by \$25–70 if we solely account for fees charged by providers, by up to \$91–136 if we additionally account for transportation costs, and by up to \$211–256 if we additionally account for costs

associated with lost wages or childcare. We also estimate that a delay of one day, which can alter the procedure type and the clinics available to a woman, can increase fees by $175 and costs of transportation, lost wages, and childcare by up to $246. We estimate that a delay of five weeks could increase fees by $575 and costs of transportation, lost wages, and childcare by up to $673. In total, the mandatory waiting period could increase the monetary cost of obtaining an abortion by up to a total of over $900 when accounting for fees, transportation costs, lost wages, and childcare.

2 Prior Research on MWPs

Descriptive studies provide some strong reasons to believe that MWPs, particularly those that substantially increase costs, may delay and/or prevent women from obtaining abortions. Survey data indicate that among women who would have preferred to have their abortions earlier, 60 percent report that delays occurred because it took time for them to make arrangements (Finer et al., 2006). This is perhaps unsurprising given that a large share of women seeking abortions has low incomes. In 2014, half had incomes less than the federal poverty line, and three-quarters had incomes less than 200 percent of the poverty line (Jones and Jerman, 2017).

Surveys of women having to make additional trips to an abortion clinic because of mandatory waiting periods highlight the challenges they faced. In Utah, 47 percent of women obtaining abortions reported negative effects due to lost wages from needing to take extra time off work, 30 percent reported negative effects due to increased transportation costs, 27 percent reported negative effects due to lost wages by family or friends, and 33 percent reported that they had to disclose their abortion to someone who they would not have told otherwise (Sanders et al., 2016). Women in Louisiana stated similar challenges, reporting concerns about missing work, encountering traffic or bad weather, thinking their car would not be able to make the trip, and having to lie about their absence to their parents or partners

(Carroll and White, 2020). Some of these women also reported that challenges making arrangements resulted in them being unable to obtain their preferred abortion method and/or made them worry that they would have to continue an unwanted pregnancy. Notably, these surveys of women's experiences with mandatory waiting periods do not include women who were unable to obtain abortions and, thus, likely understate the burdens imposed on women.

As noted earlier, just a few prior studies have evaluated the *causal* effects of MWPs on abortion rates and/or abortion timing using commonly accepted approaches to estimating causal effects: Joyce et al. (1997); Bitler and Zavodny (2001); Joyce and Kaestner (2000), and Joyce and Kaestner (2001).[5]

Bitler and Zavodny (2001) is the largest of these studies in scope, examining a wide variety of abortion restrictions and using annual abortion data for nearly all U.S. states from 1974–1997. Their estimates—based on a generalized difference-in-differences model that controls for state and year fixed effects—indicate that MWPs increase the proportion of abortions performed in the second trimester by 2.3 percentage points and increase the rate of second-trimester abortions by 41-percent. They do not find evidence of reductions in overall abortion rates. As noted in Joyce et al. (2009), the vast majority of the MWPs analyzed in Bitler and Zavodny (2001) did not require an additional clinic visit. Therefore, those findings may mask more severe effects of MWPs that do require an additional clinic visit.

Consistent with this notion, causal studies of Mississippi's MWP, which went into effect in 1992 and required an additional clinic visit, have found larger effects on the proportion of abortions obtained in the second trimester and stronger evidence of reductions in abortion overall (Joyce et al. (1997); Joyce and Kaestner (2000); Joyce and Kaestner (2001)). Further supporting the idea that requiring women to travel more to obtain an abortion has significant effects on abortion rates, several recent studies have demonstrated that increases in travel

[5]Other studies reviewed in Joyce et al. (2009) are described as lacking a comparison group to evaluate how outcomes would have changed in the absence of the MWP (Althaus and Henshaw, 1994); estimating effects primarily based on cross-sectional variation (Medoff, 2007); or inappropriately controlling for lagged abortion rates (Meier et al., 1996).

distance to the nearest provider significantly reduce abortion rates (Quast et al., 2017; Fischer et al., 2018; Lindo et al., forthcoming).

As a whole, this body of work suggests that when they require women to make an additional trip to their provider, MWPs increase the proportion of abortions obtained in the second trimester and that they can reduce abortion rates overall. That said, this summary statement is based solely on analyses that find large effects of Mississippi's MWP (Joyce, Henshaw, and Skatrud, 1997; Joyce and Kaestner 2000; Joyce and Kaestner, 2001), a study pooling together MWPs that do and do not require additional travel that finds more moderate effects (Bitler and Zavodny, 2001); and another analysis finding little evidence that South Carolina's MWP affected adolescents (Joyce and Kaestner, 2001). Further underscoring the need for additional research, these earlier causal studies do not have the same rigor that is typically expected of difference-in-differences studies conducted today. They do not demonstrate common pre-regulation trends in outcomes, and they do not use now-standard approaches to conducting statistical inference. To some degree, this raises questions about their point estimates and their statistical significance. Combined with the possibility that MWPs may have different effects today than in years past—in addition to possibly having different effects in different places—these factors highlight the reality that more research is needed to understand the role of MWPs for abortion in the modern landscape. Our study is by no means definitive, but it adds to the literature a rigorous evaluation of a recently enacted MWP that requires women to make an additional trip to their abortion provider.

3 Background on Tennessee's Mandatory Waiting Period

In May 2015, Tennessee's Gov. Bill Haslam approved a law that required women to wait at least 48 hours after counseling with a physician before they could obtain an abortion.[6]

[6]That 48-hour period excludes the day on which the information was provided. For the consultation appointment, the law requires physicians to inform a woman requesting an abortion on the following: 1)

As a result, Tennessee joined 26 states that already had a mandatory waiting period, including all of its neighboring states. Thirteen out of these 26 states required in-person counseling, necessitating an additional trip to the clinic, like the MWP in Tennessee.[7] Some of Tennessee's neighboring states had laws that required women to wait 24 hours (Arkansas, Georgia, Kentucky, Mississippi, Missouri, North Carolina, and Virginia), and one required 48 hours (Alabama). Only Alabama, North Carolina, and Georgia had MWPs that did not require an additional visit to the clinic.[8] Figure A in the Appendix depicts the MWPs across the United States before the enactment of Tennessee's MWP. It demonstrates that Tennessee was one of the few states in the South without a MWP for abortion.[9]

In addition to MWPs, the states in this region (Alabama, Arkansas, Georgia, Kentucky, Mississippi, Missouri, North Carolina, and Virginia) have many other abortion regulations. For instance, all require abortions to be performed by a licensed physician, and some require second-trimester abortions to be performed in a hospital (Alabama, Kentucky, Missouri, North Carolina, Tennessee, and Virginia). All of these states prohibit abortion during the third trimester, except in cases of life or health endangerment. All restrict public funding to abortions except in cases related to life endangerment, rape, or incest, and only Kentucky and

that according to the physician's best judgment, the woman is pregnant; 2) the weeks elapsed from the probable time of conception of her unborn child; 3) that if more than 24 weeks have elapsed from the time of conception, the child may be capable of surviving outside the womb; 4) that abortion may constitute a major surgical procedure; 5) information on the public and private agencies and services available to assist her during pregnancy and after the birth of the child, if she decided not to have an abortion, and whether women wish to keep the child or place the child for adoption; 6) that there are risks associated with her pregnancy and childbirth, and the abortion or child delivery technique to be employed, as well as a general description of the medical instruction to be followed subsequent to the abortion or childbirth in order to ensure her safe recovery; and 7) the existence of a two-day waiting period (2010 Tennessee Code. Chapter 15, Part 2, 39-15-202).

[7]These states are Arizona, Arkansas, Indiana, Kentucky, Louisiana, Mississippi, Missouri, Ohio, South Dakota, Texas, Utah, Virginia, and Wisconsin. Information on state MWPs over time are based on the Guttmacher Institute's "Counseling and Waiting Periods for Abortion" accessed at different points in time via Wayback Machine.

[8]Virginia did not require in-person counseling for women living more than 100 miles from an abortion provider.

[9]The last changes to MWP laws in nearby states are: Alabama increased the MWP from 24 to 48 hours in 2014; Arkansas increased its MWP from 48 to 72 hours in April 2019; Georgia enacted a 24-hour mandatory period in 2012; in Kentucky, a 24-hours MWP law was amended in 1998; Mississippi imposed a 24-hour MWP in 1992; Missouri increased the MWP from 24 to 72 hours in 2014; North Carolina voted an increase from 24 to 72-hour MWP in 2015, and Virginia amended the law that requires 24-hour abortion delay in 2003. See Guttmacher Institute (2019b) for more information.

Missouri allow private insurance to cover abortion. Except for Alabama, all allow providers to refuse to perform an abortion, and all require parental consent or notice for minors (Guttmacher Institute, 2019a). Except for Georgia, all of these states have imposed so-called targeted regulation of abortion providers ("TRAP laws") (Guttmacher Institute, 2019d). Therefore, the circumstances are relatively challenging for women seeking abortions—and for abortion providers—in the setting, we study.[10]

Tennessee did not enforce any other regulations in 2015 and 2016 that we would expect to generate significant changes in abortion timing or rates.[11] In 2017, however, there were some other changes that might have affected these outcomes, which we address in our empirical analysis by showing results separately by year.[12]

4 Data

In this section, we describe the process by which we collected annual data on abortions by gestational age for various states and how we ultimately arrived at the set of states used in our analysis. We use two main sources of data. Primarily, we use data from 2010–2017 that we collected from state reports. We supplement these data with data from the Centers for

[10]Since 2010, the ACA has allowed states to broaden Medicaid eligibility, creating a foundation of coverage for low-income Americans with incomes up to 138 percent of the federal poverty level (FPL). With the elimination of categorical eligibility, low-income women who are not pregnant nor have children can qualify for Medicaid coverage. In December 2014, Gov. Bill Haslam announced a plan to expand the state's Medicaid program under the ACA. However, a Senate committee voted against this proposal in February 2015. Tennessee does not provide Medicaid Family Planning Program either. Regarding its neighboring states, in 2013, Arkansas and Kentucky passed the state's expansion plans. By 2016, these were the only two bordering states that expanded Medicaid under ACA. The remaining bordering states (Alabama, Georgia, Mississippi, Missouri, North Carolina, and Virginia) did not expand Medicaid but do offer Medicaid Family Planning Programs. See Ranji et al. (2016) and Advisory Board (2019) for more information.

[11]A federal judge blocked a 2015 law requiring abortion clinics to be regulated as ambulatory surgical centers. In 2016, the laws that went into effect required written consent from the woman for any fetal tissue research or photographs of the fetus, and another one requiring facilities performing more than 50 surgical abortions a year to conduct mandatory interim assessments, report on serious injuries or deaths of patients, and be subject to regular inspections during which they must show their record of the disposition of fetal tissue (Guttmacher Institute, 2019c).

[12]In particular, in April 2017, a court issued a partial judgment to permanently enjoin ambulatory surgical center and admitting privileges requirements that were previously blocked. Also, in May 2017, the state passed a law that would require a doctor to evaluate whether a fetus is viable after 20 weeks of pregnancy and which would presume that a fetus would be viable after 24 weeks of gestation. Also, in June 2017, a Planned Parenthood clinic opened in Shelby county.

Disease Control and Prevention (CDC)'s Abortion Surveillance System which are available from through 2016.[13] We refer to the comparison group using both sources of data and spanning 2010–2016 as "Comparison Group 1," and the comparison group based solely on state reports and spanning 2010–2017 as "Comparison Group 2." See Figure 2 for a depiction of these states.

Our data collection effort based on state reports identified 38 states providing information on the number of abortions by gestational age in the form of Vital Statistics reports and/or abortion reports from their state health departments. For the remaining states, the data were not made available by the state or were not collected.[14] States vary in the type of abortion information they collect and release. There are four types of "abortion data" that we identified: 1) the number of "occurrences," which represents the number of abortions obtained from providers within the state; 2) the number of abortions obtained by residents of the state from providers within the state; 3) the number of abortions obtained by residents of the state from providers within the state plus the (known) number of abortions obtained by residents of the state from out-of-state providers;[15] and 4) the number of occurrences plus the (known) number of abortions obtained by residents of the state from out-of-state providers. These differences can make it difficult to make comparisons across states. Furthermore, they highlight the reality that abortion information released by states may not be very informative about the abortions obtained by their residents, particularly for states with clinics providing abortions to many out-of-state women.

[13]We do not use data from the Alan Guttmacher Institute (GIA) because those data do not report abortions by gestational age.

[14]The states that release information on abortions by gestational age are: Alabama, Alaska, Arizona, Arkansas, Colorado, Delaware, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, and Wisconsin. Connecticut, District of Columbia, Georgia, South Carolina, and Virginia do not release information on the number of abortions by gestational age. California and Maryland do not collect information on abortions. A Wyoming law restricts the sharing of abortion data to only local, state, or national public health officials or physicians. We contacted the health departments of Massachusetts, New Hampshire, and Rhode Island, but we did not receive any answer. The information on abortions from Florida is incomplete. We had difficulty contacting New Jersey's health department.

[15]States can get information on abortions obtained by their residents in other states through information exchange agreements with those states.

Of these 38 states for which we obtained abortion data from state agencies, 16 provide abortion data focusing on the number of abortions obtained by residents, regardless of where they are obtained, including Tennessee.[16] Our analyses use data on the 13 of these states that report data for all years from 2010–2017.[17] We refer to this set of states, for which we have data spanning 2010–2017, as "Comparison Group 2."

Our preferred estimates are based on analyses of "Comparison Group 1," which draws on data from the CDC to expand on the number of comparison states, but which restricts the analyses to 2010–2016 because more recent years of CDC data are not presently available. Another important drawback of these CDC data is that they only report abortions by gestational age *obtained in* each state, and thus, they may not accurately reflect abortions obtained by *residents of* each state. For this reason, we use CDC data for states in which no more than 20% of the abortions are provided to out-of-state women. We exclude from Comparison Group 2 states with potentially important abortion-related policies enacted during the period of our analysis.[18] Ultimately, these choices yield a set of 26 states that are included in Comparison Group 1.[19]

[16]The other 15 states are Alabama, Arizona, Delaware, Illinois, Minnesota, Missouri, New Mexico, New York, North Carolina, Oklahoma, Pennsylvania, Texas, Utah, Washington, and Wisconsin. Minnesota, Missouri, Nevada, New Mexico, New York, Oklahoma, Pennsylvania, Texas, Utah, and Wisconsin release information on abortions performed on residents in the state. Illinois, North Carolina, and Washington release information on abortions performed on residents both in the state and out-of-state.

[17]We do not use data from Delaware and Texas because of missing data in some of these years. We also do not use data for Alabama due to its 2013 law imposing regulations on outpatient clinics and private doctor's offices providing surgical and medical abortions and imposing requirements on the facilities and clinics. See Guttmacher Institute (2019c) for more information.

[18]Specifically, we exclude six states from Comparison Group 1 that have abortion data available because of their own policy changes regarding the number of trips to a provider required or due to laws that are typically associated with abortion clinic closures. These states are Arizona (enforced MWP requiring two trips to the provider in 2011), Arkansas (altered MWP to require two visits to the provider in 2015), Illinois (implemented an admitting privileges law in 2014), Indiana (implemented an admitting privileges law in 2014), Pennsylvania (implemented ambulatory surgical center requirement, admitting privileges, and transfer agreement laws in 2012), and Virginia (ambulatory surgical center requirement and a transfer agreement law in 2012). Note that Arizona, Illinois and Pennsylvania *are* included in Comparison Group 2, for which the sample size is a greater concern—that said, we note that our estimated effects on the share of abortions obtained in the second trimester and on the second-trimester abortion rate are made more conservative by this choice.

[19]Those 26 states are: Alaska, Colorado, Georgia, Hawaii, Idaho, Iowa, Kentucky, Michigan, Minnesota, Missouri, Montana, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, South Dakota, Utah, Washington, West Virginia, and Wisconsin.

The information we use to measure outcomes for Tennessee's residents, provided by Tennessee's Department of Health, reflects abortions obtained by its residents in clinics both in Tennessee and in other states. We note that these data do not include information on *all* out-of-state abortions. States typically have data-sharing agreements with one another, but not all states participate, and those that do participate do not always end up sharing their data for unknown reasons. States reporting abortions to Tennessee include Alabama (2010–2016), Georgia and Mississippi (2014, 2016), and North Carolina (2010–2014). According to CDC data, Tennessee residents most frequently seek out-of-state abortions in Georgia (548 annually), Arkansas (268 annually), and Alabama (111 annually).[20] While it is not ideal that the data we use are not entirely consistent across years in capturing out-of-state abortions, we note that our main findings are apparent even if we restrict attention to the data from 2014 and 2016, the years just before and after the MWP was implemented and also the years in which the Tennessee data captures outcomes for residents obtaining abortions in Georgia.

We evaluate the effects of the MWP on three outcomes: the percent of abortions obtained in the second trimester;[21] the second-trimester abortion rate, constructed as the number of second-trimester abortions per 1,000 women aged 15-44; and the overall abortion rate, generated as the total number of abortions per 1,000 women aged 15-44.[22]

Table 1 shows the means for each of these variables, in addition to covariates used in

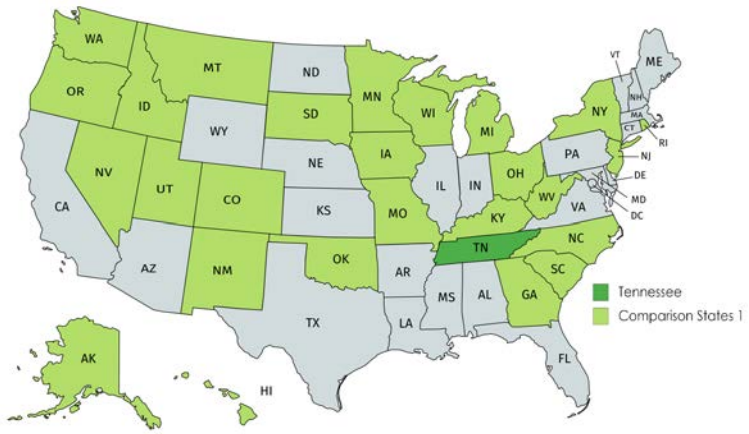
[20]CDC data confirm far fewer Tennessee residents obtaining abortions in Missouri, North Carolina, and Kentucky. While we could not find information on the number of Tennessee residents obtaining abortions in two other bordering states—Mississippi and Virginia—we expect this number to be extremely small because providers in these states were quite distant. In particular, based on historical data on providers that Caitlin Myers generously shared with us, a Tennessee resident would have had to travel at least 200 miles (multiple times) to Jackson to obtain an abortion in Mississippi as opposed to getting an abortion in Southwest Tennessee in Memphis (Shelby County). Similarly, a Tennessee resident would have had to travel at least 130 miles (multiple times) to Roanoke to obtain an abortion in Virginia as opposed to getting an abortion in Northeastern Tennessee in Bristol (Sullivan County).

[21]Due to differences in what is reported by each state, we are unable to use exactly the same definition of "second trimester" for all states. We do, however, use a consistent definition for each state over time. We define second-trimester abortions as abortions at 13+ weeks gestation for Tennessee, Alaska, Colorado, Georgia, Hawaii, Idaho, Iowa, Kentucky, Michigan, Minnesota, Missouri, Montana, Nevada, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Utah, Washington, West Virginia, and Wisconsin; 12+ weeks gestation for Arizona and Illinois; and 14+ weeks gestation for New Mexico.

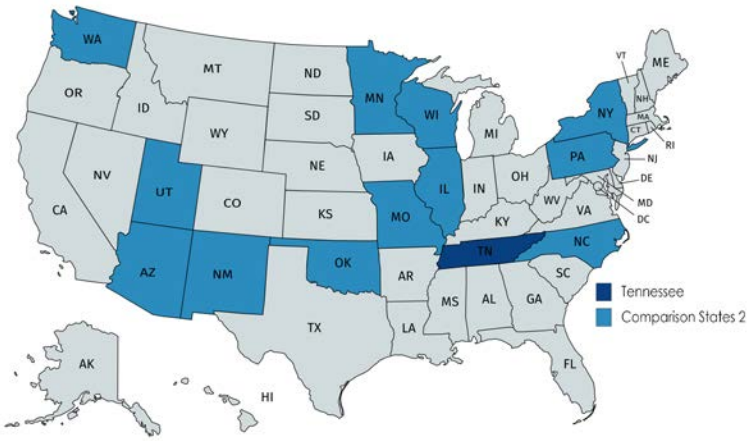
[22]Population estimates are from the United States Census Bureau (2017).

Figure 2
States used in Analyses

Panel A. Comparison States 1



Panel B. Comparison States 2



our analyses, for Tennessee and the comparison states for the pre-intervention period (2010–2014) and the post-intervention period (2015–2017).[23] Most notably, 6.6 percent of abortions were obtained in the second trimester for Tennessee residents in 2010–2014, and this number rose to 9.8 percent in 2015-2017. In the comparison states, the share of abortions obtained in the second trimester fell slightly over the same period.

[23]Unemployment rates are from the Bureau of Labor Statistics.

Table 1
Summary Statistics

	Tennessee		Comparison Group 1		Comparison Group 2	
	2010-2014	2015-2017	2010-2014	2015-2016	2010-2014	2015-2017
% of second-trimester abortions	6.59	9.79	11.08	10.83	11.55	10.75
Second-trimester abortion rate	0.59	0.68	1.16	0.99	1.24	1.02
Abortion rate	8.89	6.95	9.93	8.77	10.59	9.33
% women 15-19 years old	16.1	15.8	16.7	16.4	16.8	16.5
% women 20-24 years old	17.5	17.2	17.7	17.4	17.7	17.4
% women 25-29 years old	16.6	18.0	16.9	17.4	17.1	17.5
% women 30-34 years old	16.5	16.6	16.7	17.1	16.7	17.1
% women 35-39 years old	16.1	16.3	15.6	16.3	15.5	16.3
% women 40-44 years old	17.2	16.1	16.4	15.4	16.2	15.3
% black women	19.7	19.8	10.2	10.4	10.3	10.5
% Hispanic women	5.4	5.9	12.4	13.6	16.7	17.7
% non-Hispanic white women	71.4	70.3	67.7	65.7	64.1	62.2
Unemployment rate	8.2	4.7	7.6	4.8	7.4	4.8

Notes: This table reports variable means in the years indicated. Tennessee's mandatory waiting period law went into effect in May 2015. See Figure 2 for the states included in Comparison Group 1 and Comparison Group 2. % second-trimester abortions represents the percent of abortions that were obtained after 12 weeks of gestation. The second-trimester abortion rate is the number of abortions in the second trimester per 1,000 women (ages 15-44). The abortion rate is the constructed similarly.

5 Empirical Strategy

We first evaluate the effects of Tennessee's MWP on abortion timing and abortion rates using a difference-in-differences approach, which exploits within-state variation over time while controlling for aggregate time-varying shocks. The identifying assumption underlying this approach is that changes in abortion outcomes observed in the comparison states over time provide a good counterfactual for the changes that would have been observed in Tennessee if it did not implement the MWP.

Our estimating equation is as follows:

$$y_{s,t} = \alpha_s + \gamma_t + Treated_{s,t}\beta_0 + \mathbf{X'}_{s,t}\eta + \epsilon_{s,t} \quad (1)$$

where $y_{s,t}$ represents an outcome for residents of state s in year t; α_s are state fixed effects, which control for observed and unobserved state characteristics with time-invariant effects on the outcome; γ_t are year fixed effects, which control for time-varying factors affecting the outcomes in all the states in the same manner; $Treated_{s,t}$ represents the share of year t in

which the MWP was in effect for Tennessee;[24] $X_{s,t}$ can include time-varying characteristics of states, including measures of demographics and economic conditions; and $\epsilon_{s,t}$ is the error term. The parameter of interest is β_0, which captures the effects of Tennessee's MWP law on its residents.

Because we analyze a setting in which one state changes treatment status, we conduct randomization inference in addition to reporting standard errors clustered at the state level.[25]

Our randomization inference approach allows us to conduct exact inference without relying on large-sample approximations and without making assumptions about the distributions of the error terms. To do so, we consider the distribution of possible treatment effect estimates that could be obtained if we apply our estimating equation to each state, one-by-one. We then compare the estimate for Tennessee to this distribution to assess its statistical significance and to calculate p-values following the definition provided in Young (2018), which specifies the p–value to be uniformly distributed, and which offers an exact test with a rejection probability equal to the nominal level of the test.[26] Since this definition has a random component from a uniform distribution, we report the upper bound of each p–value, which corresponds to a draw from the uniform distribution equal to one. A downside of this approach is that 1/27 and 1/13 are the minimum p-values that can be obtained in analyses

[24]Because Tennessee's law went into effect in May 2015, this variable takes the value of 7/12 for Tennessee in 2015, it takes the value of one for Tennessee in 2016 and 2017, and otherwise takes the value of zero.

[25]In the ideal difference-in-differences setting, in which there are many clusters including many that change treatment status, cluster-robust standard errors will lead to correct inference (Bertrand et al., 2004; Roodman et al., 2019). In our setting, we have only one that changes treatment status. This is relevant because t-tests based on cluster-robust standard errors tend to over-reject severely when the number of treated clusters is small (MacKinnon and Webb, 2016; MacKinnon and Webb, 2018). In the extreme case, when only one cluster is treated, cluster-robust standard errors would severely underestimate the variance of the difference-in-difference estimator (Ferman and Pinto, 2019). Wild-bootstrap provides an alternative when conventional inference methods are unreliable because large-sample assumptions do not hold. However, in difference-in-differences models with few treated clusters, the unrestricted wild bootstrap over rejects while the restricted one under rejects (Roodman et al., 2019).

[26]The definition is as follows:

$$p - value = \frac{1}{M}\sum_{S=1}^{M} I_S(> T_E) + U * \frac{1}{M}\sum_{S=1}^{M} I_S(= T_E) \tag{2}$$

where T_S are equally probable potential treatment allocations, T_E is the true treatment effect, M is the total number of potential treatment allocations, $I_S(> T_E)$ is an indicator function for $T_S > T_E$, $I_S(= T_E)$ is an indicator function for $T_S = T_E$, and U is a random variable drawn from a uniform distribution (0,1).

using Comparison Group 1 and Comparison Group 2, respectively, where 27 and 13 are the number of states used in those analyses.

In addition to reporting the results from Equation (1), we also report event-study estimates; estimates that separately evaluate the effects for each year from 2015–2017; and estimates documenting the sensitivity to the inclusion of each of the states in the comparison group. We discuss the specific details of each of these exercises below.

As an alternative strategy to estimate the effects of Tennessee's MWP, we use a synthetic control design (Abadie and Gardeazabal, 2003; Abadie et al., 2010; Abadie et al., 2015), comparing the outcomes of residents of Tennessee to the outcomes of residents of a "Synthetic Tennessee." The intuition behind our implementation of this strategy is to use data from 2010–2014 to identify the weighted average of comparison states that provides the best match for the outcomes observed in Tennessee over this period, i.e., the synthetic control. Under the assumption that the synthetic control also provides a good match for the outcomes that would have been expected in Tennessee if it had not enacted a MWP, the difference between the outcomes observed for Tennessee and the outcomes observed for the synthetic control provides a valid estimate of the causal effect of the mandatory waiting period. We implement this strategy by determining the non-negative weights for each potential "donor state" that minimize the function:

$$(X_{TN} - X_{SC}W)'V(X_{TN} - X_{SC}W) \tag{3}$$

where X_{TN} is a (5×1) vector of variables measuring outcomes from 2010–2014, X_{SC} is a $(5 \times K)$ matrix containing the same variables for the K states in the donor pool (corresponding to Comparison Group 1 or Comparison Group 2 in different analyses), W is a $(K \times 1)$ vector of weights given to each each "donor state" (summing to one), and the diagonal matrix V are the "importance weights" assigned to each variable in X. We follow Ferman and Pinto's (2017) recommendation to demean the data using information from the pre-intervention period, and then construct the SC estimator using the demeaned data.[27]

[27]Ferman and Pinto (2017) point out that, otherwise, the synthetic control's restriction to convex combina-

To conduct statistical inference for our synthetic control estimates, we follow Abadie et al. (2010) and estimate the distribution of estimated treatment effects under the null hypothesis of no effect by reassigning treatment to each state in the donor pool and applying the same method to estimate a placebo effect for each state. According to Abadie (2020), the permutation distribution is more informative than mechanically looking at p-values alone. We report one-sided and two-sided p-values, although Abadie (2020), comments one-sided inference is often most relevant.

6 Results

6.1 Difference-in-Differences

6.1.1 Graphical Evidence of Changes Over Time

Our difference-in-differences approach relies on the identifying assumption that the changes in these outcomes observed in the comparison states provide a good counterfactual for the changes that would have been observed in Tennessee if it did not enact its MWP.

To assess the plausibility of this assumption, Figure 3 compares the percent of abortions obtained in the second trimester for residents of Tennessee and residents of the comparison states. This graph shows that this percentage was quite stable in both Tennessee and the comparison states from 2010–2014. In other words, they exhibited parallel trends in the lead up to Tennessee's policy change. This provides support for our assumption that they would have continued to exhibit parallel trends in subsequent years in the absence of Tennessee's MWP.

Figure 3 also shows some initial evidence of the effect of Tennessee's MWP, which we subsequently confirm in our regression analyses. In particular, it shows that the percentage of abortions obtained in the second trimester fell slightly after 2014 in the comparison states.

tions of the control units may lead to bias even if treatment assignment is only correlated with time-invariant unobserved variables.

In stark contrast, in Tennessee, it grew from 6-7 percent from 2010–2014 to almost 8 percent in 2015 before increasing to roughly 11 percent in 2016 and 2017. Thus, after several years in which its percentage was roughly half of the comparison states, Tennessee converged to or nearly to the levels of the comparison groups after it implemented a MWP.

Figure 4 is similar but focuses on the second-trimester abortion rate and the overall abortion rate, respectively, in different panels. These graphs also provide support for the common trends assumption, as they demonstrate similar trends for Tennessee and the comparison groups from 2010–2014. They also provide some evidence that Tennessee's MWP increased second-trimester abortions, but less clear evidence of effects on abortions overall (the majority of which are first-trimester abortions).[28]

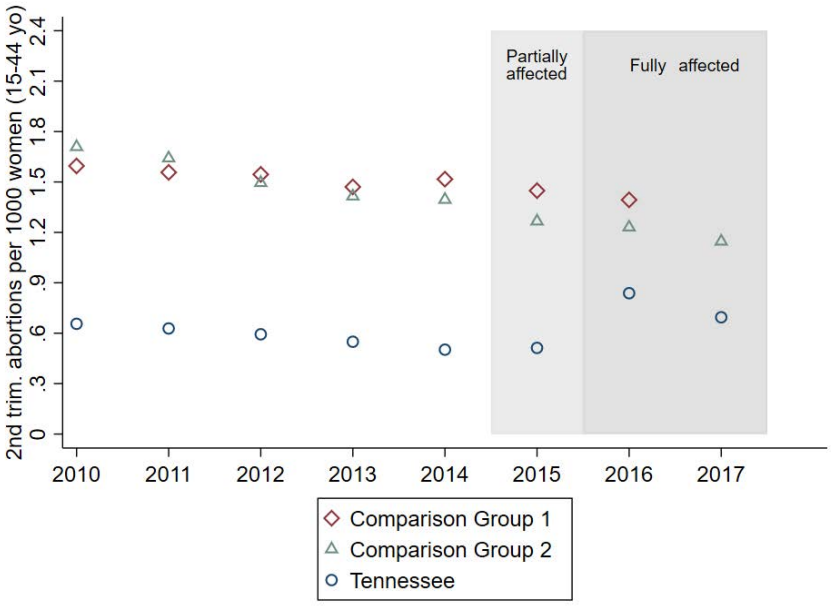
[28]Figure B in the Appendix show the evolution of the log of the second-trimester abortion rate and the log of the abortion rate for Tennessee and the comparison states. The patterns are similar to those depicted in Figure 4.

Figure 3
Percent of abortions in the second trimester

Notes: Tennessee's mandatory waiting period law went into effect in May 2015. See Figure 2 for the states included in Comparison Group 1 and Comparison Group 2. For the sets of comparison states, we report the average weighted by the total number of women (ages 15-44) in the state. Sources: Number of abortions by gestational age were collected from state health departments by the authors and CDC Abortion Surveillance Reports. Annual state-level population estimates were obtained from the United States Census Bureau (2017).

Figure 4
Abortions per 1,000 women aged 15-44

Panel A: Second Trimester Abortion Rate



Panel B: Overall Abortion Rate

Notes: See Figure 3.

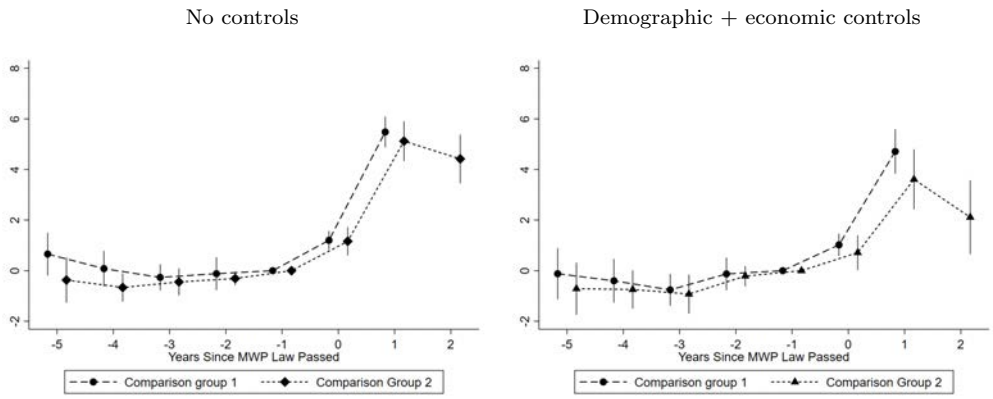
6.1.2 Event-Study Estimates

As an alternative approach to showing how Tennessee's outcomes evolve over time relative to the comparison groups, Figure 5 shows event-study estimates of the effects over time, in the years leading up to and following Tennessee's MWP.[29] Specifically, Figure 5 shows estimates that control only for state and year fixed effects and estimates that additionally adjust for demographics and economic conditions. These graphs provide additional evidence of common trends and also additional evidence that Tennessee's MWP resulted in substantial changes in abortion timing and second-trimester abortion rates after it went into effect. This is true for estimates based on both comparison groups and both model specifications.

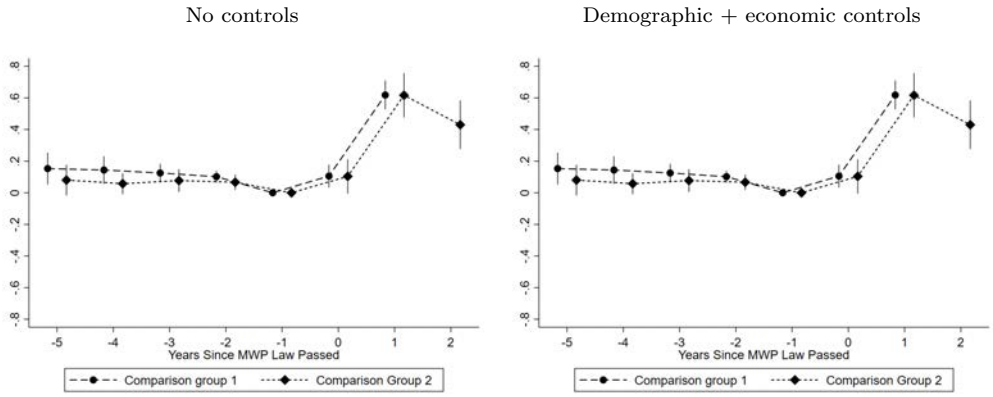
[29]The year before the law went into effect (2014) is serves as the reference period. Also, note that confidence intervals are based on clustered-standard errors at the state-level; however, as we mentioned above, this method does not necessarily provide the correct rejection rate for the null-hypothesis of no-significance of each coefficient.

Figure 5
Event-study Estimates of Effects of Tennessee's Mandatory Waiting Period

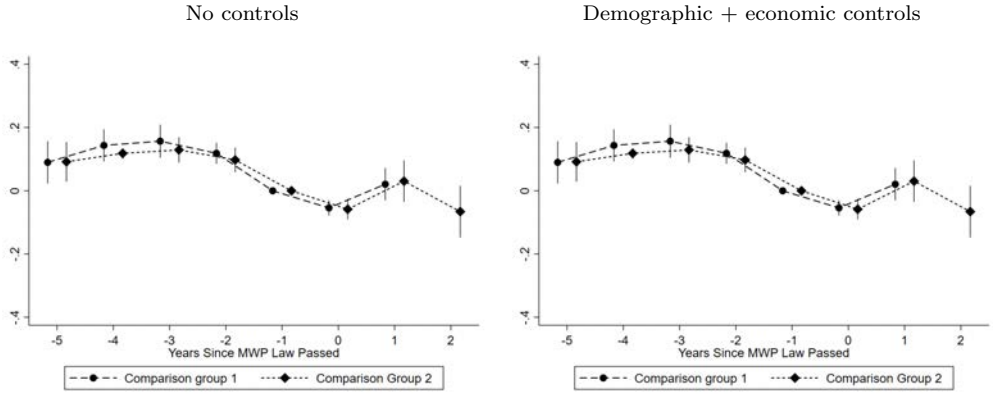
Panel A: Percent of abortions in the second trimester



Panel B: Log of the second-trimester abortions per 1,000 women (ages 15-44)



Panel C: Log of the number of abortions per 1000 women (ages 15-44)



Note: See Figure 2 for the states included in Comparison Group 1 and Comparison Group 2. The percent of abortions in the second trimester is calculated as the percent of all abortions that were obtained after 12 weeks of gestation. The second trimester abortion rate is the number abortions obtained after 12 weeks of gestation per 1,000 women (ages 15-44). The overall abortion rate is the number abortions per 1,000 women (ages 15-44). Estimates are based on indicators for Tennessee g years from its MWP going into effect in 2015, with 2014 serving as the omitted category. Estimates in both columns control for state fixed effects and year fixed effects. Estimates in the second column additionally control for demographics and the unemployment rate. The graphics also depict 95-percent confidence intervals based on standard errors clustered at the state-level.

6.1.3 Difference-in-Differences Main Results

Table 2 presents our main results based on Equation (1). Columns 1 through 3 show estimates of the effect of Tennessee's MWP on the percent of abortions obtained in the second trimester: Column 1 shows the results from our baseline difference-in-differences model with state fixed effects and year fixed effects; Column 2 shows estimates that additionally adjust for changes in states' demographics, and Column 3 shows estimates that additionally adjust for changes in states' economic conditions (the unemployment rate). The subsequent columns of Table 2 are organized similarly but show estimated effects on the log of the second-trimester abortion rate (in columns 4–6) and the log of the overall abortion rate (in columns 7–9).[30]

Like the graphical evidence presented in the previous subsection, our regression-based estimates indicate that Tennessee's MWP increased the percent of abortions obtained in the second trimester by its residents. The estimated effect shows the MWP reduced this share by 3.2–4.9 percentage points, which represents a 48–73 percent increase over its 2014 level (6.7 percent), depending on the comparison group and specification. Panel A of Figure 6 shows the results of our randomization-inference procedure for the estimates using the richest specification (Column 3). In particular, it shows the distribution of treatment effects that are possible with different permutations of the treatment variable across states, demonstrating that no other permutation yields such a large estimated impact as the one we obtain for Tennessee, using either Comparison Group 1 or Comparison Group 2.[31]

Our estimates of the effect on the number of second-trimester abortions per 1,000 women and the overall abortion rate indicate that these effects are a result of more women having abortions in the second trimester and fewer women having abortions overall. Specifically, the point estimates indicate that Tennessee's MWP increased the second-trimester abortion rate by 22–43 percent (Column 6) and reduced the overall abortion rate by 14–17 percent

[30]Estimates focusing on the percent of abortions in the second trimester are weighted by the average number of abortions from residents aged 15-44 in each state. Estimates focusing on abortion rates are weighted by the average number of women who were residents of each state aged 15-44.

[31]As evident in the p-values presented in Table 2, this is also for our baseline model and our model that solely adjusts for demographics.

(Column 9), depending on the comparison group that is used.[32] However, we note that these estimated effects are typically not statistically significant at conventional levels when we conduct randomization inference for these estimates, the results of which are shown in panels B and C of Figure 6).

Table 2
Difference-in-differences estimates of effects of Tennessee's mandatory waiting period

	% of abortions in 2nd trimester			log 2nd-trimester abortion rate			log overall abortion rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Comparison Group 1									
Estimated Effect	4.675	4.370	4.561	0.405	0.322	0.360	-0.121	-0.169	-0.155
two-sided p-value (CSEs)	[0.00]	[0.00]	[0.00]	[0.00]	[0.06]	[0.01]	[0.00]	[0.00]	[0.00]
two-sided p-value (RI)	[0.07]	[0.04]	[0.04]	[0.15]	[0.19]	[0.19]	[0.41]	[0.22]	[0.22]
one-sided p-value (RI)	[0.04]	[0.04]	[0.04]	[0.07]	[0.11]	[0.15]	[0.30]	[0.11]	[0.07]
Observations	189	189	189	189	189	189	189	189	189
Panel B. Comparison Group 2									
Estimated Effect	4.872	3.533	3.222	0.428	0.226	0.201	-0.120	-0.124	-0.127
two-sided p-value (CSEs)	[0.00]	[0.00]	[0.00]	[0.00]	[0.06]	[0.01]	[0.00]	[0.00]	[0.00]
two-sided p-value (RI)	[0.08]	[0.15]	[0.08]	[0.15]	[0.38]	[0.38]	[0.15]	[0.15]	[0.23]
one-sided p-value (RI)	[0.08]	[0.08]	[0.08]	[0.08]	[0.23]	[0.23]	[0.08]	[0.08]	[0.08]
Observations	104	104	104	104	104	104	104	104	104
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Unemployment rate	No	No	Yes	No	No	Yes	No	No	Yes

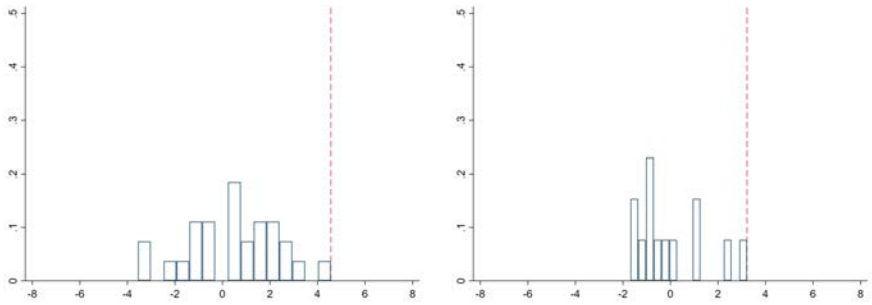
Notes: See Figure 2 for the states included in Comparison Group 1 and Comparison Group 2. The analyses using Comparison Group 1 uses data from 2010–2016 whereas the analyses using Comparison Group 2 uses data from 2010–2017. The percent of abortions in the second trimester is calculated as the percent of all abortions that were obtained after 12 weeks of gestation. The second trimester abortion rate is the number abortions obtained after 12 weeks of gestation per 1,000 women (ages 15-44). The overall abortion rate is the number abortions per 1,000 women (ages 15-44). The treatment effect is identified based on the coefficient on the variable measuring the share of the year in which the policy was in effect for Tennessee—this variable takes the value of 7/12 for Tennessee in 2015 and one for Tennessee in 2016 and 2017. The demographic controls are the shares of women in five-year age groups (15-19, 20-24,...,40-44) and the share that are Hispanic, Black, or non-Hispanic White (among women ages 15-44). The p-values displayed include those based on clustered standard errors at the state-level (CSEs) and those based on randomization inference. See section 5 for more information on the reported p-values. Sources: Number of abortions by gestational age were collected from states health departments by the authors and CDC Abortion Surveillance Reports.

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

Figure 6
Permutation Test Results Associated with Table 2 Estimates

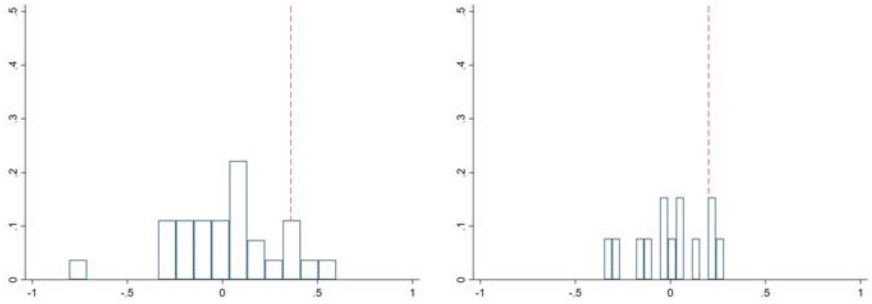
Panel A: Percent of abortions in the second trimester

Comparison Group 1 | Comparison Group 2



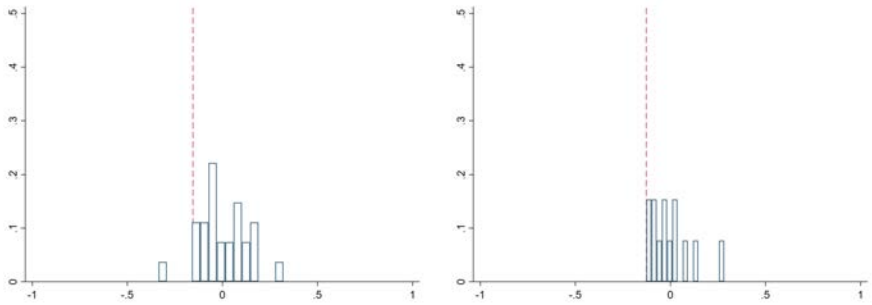
Panel B: Log of the second-trimester abortions per 1,000 women (ages 15-44)

Comparison Group 1 | Comparison Group 2



Panel C: Log of the number of abortions per 1,000 women (ages 15-44)

Comparison Group 1 | Comparison Group 2



Note: Each graphic shows the results of permutation tests corresponding to the results in Table 2 that control for state fixed effects and year fixed effects, demographic controls, and the unemployment rate (columns (3), (6), and (9)). The vertical line indicates where the estimated treatment effect for Tennessee lies in the distribution of possible estimated treatment effects that could be estimated for any state.

6.1.4 Difference-in-differences Robustness Tests

Table 3 shows estimated effects separately for the year in which Tennessee's MWP went into effect and in subsequent years, based on the following model:

$$y_{s,t} = \alpha_s + \gamma_t + TN15_{s,t}\beta_1 + TN16_{s,t}\beta_2 + TN17_{s,t}\beta_3 + \mathbf{X'}_{s,t}\eta + \epsilon_{s,t} \quad (4)$$

where $TN15_{s,t}$, $TN16_{s,t}$, and $TN17_{s,t}$ are indicator variables for Tennessee in 2015, 2016, and 2017, respectively, and $y_{s,t}$, α_s, γ_t, $X_{s,t}$, and $\epsilon_{s,t}$ are defined the same as they were in Equation 1. Our analyses using Comparison Group 1 omits the variable $TN17_{s,t}$ because they only use data from 2010–2016. In any case, the primary parameter of interest from this model is β_2, which we expect to capture the effect of the MWP being fully in effect. In contrast, β_1 captures the effect of the policy going into effect midway through the year and β_3 may in part capture the effects of other changes in access to abortion in Tennessee that occurred in 2017.[33] For this reason, we focus our discussion on the estimated effect for 2016, or β_2.

These estimates indicate that Tennessee's MWP increased the percent of abortions obtained in the second trimester by its residents by 4.1–5.1 percentage points (Column 3) when it was fully in effect (in 2016), which is consistent with the estimated effects reported in Table 2, and which represents a 61–76 percent increase over Tennessee's 2014 level (6.7 percent). Panel A of Figure 7 shows the results of our randomization inference procedure for these estimates, the results of which demonstrate that no other permutation of the treatment variables yields such a large estimate as the estimated effect we observe for Tennessee.[34] The estimated effects on the second-trimester abortion rate and the overall abortion rate in 2016 are also consistent with the estimates reported in Table 2, though in this analysis we find estimates that are somewhat larger in magnitude for the effect on the second-trimester

[33] Because these changes include state restrictions and also the opening of a clinic, the expected net effect of these changes is ambiguous.

[34] This is also the case for the estimated impact from our baseline model (Column 1) and our model that adjusts for solely for demographics (Column 2).

abortion rate and somewhat smaller in magnitude for the impact on the overall abortion rate.

As another way of assessing the robustness of our main results, we verified that they are not sensitive to the inclusion of any specific state from the comparison group. Figure C in the appendix reports the results from this analysis. In particular, it shows how our main results (shown in columns 3, 6, and 9 of Table 2) compare to the distribution of estimates that are possible using the same methodology if any single state from the comparison group is omitted from the analysis.

Table 3
Difference-in-differences estimates of effects of Tennessee's mandatory waiting period *by year*

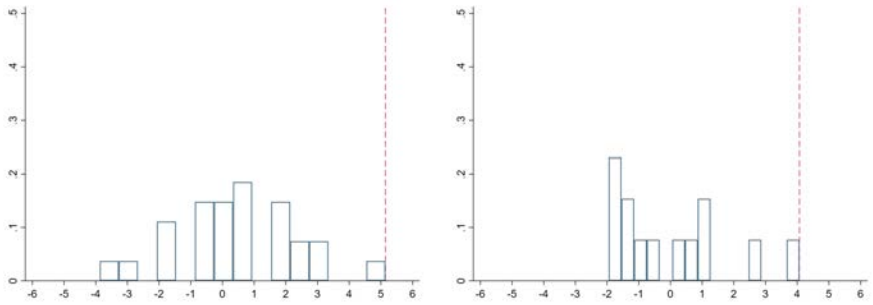
	% of abortions in 2nd trimester			log 2nd-trimester abortion rate			log overall abortion rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Comparison Group 1									
1(TN in 2015)	1.130	1.036	1.363	0.001	-0.052	0.012	-0.156	-0.198	-0.174
two-sided *p*-value (CSEs)	[0.00]	[0.01]	[0.00]	[0.99]	[0.31]	[0.81]	[0.00]	[0.00]	[0.00]
two-sided *p*-value (RI)	[0.63]	[0.70]	[0.37]	[1.00]	[0.78]	[1.00]	[0.15]	[0.04]	[0.07]
one-sided *p*-value (RI)	[0.41]	[0.44]	[0.30]	[0.52]	[0.33]	[0.63]	[0.11]	[0.04]	[0.07]
1(TN in 2016)	**5.412**	**5.060**	**5.142**	**0.513**	**0.431**	**0.448**	**-0.081**	**-0.124**	**-0.118**
two-sided *p*-value (CSEs)	**[0.00]**	**[0.00]**	**[0.00]**	**[0.00]**	**[0.00]**	**[0.00]**	**[0.01]**	**[0.00]**	**[0.00]**
two-sided *p*-value (RI)	**[0.04]**	**[0.04]**	**[0.04]**	**[0.07]**	**[0.15]**	**[0.15]**	**[0.63]**	**[0.37]**	**[0.33]**
one-sided *p*-value (RI)	**[0.04]**	**[0.04]**	**[0.04]**	**[0.04]**	**[0.11]**	**[0.11]**	**[0.41]**	**[0.15]**	**[0.15]**
Observations	189	189	189	189	189	189	189	189	189
Panel B. Comparison Group 2									
1(TN in 2015)	1.520	0.714	1.140	0.047	-0.067	-0.003	-0.146	-0.140	-0.132
two-sided *p*-value (CSEs)	[0.00]	[0.14]	[0.01]	[0.41]	[0.24]	[0.95]	[0.00]	[0.00]	[0.00]
two-sided *p*-value (RI)	[0.38]	[0.77]	[0.46]	[0.62]	[0.54]	[1.00]	[0.08]	[0.15]	[0.23]
one-sided *p*-value (RI)	[0.23]	[0.38]	[0.23]	[0.38]	[0.23]	[0.38]	[0.08]	[0.08]	[0.15]
1(TN in 2016)	**5.478**	**4.251**	**4.070**	**0.560**	**0.366**	**0.355**	**-0.057**	**-0.065**	**-0.066**
two-sided *p*-value (CSEs)	**[0.00]**	**[0.00]**	**[0.00]**	**[0.00]**	**[0.00]**	**[0.00]**	**[0.10]**	**[0.04]**	**[0.03]**
two-sided *p*-value (RI)	**[0.08]**	**[0.008]**	**[0.08]**	**[0.15]**	**[0.15]**	**[0.15]**	**[0.54]**	**[0.54]**	**[0.54]**
one-sided *p*-value (RI)	**[0.08]**	**[0.008]**	**[0.08]**	**[0.08]**	**[0.08]**	**[0.08]**	**[0.38]**	**[0.38]**	**[0.31]**
1(TN in 2017)	4.774	3.255	2.591	0.374	0.147	0.079	-0.153	-0.163	-0.172
two-sided *p*-value (CSEs)	[0.00]	[0.01]	[0.00]	[0.00]	[0.30]	[0.45]	[0.00]	[0.00]	[0.00]
two-sided *p*-value (RI)	[0.08]	[0.23]	[0.23]	[0.15]	[0.62]	[0.54]	[0.15]	[0.23]	[0.23]
one-sided *p*-value (RI)	[0.08]	[0.08]	[0.08]	[0.08]	[0.23]	[0.31]	[0.08]	[0.15]	[0.08]
Observations	104	104	104	104	104	104	104	104	104
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Unemp. rate	No	No	Yes	No	No	Yes	No	No	Yes

Notes: See Figure 2 for the states included in Comparison Group 1 and Comparison Group 2 and Table 2 for additional details regarding the analyses.

Figure 7
Permutation Test Results Associated with Table 3 Estimates for 2016

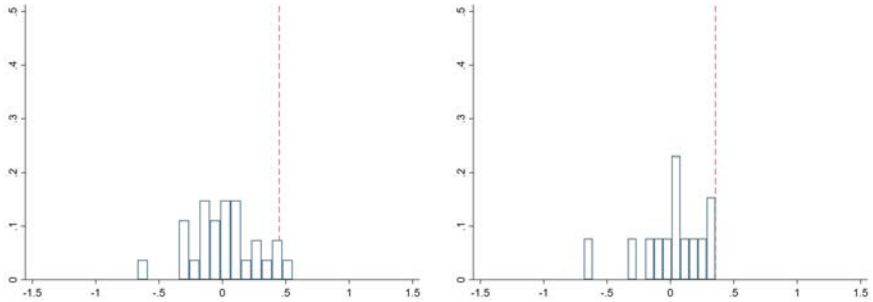
Panel A: Percent abortions in the second trimester

Comparison Group 1 | Comparison Group 2



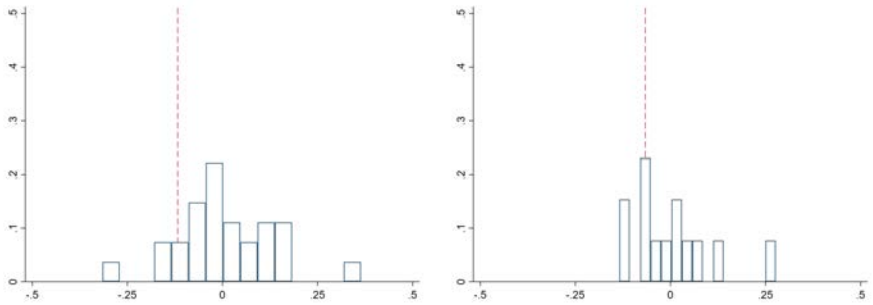
Panel B: Log of the second-trimester abortions per 1,000 women (ages 15-44)

Comparison Group 1 | Comparison Group 2



Panel C: Log of the number of abortions per 1,000 women (ages 15-44)

Comparison Group 1 | Comparison Group 2



Note: Each graphic shows the results of permutation tests corresponding to the estimated effects for 2016 in Table 3, which control for state fixed effects and year fixed effects, demographic controls, and the unemployment rate (columns (3), (6), and (9)). The vertical line indicates where the estimated treatment effect for Tennessee lies in the distribution of possible estimated treatment effects that could be estimated for any state.

6.2 Synthetic Control Estimates

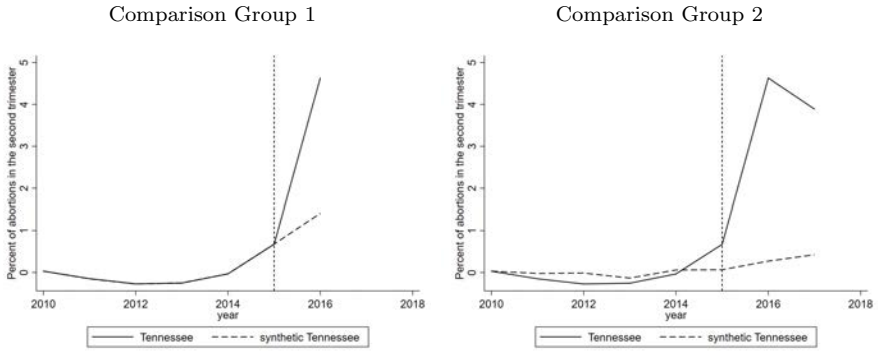
In this section we present estimated effects based on a synthetic control design (Abadie et al., 2003; 2010; 2015). In implementing this design, we follow Ferman and Pinto (2017) and construct synthetic controls by matching on the demeaned outcomes observed in the pre-intervention period (2010–2014) when evaluating each outcome variable.

Figure 8 compares Tennessee to "synthetic Tennessee" for each of the outcomes we consider, using both Comparison Group 1 and Comparison Group 2 to construct different versions of "synthetic Tennessee." This graph demonstrates that we are able to identify a synthetic control that is very similar to Tennessee before its MWP, particularly for evaluating the percent of abortions obtained in the second trimester and the second-trimester abortion rate, and also indicates that these outcomes rose dramatically for Tennessee relative to its synthetic controls after its MWP went into effect.

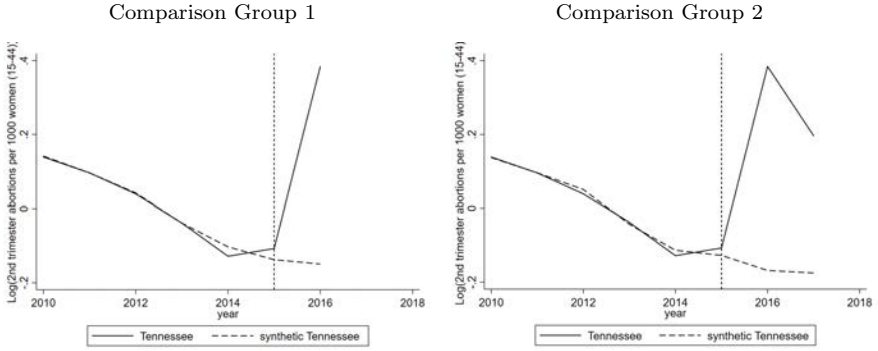
Figure 9 shows how these estimated effects compare to the distributions of estimates that are possible if the same methodology is applied to any state included in the analyses. Underscoring the statistical significance of the estimated effect on the percent of abortions obtained in the second trimester, none of the placebo tests yields an estimate as large and positive as the estimated effect for Tennessee, for 2016 or 2017 or using Comparison Group 1 or Comparison Group 2. Moreover, none of the placebo tests yields an estimate as large and positive as the ones we obtain for Tennessee when we evaluate the second-trimester abortion rate in 2016, and just one is as large and positive as the one we obtain when we evaluate the second-trimester abortion rate in 2017. The estimated effects on the overall abortion rate are less conclusive.

Figure 8
Demeaned Outcomes for Tennessee and Synthetic Controls

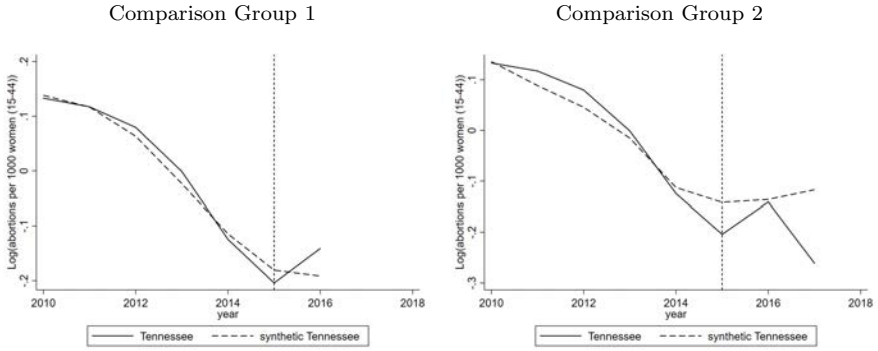
Panel A: Percent of abortions in the second trimester



Panel B: Log of the second-trimester abortions per 1,000 women (ages 15-44)



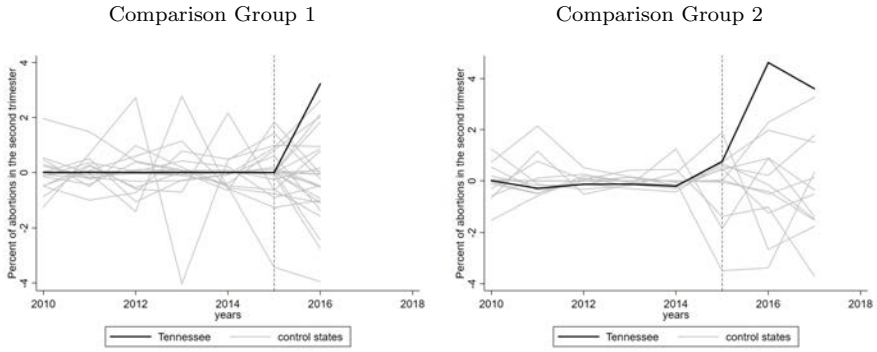
Panel C: Log of the number of abortions per 1,000 women (ages 15-44)



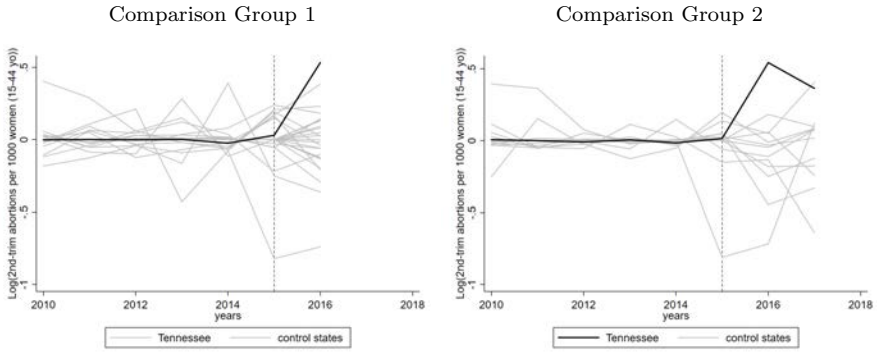
Note: Tennessee's mandatory waiting period law went into effect in May 2015. The synthetic controls were constructed following Ferman and Pinto (2017), matching on demeaned outcomes prior to 2015. See Figure 2 for the states included in Comparison Group 1 and Comparison Group 2. The percent of abortions in the second trimester is calculated as the percent of all abortions that were obtained after 12 weeks of gestation. The second trimester abortion rate is the number abortions obtained after 12 weeks of gestation per 1,000 women (ages 15-44). The overall abortion rate is the number abortions per 1,000 women (ages 15-44). Sources: The number of abortions by gestational age were collected from states' health departments by the authors and CDC Abortion Surveillance Reports. Annual state-level population estimates were obtained from the United States Census Bureau (2017).

Figure 9
Permutation Tests Associated with Synthetic Control Estimates

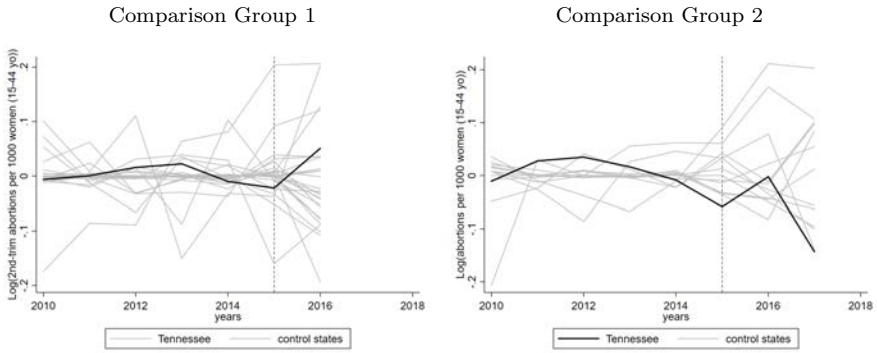
Panel A: Percent of abortions in the second-trimester



Panel B: Log of the second-trimester abortions per 1,000 women (ages 15-44)



Panel C: Log of the number of abortions per 1,000 women (ages 15-44)



Note: The figure depicts estimates evaluating Tennessee using the synthetic control design, as in Figure 8, along with the set of placebo estimates (in gray) that can be obtained by applying the same methodology to each of the states in the comparison groups. See Figure 8 for additional information.

7 Monetary Costs of the MWP

Previous studies have reported on women's perceptions about and experiences with MWPs based on surveys. In these surveys, women reported problems associated with transportation, employment, school, and childcare (Lupfer and Silber, 1981; Karasek et al., 2016; Roberts et al., 2016; and Sanders et al., 2016). Notably, our estimates suggest additional monetary costs are likely to result from women being delayed from obtaining abortions.

Delayed abortions can increase monetary costs for two main reasons. First, delays can increase the cost of the procedure which typically rise with gestational age.[35] Second, delays can require women to travel to more distant providers because providers vary in the types of procedures they offer and the gestational ages at which they offer them. Women's options become more limited at higher gestational ages. As a result, delays can increase transportation costs, potential lost wages, and potential childcare expenses.

To gain a better sense of the additional monetary costs faced by women seeking abortions under Tennessee's MWP, we have done several back-of-the-envelope calculations that take into account costs associated with the additional consultation appointment and the costs associated with being delayed from obtaining an abortion. The cost of the additional appointment involves the cost of the appointment itself, the cost of transportation to the appointment, lost wages for women who have to take time off of work, and childcare expenses for women who require such care. We consider delays from one to five weeks. The cost of the delay includes any additional cost of the procedure and, if the delay requires travel to a more-distant provider, additional transportation costs and lost wages and childcare expenses for women for whom these costs are relevant. It is worth mentioning these calculations are not welfare costs; we are providing information on the potential financial costs women would face due to the MWP.

[35] Figure D in the Appendix shows the costs of obtaining an abortion at a clinic in Tennessee in October 2015, a few months after the MWP law went into effect.

7.1 Additional costs ignoring costs of delays

To begin, we focus on the costs that would be expected for a woman who is not delayed from obtaining an abortion. For such a woman, the additional costs consist solely of the additional costs associated with the mandatory counseling appointment.

We estimate the additional amount that clients had to pay to providers based on the change in the cost of obtaining an abortion—inclusive of all appointments—between July 2015 and October 2015. In particular, the fees for getting an abortion—inclusive of all appointments—rose by \$25–70 between July 2015 and October 2015.[36] We use this range as a conservative estimate of the additional fees resulting from the MWP, though we note that providers charged \$180–275 for consultation appointments after the MWP was enacted, followed by additional fees at the time of the procedure, which would vary depending on the procedure type and the gestational age.

We estimate transportation costs as a function of where a woman lives and the gestational age for which she is seeking an abortion. These jointly determine the nearest provider that could provide a woman with abortion care and the travel time required to reach this provider using the provider-search tool from Goldenberg et al. (2017), which provides calculations for women living in Tennessee's twelve largest cities.[37] The tool provides information on the nearest provider, disregarding if this provider is in the state or out-of-state. Because a more-limited set of clinics provide care to women seeking abortions at higher gestational ages, women seeking abortions at such gestational ages often have to travel farther to reach their nearest provider. Thus, the transportation costs are comparatively high for women living relatively far from clinics (e.g., women in rural areas) and for women seeking abortions

[36]The information on abortion prices is from Knoxville Center for Reproductive Health, one of the seven clinics providing abortion services in Tennessee as of 2017. We used Wayback Machine to obtain information on the prices women faced in 2015.

[37]Goldenberg et al. (2017) was published in September 2017. Therefore, we expect the estimations on travel distance to reflect the abortion landscape as of that date. The tool provides information for cities as small as approximately 50,000. Specifically, it provides information for the following twelve cities in Tennessee, ordered by population: Nashville, Memphis, Knoxville, Chattanooga, Clarksville, Murfreesboro, Franklin, Jackson, Johnson City, Bartlett, Hendersonville, and Kingsport.

at higher gestational ages. Notably, some women in Tennessee have to travel three hours roundtrip to reach their nearest provider regardless of gestational age at which they are seeking an abortion (e.g., those residing in Chattanooga). We calculate a maximum of six hours of travel required for Tennessee residents seeking an abortion at different gestational ages (e.g., women in Knoxville or Jackson seeking an abortion at 20 weeks, women in Johnson City or Kingsport seeking an abortion at 16 weeks). As such, we estimate that the additional transportation costs could be up to $66, based on the cost of gas for a woman who needs to travel an extra six hours roundtrip for the counseling appointment.[38] Naturally, women without access to a car may incur additional costs.

We estimate costs associated with lost wages and/or childcare for women who have to take time off work similarly, based on the amount of time it is expected to take for a woman to reach the nearest provider that can serve her, and additionally factor in the amount of time that the appointment takes itself which can take 3–6 hours.[39] Given the possibility of driving up to six hours and a total appointment time of up to six hours, women could lose up to twelve hours of wages or could have to pay for up to twelve hours of childcare to attend the consultation appointment. At Tennessee's minimum wage, which has remained at 7.25 per hour since 2015, twelve hours of lost wages would amount to $87. At a cost of $10 per hour for a babysitter, twelve hours of childcare would amount to $120.[40]

Given the calculations described above, we conservatively estimate that costs associated with the consultation appointment range from $25–70 if we focus solely on the fees required by providers. Additionally, accounting for transportation costs and the fact that some women

[38]We assume a gas cost $2.75 per gallon, and woman drives to a clinic at 60 miles per hour on average in a vehicle with a fuel efficiency of 30 miles per gallon.

[39]This range of times is based on the Knoxville Center for Reproductive Health's website: https://kcrh.com/frequently-asked-questions/. It states, "with new laws and restrictions in place and a required 48 hour waiting period, two visits are now required. You can expect to be at the center for 3-6 hours for each visit. The first visit will include medical history, ultrasound, lab, informed consent, video, and educational materials to review as well as individual counseling sessions. The second visit will include the procedure itself, whether aspiration or medical and recovery time for aspiration patients. So there are a lot of 'other' time-consuming parts of your visit here. We strive to give you the individual attention you deserve but remember on busy days, there are many other women needing all these services too."

[40]According to Guttmacher Institute (2018), as of 2014, 59% of women who got an abortion in the U.S. had one or more children.

will have to travel six hours to reach the nearest provider who can serve them, the costs range from $91–136. Additionally, accounting for costs associated with lost wages or childcare brings the range from $211–256.

7.2 Additional costs accounting for delays

Though our empirical analysis indicates that the MWP delayed women from obtaining abortions, it does not tell us precisely how long the delays typically were. For this reason, in this section, we provide estimates of the costs of delays ranging from one day to five weeks.

Based on the fees charged for different abortion procedures at different gestational ages, a one-day delay can increase the fees by up to $175; a two-week delay can increase the cost of the procedure by up to $275, a three-week delay can increase the cost of the procedure by up to $425; a four-week delay can increase the cost of the procedure by up to $525; and five-week delay can increase the cost of the procedure by up to $575.[41]

As we highlighted earlier, delays can also reduce the set of clinics from which a woman can obtain care because clinics vary in the types of procedures they offer and the gestational ages at which they offer them. As such, delays can increase travel time and also costs associated with transportation, lost wages, and childcare. Based on information from the same provider search tool described earlier, we estimate that a one-day delay could increase travel time by up to five hours. Making the same conservative assumptions as we have previously, we estimate that such a delay could increase transportation costs by up to $21; lost wages by up to $36.25; and childcare costs by $50. We estimate that a five-week delay could increase travel time by up to six hours. Such a delay could increase transportation costs by up to $38; lost wages by up to $43.5; and childcare costs by $60.

As a whole, these calculations indicate that a one-day delay could increase a woman's cost by $175 based on the cost of the procedure alone. If the delay restricts the clinics at which a woman can obtain abortion care, her additional costs could rise by up to $196,

[41] These costs are based on the fee schedule from Knoxville Center for Reproductive Health as of October 1st, 2015 which is shown in Figure D in the Appendix.

accounting for additional transportation costs, and her additional costs could rise by up to $232.5, accounting for additional transportation costs and lost wages or by $246 accounting for transportation costs and childcare. Our calculations indicate that a five-week delay could increase a woman's cost by $575 based on the cost of the procedure alone, by $613 accounting for additional transportation costs, by $656.5 when also accounting for additional lost wages, and by $673 when accounting for childcare expenses instead of lost wages.

The total costs of the MWP would be a combination of the additional costs associated with the counseling appointment and the costs of the delay. According to our calculations, the total cost of the MWP would be up to $645 based on the cost of the procedure alone. If we account for transportation costs, this could rise to $749, by up to $912.5, also accounting for lost wages, and by up to $929 if accounting for childcare expenses and not lost wages.

7.3 Costs in Context

To put our cost calculations in context, it is important to note that the majority of abortion patients are low income, and even in the absence of the waiting period or other restrictions, many women incur financial hardship to obtain an abortion (Karasek et al., 2016). A family of three at the federal poverty level in 2014 had a monthly income of $1,649. As such, the *additional* financial costs for a woman to obtain an abortion caused by Tennessee's MWP *over and above prior costs* can amount to a substantial share of women's monthly income.

8 Conclusions

In this study, we provide the first estimates of the effects of a MWP for abortion since studies evaluating the effects of states adopting such policies in the early 1990s. Consistent with rigorous research on Mississippi's MWP (Joyce et al. 1997, Joyce and Kaestner, 2000), which also required an additional trip to the provider for an in-person consultation before the waiting period began, we find significant effects on the share of abortions obtained in

the second trimester, and we also find some suggestive evidence of impact on the overall abortion rate. Relative to this earlier work, our point estimates indicate somewhat larger effects on the percent of abortions obtained in the second trimester and somewhat smaller effects on the overall abortion rate.

These findings are consistent with a number of recent studies documenting the causal effects of barriers to accessing reproductive health care. In particular, they are consistent with research on the impact of physical attacks on abortion providers (Jacobson and Royer, 2011) and with several recent studies showing that increases in the distance women have to travel to reach their nearest abortion provider cause significant reductions in abortion rates (Quast, Gonzalez, and Ziemba, 2017; Fischer, White, and Royer, 2018; Lindo et al., forthcoming. Other studies have found significant effects of the distance that women have to travel to reach family planning clinics on birth rates (Lu and Slusky, 2019; Fischer, White, and Royer, 2018; Kelly et al., 2019). Recent studies have also demonstrated that parental involvement laws can have significant effects on abortion rates among minors (Joyce et al., 2019).

As more data become available, and as the landscape for reproductive health care continues to change at a rapid rate, it will be important for researchers to continue to evaluate important policy changes. With regards to Tennessees' MWP, future research could examine whether the effects persist into subsequent years, whether they extend to residents in neighboring states, whether they lead to any measurable impacts on birth rates, and whether they affect other outcomes for women and their families. For MWPs more broadly, future research could examine the effects in other states, the effects of changes in the duration that women are required to wait, and the margins of adjustment that are available to providers who might struggle to cope with the requirement that they have an additional appointment for each patient.

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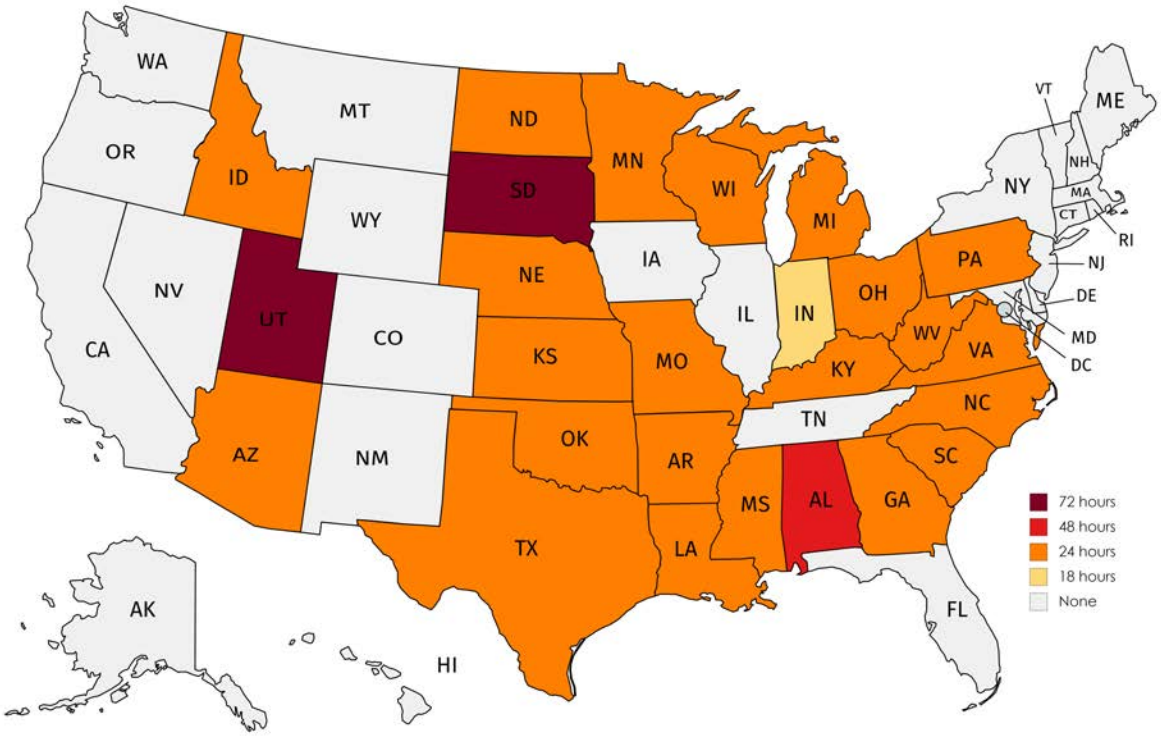
Appendix

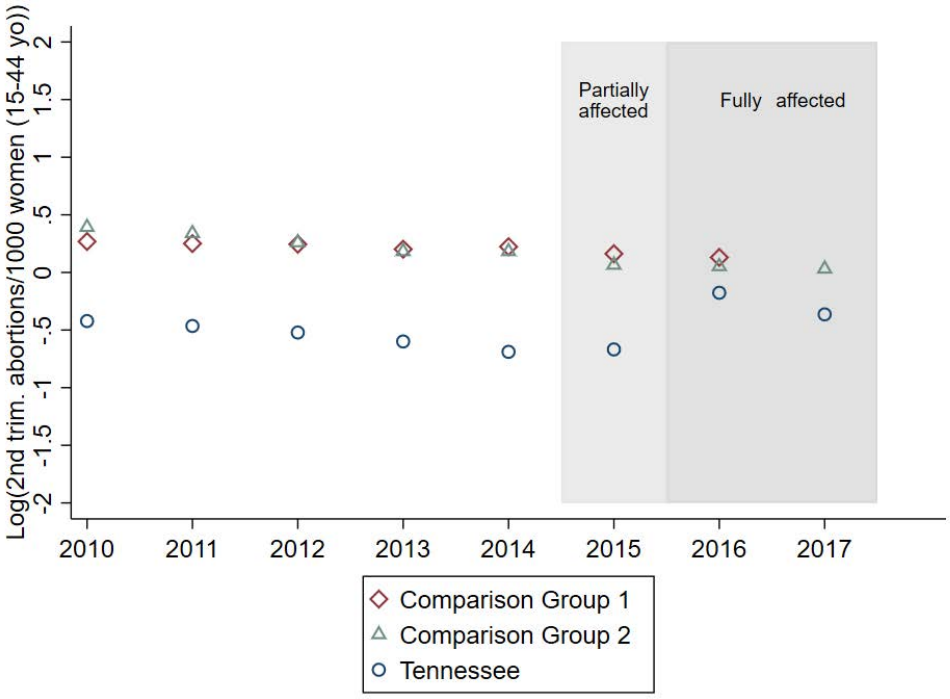
Figure A
Mandatory waiting period lengths, 2014



Note: The map shows the mandatory waiting period in each state at the beginning of 2014. Source: Huffington Post.

Figure B
Log of abortion rates

Panel A: Log of abortions in the second trimester per 1,000 women aged 15-44



Panel B: Log of abortions per 1,000 women aged 15-44

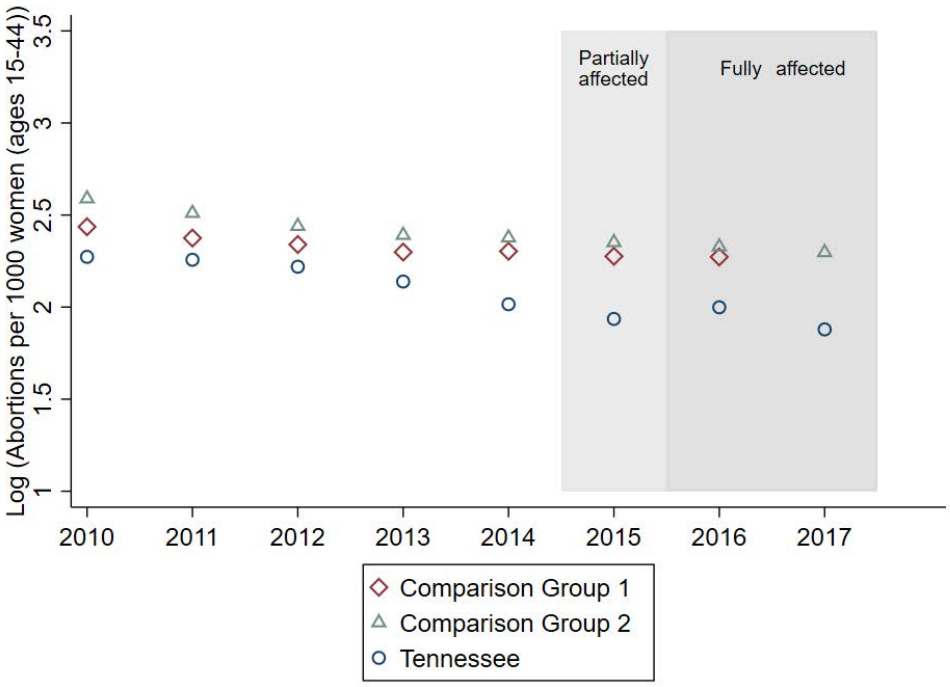
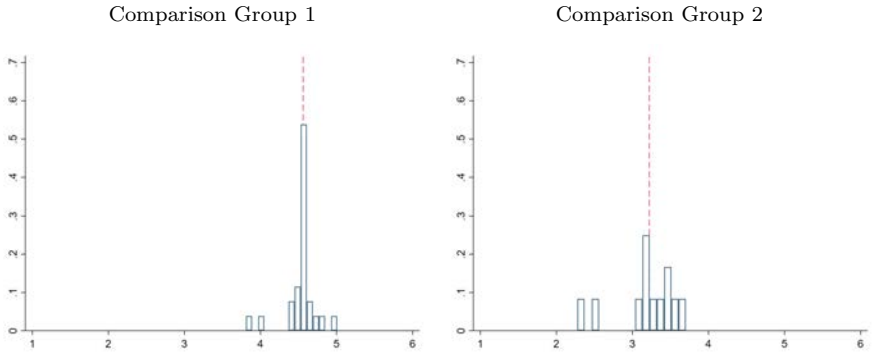
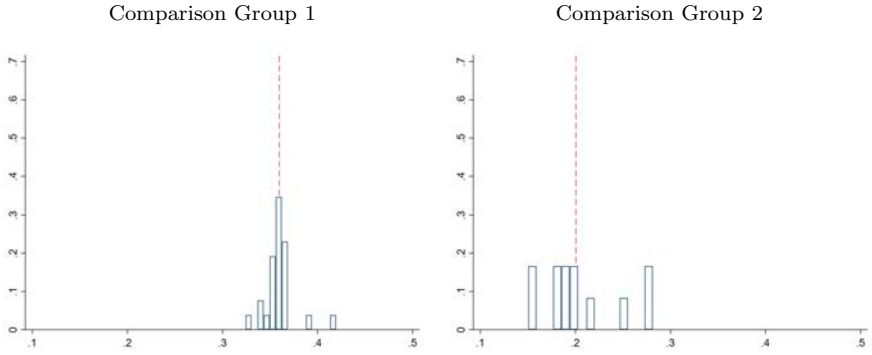


Figure C
Comparison of Main Difference-in-Differences Estimates to
The Distribution of Estimates Omitting One State from the Comparison Group

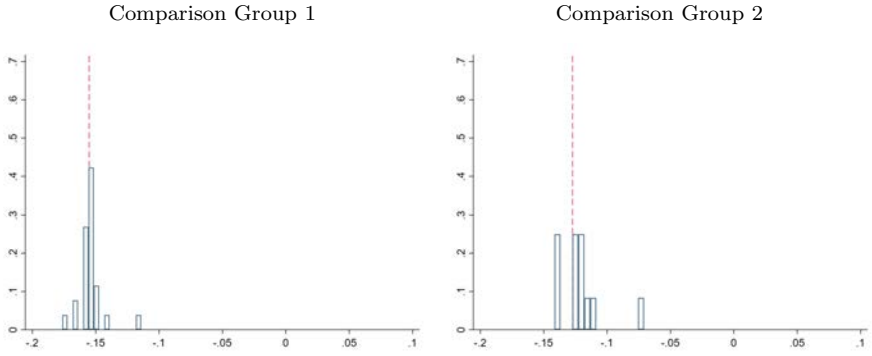
Panel A: Percent of abortions in the second trimester



Panel B: Log of the second-trimester abortions per 1,000 women (ages 15-44)



Panel C: Log of the number of abortions per 1,000 women (ages 15-44)



Note: The vertical line shows the estimate from Table 2 that controls for state fixed effects and year fixed effects, demographic controls, and unemployment rates (columns (3), (6), and (9)). The distribution around this line shows the effects that we obtain if we omit any single state from the comparison groups.

Figure D
Abortion prices as of October 2015

Abortion Fees

Pregnancy is measured from the first day of the last normal menstrual period (not from conception) and is verified by ultrasound.

As of October 1st the fees will be:

Medical Abortion	up to 10 weeks	$525
Surgical Abortion	6-11 weeks, 6 days	$575
	12-12 weeks, 6 days	$750
	13-13 weeks, 6 days	$850
	14-14 weeks, 6 days	$1000
	**15-16 weeks, 3 days	$1,100
Twin Pregnancy	13-15 weeks	$1,050

** Limited scheduling based on physician availability.

Abortion Fees Include:
The abortion procedure, lab work, ultrasound, counseling, medications given at the Center, take home medications, and the follow-up exam three to four weeks later.

Due to the 48 hour waiting period and imposed two clinic visits, the fee is split into two payments. The first visit is $180; the second visit is the remaining fee based on the gestational age at the time of the second visit. Full payment at the first visit is an option, if preferred.

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Note: This information was obtained using Wayback Machine. Source: Knoxville Center for Reproductive Health.