Provider Choice, Home Births, and Health Outcomes[*]

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Updated Version

Abstract

Home births in the US have increased twofold since the early 2000s, yet little is known about the policies that have driven the increase. Moreover, this increase in births outside of hospitals prompts concerns for maternal and infant health. In this paper, I use natality data from 1989 to 2021 to estimate relative changes in the prevalence of home birth and subsequent health outcomes before and after a change in access to provider choice. Staggered difference-in-differences estimates indicate a 20–30 percent increase in home births when states increase provider choice through non-nursing midwifery licensing. I find the change in access is most salient for college-educated mothers, low-risk pregnancies, and mothers who pay out of pocket. I find little evidence of an effect on other measures of infant health or maternal health.

JEL Classification: I14, I18, J18, J16
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I. Introduction

Rates of home births in the US have doubled in recent years; in 2008, less than 32,000 births occurred at home, while in 2021, around 64,000 births occurred at home (CDC, 2022). Despite the dramatic increase, substantial controversy remains on the safety and implications of home births. The American College of Obstetricians and Gynecologists (ACOG) states that the hospital is the safest place to give birth, and many healthcare professionals argue that home birth is dangerous even for low risk mothers (AMA, 2021; Sánchez-Redondo, Cernada, Boix, et al., 2020). However, proponents of home birth say if done safely, it can reduce medical interventions and improve the birthing experience for mothers. Moreover, the costs of home births are borne by the mothers themselves, freeing up hospital beds for others in need. Overall, there is little causal evidence on what policies drive the increase in home births.

To better understand the increasing trends in home births and whether these trends yield negative health consequences, I study an expansion of provider choice for birth through state licensing of non-nursing midwives to show that these licensing laws increase the prevalence of home births and then estimate the effects on health outcomes. Studying the health effects of policies that increase access to home birth is particularly important because a typical home birth is less costly than hospital births. If home birth does not result in negative health outcomes, then a shift in low-risk births from the hospital to home can reduce the out-of-pocket cost of vaginal birth from around \$15,000 to \$5,000 (KFF, 2022); (Anderson and Gilkison, 2021). In addition, making it easier to have a home birth for mothers can increase their non-monetary welfare by increasing their choice set of places to give birth and reducing undesired medical interventions.

From 1989 to 2021, 27 states in the US began allowing and requiring the licensing of non-nurse midwives. Non-nurse midwives typically attend home births in lieu of a doctor; however, non-nurse midwives are not allowed licenses in all states. Because non-nurse midwives are the primary attendants for home births, increasing the supply of midwives through licensing increases a mother's choice set for place of delivery by providing easier access to home births. I exploit timing in state adoption of licensing laws for non-nurse midwives with a difference-in-differences estimation strategy to estimate the effects of licensing non-nurse midwives on the prevalence of home births in a state and the subsequent health outcomes of mothers and infants.

I focus on state licensing legislation from 1993 to 2019 using natality data from 1989 to 2021. In this period, the majority of states transitioned from not allowing non-nursing midwives to practice to allowing them and requiring licenses.[1] The term "Non-nursing midwife" refers to all midwives without a nursing degree. While the exact requirements for licensure differ across states, they are similar in that they primarily practice in homes, and the regulation is separate from nursing midwives who primarily practice in hospitals.[2] Because states begin licensing non-nursing midwives in different years, I leverage the variation in timing across states in a difference-in-differences framework (Callaway and Sant'Anna, 2021).

First, I show that when a state begins licensing non-nurse midwives, there is an increase in the number of practicing non-nurse midwives. Because non-nurse midwives are the most common attendants at home births, I then study the effect on the prevalence of home births using birth records from the National Center for Health Statistics from 1989 to 2021. I show that the 20-30 percent increase in home births is driven by a positively selected group of college-educated and low-risk mothers who pay out of pocket. This corresponds to around 4,000 additional home births per year. While there is a substantial increase in home births, I find little evidence of negative effects on infant and maternal health. In particular, I find no statistically significant effect on prenatal visits, birth weight, or measures of infant health shortly after birth.[3]

While birth data do not allow direct observation of mothers who are transferred to a hospital, I use hospitalization data from the Healthcare Cost and Utilization Project (HCUP) to study hospitalizations of mothers and infants due to delivery complications. I find no evidence of increased hospitalizations for mothers or infants after non-nurse midwifery legislation. Overall,

[1] In some states, prior to licensing, non-nursing midwives were allowed but not licensed.

[2] Nurse midwives are already regulated in each state during this period, and only 7 percent of nurse midwives report practicing in homes (GAO, 2023).

[3] I present some evidence of an increase in neonatal seizures, which is a rare outcome that occurs when infants lose access to oxygen. However, this estimate is not robust to multiple hypothesis testing.

the difference-in-differences results suggest that increasing access to non-nurse midwives can be cost saving for society by increasing home births for low risk pregnancies with limited negative health effects and be welfare improving for a mother by increasing options for the delivery place. Specifically, increasing access to midwives and home birth results in around 3,700 additional home births per year without substantial negative health effects, translating to healthcare savings of 32 million dollars (Caron, Wheless, Patters, and Wheless, 2015; KFF, 2022).

Mothers' existing formal healthcare is likely to influence their response to the increase in provider choice. I show that the initial choice set matters, and women living in rural counties increase their take-up of home births more than women living in urban counties. Access to maternity care differs vastly between rural and urban areas in the US, with 2.2 million women living in counties defined as maternity care deserts with limited access to prenatal care (MOD, 2022). However, because the women who increase home birth after midwifery laws are low risk and have higher socioeconomic status (SES), they are less likely to be constrained by the limited access to obstetric care prior to midwifery licensing than other rural women who are not college-educated and have lower socioeconomic status. While many proponents of midwifery laws cite them as the solution to maternity care desserts for all women, I present some evidence that, in fact, it is the least vulnerable that shift their behavior when midwifery laws are passed.

To further understand the role that access to formal healthcare plays in the take up of home birth, I estimate the effect of maternity ward closures on the prevalence of home births. In contrast to midwifery licensing, which offers an exogenous shock that increases access to care and provider choice, maternity ward closures are a shock that decreases access to care. I find that when a county no longer has a maternity ward, home births increase by 12 percent. Unlike midwife laws and the increase in the choice set, a non-positively selected group of women take up home birth after closures. The heterogeneity in the demographics of mothers who take up home birth after an increase in access to care (midwifery) and a decrease in access to care (hospital closures) highlight the need for a nuanced discussion of how policies and shocks that affect home birth can have differential impacts on health for different groups. Ultimately, I find that around 25 percent of the increase in home births from 1992 to 2019 can be attributed to midwifery licensing, while 2.5 percent can be attributed to maternity ward closures.

My findings contribute to the existing literature in three main ways. I present new evidence on how modern non-nursing midwifery laws affect the prevalence of home births. Previous literature on midwives in economics examines the health impact of changes in the scope of practice for nurse midwives on hospital births.[4] Markowitz, Adams, Lewitt, and Dunlop (2017) and Hoehn-Velasco, Jolles, Plemmons, and Silverio-Murillo (2022) show that increases in the scope of practice for nurse midwives result in little change in health outcomes but do decrease cesareans. I build on these studies by studying the effect of licensing that allows non-nurse midwives to begin practicing on the prevalence of home births. In contrast, the work on nurse midwives studies increases the scope of practice for already practicing nurse midwives in hospital settings. I find limited health effects of allowing non-nurse midwives who work in home settings, just as previous work found limited health effects of nurse-midwives who primarily practice at hospitals.

Midwives have also been studied in a historical context. Using early midwifery regulation from 1900–1940, Anderson, Brown, Charles, and Rees (2020) find that requiring midwives to be licensed reduces maternal mortality by 6 to 7 percent. Further, these early midwifery regulations affect long-run outcomes by increasing longevity and reducing long-run mortality of children (Fletcher and Noghanibehambari, 2023). My paper presents new estimates on non-nurse midwifery licensing in the modern context. While the historical research on midwives informs us about the general effects of licensing laws, it cannot speak to the effect of increasing provider choice and access to home birth in the modern context where birth has been medicalized, and medical technology has changed vastly (Goode and Rothman, 2017).

More broadly, my findings contribute to the literature on behavioral responses to provider choice and the heterogeneity of impacts for different populations. Much of the existing literature focuses on physical access to care, showing that distance to the nearest hospital affects take-up of preventative care, especially for Black children (Currie and Reagan, 2003). For pregnant women

[4]From 1989 to 2021, nurse midwives were licensed in all US states; however, there is variation in the scope of practice for these midwives.

in particular, Aizer, Lleras-Muney, and Stabile (2005) show that Black mothers respond less to an increase in provider choice than White mothers. In contrast to the previous literature, I find that both White and Black mothers respond to increases in provider choice, with heterogeneity being driven by education level.

Finally, I study the health effects of a change in provider choice, contributing to a growing literature on the effects of maternity ward closures on health. Research shows closures lead to a reduction in cesareans and no impact on infant health (Fischer, Royer, and White, 2024; Battaglia, 2022). I contribute by directly studying the impact of maternity ward closures on the prevalence of home birth and, more broadly, by studying the health impacts of an increase in provider choice using midwifery laws.

II. Background

II.1. Non-Nurse Midwifery Licensing

Midwives have a long history of performing home births. As Goode and Rothman (2017) explain, midwifery in the US is inextricably linked with enslaved people and began in the South with "grand" midwives who were enslaved and attended births for other enslaved people and plantation owners.They were often not recognized as midwives until they witnessed, attended, and supervised many births. Before the 1930s and the introduction of sulfa drugs, giving birth in hospitals did not reduce maternal mortality, and the majority of births occurred at home (Jayachandran, Lleras-Muney, and Smith, 2010). Now, around 1 percent of all births in the US are home births, most often performed by a non-nursing midwife.

There are two main categories of midwifery – nurse and non-nurse.[5] Nurse midwives are registered nurses who have a master's degree in midwifery and primarily practice in hospitals and birthing centers. Each state in the US regulates nurse midwives, often called Certified Nurse Midwives (CNMs). Non-nurse midwives differ from nurse midwives in that they do not have a

[5]In contrast to midwives, Doulas do not perform medical interventions. However, they can work in conjunction with a doctor or midwife.

nursing degree; however, within the category of non-nurse midwives, there are different types of licenses. The three most common types of non-nurse midwives are Certified Midwives (CMs), Certified Professional Midwives (CPMs), and direct entry or licensed midwives. CMs are closely related to CNMs because they have a master's degree and are licensed by the American Midwifery Certification Board, which also licenses CNMs. Given this relation, I have excluded states which only license CMs from the main analysis.[6] Aside from CMs, I group all other non-nurse midwife licensing legislation together for a number of reasons. Firstly, licensing of CPMs and direct-entry midwives often happens in tandem, or the wording of legislation only refers to "non-nurse midwives". Additionally, while the exact term used in each law may differ, there is an explicit difference between nurse and non-nurse midwives and where each primarily practices.

Of non-nurse midwives, CPM is the most common type of midwife that states license. CPMs are not required to have an academic degree but do have supervised clinical requirements and are certified by the North American Registry of Midwives. The clinical education must last 2 years and include a minimum of 55 births. Midwives referred to as direct entry, licensed, or lay midwives are not overseen and licensed by a national board; rather, each state determines its own licensing requirements. Regardless of type, non-nurse midwives can provide comprehensive care throughout the pregnancy, birth, and postpartum period. Specifically, they can conduct all prenatal visits in the pregnant woman's home and order ultrasounds and other necessary labs. They are trained to recognize and refer high risk pregnancies to obstetricians. While they do not have prescriptive authority, they can administer medications and use devices based on state-specific regulations but are trained only for vaginal deliveries.

Prior to the licensing of non-nurse midwives within a state, home births could occur, performed by physicians, nurse midwives, or unlicensed (and often illegal) non-nurse midwives. Home births with physicians and nurse midwives are uncommon. In fact, only 7 percent of all nurse midwives report practicing in home birth settings (GAO, 2023), and in 2010, only 2.5 percent of all home births were attended by doctors. After the licensing of non-nurse midwives, home births could be

[6] Only New Hampshire and New York license CMs and no other type of non-nurse midwife, so they are excluded. I show robustness to including these states in Section V.2

performed by physicians, nurse midwives, and non-nurse midwives. Ex-ante, I expect home births to increase because more attendants are licensed to perform them.

Lastly, I explore *why* states have adopted the licensing laws. The reasons can be categorized into 3 broad categories. Firstly, policy makers realize that home births are occurring with unlicensed or illegal midwives, and they desire to make those births safer. This is often a result of a publicized story of a midwife being arrested after the death of an infant, as occurred in Oregon in 2013. Secondly, in some states, midwives have been pushing grassroots campaigns to allow the licensing of midwives for years. For example, when the midwifery law in Missouri passed in 2007, midwives had been fighting for it since the 1990s. Lastly, as attention on maternity care desserts has grown, so has the desire to provide healthcare to rural women. Thus, states like Kentucky have allowed licensing to fill gaps in healthcare in rural areas. Relatedly, I explore the differences in the extent to which non-nurse midwives were restricted from working before a state's licensing law. In some states, midwives found practicing before the licensing laws were arrested. However, in other states, midwives were left to practice unlicensed freely. I explore the heterogeneity in the strictness of midwifery allowance prior to legislation in heterogeneity analysis in Section V.1.2.

III. Data

As of 2021, 33 states allow and license non-nurse midwives. I have collected data from state legislative records to establish a data set of licensing timing. The treatment year is defined as the year when a state passed legislation allowing the licensing of non-nurse midwives. Although the difference between passage and effective start dates of licensing varies across states, all states begin licensing non-nurse midwives in the following year at the latest.[7] New York and New Hampshire are excluded because they solely license Certified Midwives, which are more closely related to CNMs than other types of non-nursing midwives. I drop Hawaii, Kansas, Maine, Nevada, and West Virginia in the main analysis. In these states, midwifery was not licensed during the time

[7]In the case of Missouri, in 2007, the state legalized non-nursing midwifery, but it was held up in court. In 2008, the Missouri Supreme Court upheld the law. In this case, I use 2008 as the treatment year.

period of this study, but they do always allow midwives to practice because birth is considered a natural occurrence instead of medical.[8] Lastly, I exclude Delaware due to conflicting reports of years of licensing legislation.

Figure 1 shows how states have adopted midwifery licensing over time.[9] I present summary statistics in Table 1, showing that states which pass midwifery licensing legislation and states do not pass legislation have similar birth rates and populations of birthing-aged females and nonwhite populations. Overall, there are 8 treated before 1989, 23 states included as eventually treated, and 11 states are never treated.

I use two datasets to measure the supply of non-nurse midwives. Firstly, I use data on the number of CNMs in each state from The Nurse Practitioner's annual legislative update to identify nurse midwives, which publishes counts of licensed CNM from 2000–2021. Then, to identify the supply of non-nurse midwives, I use data on CPM from The North American Registry of Midwives (NARM) annual counts of CPM in each state from 2001 to 2020. This data is missing for 2011, 2017, and 2018, so the first stage results must be interpreted without these years.

I use the National Center of Health Statistics Vital Statistics birth records from 1989 to 2021 to analyze the effect of this increase in provider choice on birthplace. These birth certificate data contain demographic data on the mother, including race, age, educational attainment, and payment source.[10] They also contain the place of birth and county of residence. I categorize place of birth as a home or non-home birth.[11] Figure 2 shows the twofold increase in home births in the US from 1989 to 2021, an increase from around 32,000 to 64,000 births in a given year. In addition to information on the birth location, these data also have information on delivery, such as the delivery method and inductions. They also have data on maternal health characteristics, which I use to define high risk pregnancies and low risk pregnancies. Births are defined as high risk if one or more of the following conditions are met: breech, hypertension (chronic or pregnancy-related),

[8]In subsequent analysis, I show that estimates are robust to including these states in the comparison group and including New York and New Hampshire as treated states.

[9]The appendix contains details on the legislation in each state.

[10]Data on the payment source is only available from 2009-2021.

[11]I also use hospital or non-hospital births, and estimates are consistent across non-hospital and home births.

eclampsia, premature, previous cesarean, or a plural birth. Births are low risk when none of the former are true.

If the expansion of provider choice increases home births, it may also affect health risks for infants and mothers or change the composition of infants born outside of a hospital. To measure infant health, I use the birth certificate data, which contains information about the infant, such as birth weight and gestation.[12] While most of my outcomes use birth certificate records, I also provide estimates on fetal and infant death with data from the Center for Disease Control (CDC) Wonder from 2005 to 2021. I focus on fetal deaths as a proxy for complications prior to birth and infant deaths within 24 hours of birth as a proxy for post-labor complications.[13] Lastly, I use the National Immunization Survey to see if there is a reduction in Hepatitis B vaccinations at birth (NIS, 2023). Vaccination could change if switching to home births disrupts or changes the connection between families and formal healthcare. The first dose of Hepatitis B vaccination is recommended to be given to an infant within 24 hours of birth. In all but one state that regulates non-nurse midwives, midwives are not licensed to give this vaccination.

Measuring maternal health with birth record data is challenging because the place of birth is categorized by where the delivery occurred, not where it was intended to occur. To estimate the effects on overall maternal health and determine if mothers or their infants are being transferred to the hospital during or within a day of delivery, I use data from National Inpatient Hospitalization from The Healthcare Cost and Utilization Project (HCUP). These data include 100 percent of hospitalizations from a sample of hospitals in each state from 1998 to 2011.

Finally, I use Area Health Resource Files (AHRE) to provide additional insight into the places where midwifery licensing legislation is most salient. These data contain rural-urban continuum codes and data on hospital access for each county in the US. I use population data from the National Cancer Institute's Surveillance, Epidemiology, and End Results Program (SEER) to add county

[12] It is possible that midwives report health outcomes for home births on the birth records systematically different than hospital births. To determine if differential reporting is likely occurring, I estimate the effect of midwifery legislation on reporting birth weights at round numbers. I find no change in reporting birthweight at 1000 grams, 1500 grams, 2500 grams, 3000 grams, or 3500 grams.

[13] I also provide estimates for abortion using KFF state and year 2009-2020 abortion data to rule out changes in the likelihood of giving birth.

and state-level covariates for the total population and the Current Population Survey (CPS) for state-level unemployment, poverty rates, and median household income.

IV. Empirical Approach

My preferred estimation strategy for studying the effect of an increase in provider choice is a difference-in-differences design that exploits the variation in state timing of non-nurse midwife licensing legislation. The variation in treatment timing could result in biased estimates from a TWFE design if treatment effects are dynamic (Goodman-Bacon, 2021).[14] To avoid biased estimates, I use methods proposed in Callaway and Sant'Anna (2021) that compare changes in birth-related outcomes of states that pass non-nurse midwifery licensing legislation relative to those that have not yet passed such legislation or never do so. Because the data begins in 1989, I define states treated in 1989 or earlier as always treated. I balance the panel to include treated states with 4 years of data prior to treatment and 4 years after. Thus there are 18 treated states from 1993 to 2017. Formally, to estimate the average treatment effect on the treated (ATT), I use weighted least squares. I assume that there is no treatment anticipation $\delta = 0$ and parallel trends between group g and groups that are "not yet treated" by time t to identify ATT(g, t):

$$ATT(g,t) = E[Y_t - Y_{g-1}|G_g = 1] - E[Y_t - Y_{g-1}|D_t = 0] \tag{1}$$

Y_t is the outcome of interest such as rate of home birth and infant health measures at time t, G_g is a binary variable equaling one if the state is first treated in period g, and D_t is a binary variable equaling zero for states "not yet treated" by t.

Aggregating the group time average treatment effects together gives the overall effect of midwifery licensing on place of birth and health. This aggregation can be done in multiple ways, and I present results using 3 methods. The first is "Simple Aggregation," which is just the weighted aver-

[14]Negative weights from TWFE occur when already treated states are used as a comparison for currently treated states. Because it may take a few years for the demand for home birth to change after midwives are allowed to practice treatment, effects are likely dynamic in this setting.

age of all group-time average treatment effects based on group size. This method puts more weight on ATT(g,t)'s with larger group sizes and observations further past treatment. Next is "Event Time Aggregation," where I aggregate across event time. This aggregation is used in event study figures and gives the average effect of participating over specific years of exposure. Lastly, the "Group Time Aggregation" first computes the average of treatment for each group time and then averages those effects together. This creates a measure of the average effect of treatment experienced by all states ever treated.[15] I weight states by the number of births to improve efficiency and cluster standard errors at the state level. The key identifying assumption is that in the absence of a change in provider choice, trends in home birth and health outcomes would have remained parallel in treatment and comparison states. A main corollary of this assumption is that demand for home births did not induce states to begin licensing non-nurse midwives.

Callaway and Sant'Anna (2021) uses a varying base period where the event study coefficients in the pre-treatment and the post-treatment are created asymmetrically. For pre-treatment coefficients, the reference period is the period immediately preceding it. For the post-treatment coefficients, the reference period is the period directly before treatment. This differs from the standard TWFE event study, where the pre-treatment and post-treatment coefficients are calculated symmetrically, with the reference period always being the period before treatment. Callaway and Sant'Anna's pre-period estimates represent "pseudo-ATT estimates" of the estimated "effect" of the treatment if it occurred in that period. Nevertheless, I also present traditional event study estimates where the reference period is the period prior to treatment for both the pre-and post-treatment coefficients in Figure A5.

Before I discuss the estimated effects of increasing access to midwives through the licensing of non-nurse midwives, I present evidence to support the identifying assumption. Table 2 shows that time-varying state-level maternal characteristics, median household income, CNM scope of practice laws, and state adoption of Perinatal Quality Collaboratives are uncorrelated with the

[15]The main tables report "Simple Aggregation", and the main figures show "Event Aggregation" but I show robustness to "Group Aggregation" in the appendix Tables A2 and A3.

timing of state midwifery licensing legislation.[16] These results show that it is unlikely states opt into non-nurse midwifery licensing because of a broader trend in preferences for nurse midwives or maternal and infant health. Further, treatment is uncorrelated with the baseline rates of home births, inductions, or nurse midwife-attended births. This result, shown in Table 3, suggests that baseline preferences for home birth and health are not driving the uptake of legislation. Moreover, my event study figures in Section V provide visual evidence that treatment is uncorrelated with existing trends in preferences for home birth and health outcomes. Another threat to identification occurs if maternity ward closures induce midwifery legislation. Figure 3 shows that maternity ward closures do not cause midwifery licensing laws.[17]

V. Results

First, I study the impact of midwifery licensing legislation on the number of certified professional midwives within a state. Then, I estimate the effects of midwifery legislation on the percentage of home births in a state and infant and maternal health using NCHS birth records data and HCUP hospitalization data. Finally, I show robustness to weighting and comparison group as well as the choice of estimator in Section V.2.

V.1. Effect of Midwifery Licensing

V.1.1. Evidence of an increase in midwives

First stage estimates indicate when a state begins licensing non-nurse midwives to practice, the number of licensed CPMs increases.[18] In panel (a) of Figure 4, I find an increase in the supply of Certified Professional Midwives practicing in a state when states begin allowing non-nurse midwives, suggesting there is a take-up of non-nursing midwifery as a career. Further, panel (b) of Figure 4 shows that the supply of nurse midwives does not change in response to licensing

[16] Perinatal Quality Collaboratives are state-level programs aimed at improving maternal and infant health.

[17] Section VI.1 discusses how hospital closures are measured.

[18] In many states, it was illegal to practice as a non-nurse midwife before licensing legislation; however, in some states, it was allowed but unlicensed. For this reason, the reporting of CPMs in the pre-period is non-zero.

legislation for non-nurse midwives, providing evidence against substitution from a career as a nurse midwife to a non-nurse midwife. While CPMs are only a subset of non-nurse midwives and states often also allow direct entry midwives in addition to CPMs, Figure 4 provides evidence that more non-nurse midwives practice when they are allowed to be licensed.

V.1.2. Changes in place of birth

In Figure 5, I present graphs plotting the event study estimates for the effect of licensing on the percent of home birth and their corresponding 95% confidence intervals from the WLS model in Equation (1), controlling for state and year fixed effects. First, I note that prior to event time zero, when a state passes midwifery legislation, the estimates are statistically similar to zero, suggesting that prior to state licensing, outcomes in treatment and comparison states trend in parallel. When a state begins licensing midwives, estimates indicate a 0.21 percentage point increase in the share of births occurring at home, a 31 percent increase relative to the baseline mean. Table 4 column 1 reports the corresponding simple ATT estimate.[19] Table 4 also shows that results are robust to unweighted estimates.

Advocates for home birth point to it being safe for low risk pregnancies, so if high risk mothers increase home birth, then even advocates for home birth would suggest against it. Thus, heterogeneity in who delivers at home is particularly important. Figure 6 shows the simple aggregation coefficients and 95% confidence intervals for subgroups. More formally, Columns 2-11 of Table 5 show the ATT estimates on the percent of home births for each subgroup. I find that the increase in home births is driven by college-educated mothers, those with "low risk" pregnancies, and non-first births. Low risk pregnancies are those in which the mother does not have hypertension or eclampsia, and has not had a previous cesarean, breech baby, premature birth, or a plural birth. Particularly, for low risk mothers, home births increased by 30 percent. This

[19] While the main outcome of interest is the percent of home births, the Natality data also includes information on the reported attendant at birth. Figure A1 shows event study estimates for the effect of midwifery licensing on the percent of births attended by a non-nurse midwife. While less precise, there is an increase in births attended by non-nurse midwives. The data on attendant at birth is often missing; in fact, in 2010, 25 percent of home births had the attendant reported as "other" or missing.

heterogeneity analysis suggests that when a state increases access to home birth through non-nurse midwives, positively selected mothers shift into home births. In addition, while White mothers have a higher baseline likelihood of giving birth at home, non-nurse midwife licensing causes a 64 percent increase in home births for Black mothers and only a 20 percent increase for White mothers. The large increase in home births for Black mothers is likely related to their experience giving birth in hospitals and the large gap in maternal morbidities and mortality between Black and White mothers. Black mothers are increasingly looking for options outside of the traditional hospital birth (Reissig, Fair, Houpt, and Latham, 2021); (Suarez, 2020). Further, as Figure 7 shows, the increase is driven by births paid for out of pocket. I discuss the implications of the majority of births being paid out of pocket in further detail in Section VI.

In addition to the heterogeneity across characteristics of mothers, there may also be important differences in the effect of midwifery licensing based on the availability of other healthcare. Access to maternity care differs vastly between rural and urban areas in the US, with over 2 million women living in counties defined as maternity care deserts with limited access to prenatal care (MOD, 2022). To investigate to what extent healthcare access plays a role in inducing home births after midwifery licensing legislation, I estimate the effects of Equation (1) for metro and non-metro counties. In Figure 8, I present graphs plotting the event time aggregations corresponding to Table 6. Panel (a) shows that non-metro counties rather than metro counties drive the effect on home births. Rural counties have lower access to healthcare, so these results provide evidence that the licensing legislation of midwives is particularly salient in places with less access to standard healthcare.

States differ vastly on several factors related to the likelihood someone may switch to home birth. Firstly, some states provide Medicaid coverage of home birth while others do not. Table 7 columns 1 and 2 explore this heterogeneity.[20] There is no detectable heterogeneous effect on home births regardless of if the state Medicaid covers it, likely due to a loss of power. Next, I estimate

[20]The states that have no Medicaid coverage and are dropped from the analysis are: AL, CO, ID, IN, MD, MI, MO, SD, TN, UT, and WI

the effect on home births for states that have high and low maternal mortality.[21] Again, Column 3 shows that there is no distinguishable differential effect for states that have above average maternal mortality. Lastly, to investigate if the magnitude of the effect of licensing legislation on home births differs by the pre-period strictness of state laws regarding midwives, I separate effects on home birth by "strict" and "non-strict" states.[22] Columns 5 and 6 show estimates on home birth by state strictness prior. Point estimates suggest a larger increase in home births in states with stricter pre-legislation treatment of non-nurse midwives, consistent with licensure legislation relaxing a more binding constraint. However, these estimates are not statistically different than one another. Still, this finding fits with ex-ante expectations that there will be a smaller effect on home births in states that were more friendly to home birth prior to licensing legislation.

V.1.3. Delivery and Infant Health Effects

Next, I estimate the effect of non-nursing midwifery licensing legislation on delivery outcomes. Delivery outcomes, which may differ by place of birth, include delivery method, if the delivery was early (37 or 38 weeks gestation), and inductions. Women self-select into home birth often due to a desire for fewer medical interventions. Because midwives cannot perform cesareans and, in most states, are not allowed to administer medication that induces delivery, a reduction in these outcomes could be expected from an increase in home births. I find no measurable effect on cesareans or forceps usage as seen in Table 8. I do find a reduction in inductions of 3.6 percentage points, corresponding to a 16 percent change from the mean. Notably, the reduction in inductions is larger than the increase in home births. Thus, some of the reduction in inductions is coming from hospital births. One explanation for this discrepancy is that some non-nurse midwives offer hybrid care wherein the midwife does all prenatal care and begins the labor at home, but the actual delivery occurs at the hospital. In Figure 9, I present graphical evidence of the decrease in inductions.

[21] The states that have below maternal mortality are defined by having maternal mortality below the national average from 2018–2021: AK, CA, CO, ID, MD, MI, MN, MT, OR, RI, SD, UT, VT, WA, WI, and WY.

[22] In the analysis for strict states I exclude states that explicitly were lenient on midwives or allowed optional licensing prior to officially licensing non-nurse midwives. These states include OR, TN, MI, ID, MN, OK, and WI. In the analysis for non-strict states, I exclude states where midwives practicing illegally were arrested, or the midwives were explicitly illegal. These states include IN, SD, VA, MO, CO, MD, and MT.

Additionally, I find no evidence of an effect of licensing on the number of births, which suggests there is not a shift in childbearing decisions.[23]

Although the delivery location is unlikely to affect health outcomes such as birth weight and gestation because low risk pregnancies drive the increase in home births, non-nurse midwife licensing may still affect these health outcomes by changing the quality or quantity of prenatal care (Corman, Dave, and Reichman, 2019). Table 9 shows simple ATT estimates on birth weight, the probability that an infant is born with low or very low birth weight, and five-minute APGAR score.[24] I find no evidence of an effect of midwifery licensing on these infant health outcomes. I can rule out decreases in birth weight of 15 grams at 95 percent confidence. An increase of 15–40 grams is the estimated impact of exposure to Food Stamps during pregnancy (Almond, Hoynes, and Schanzenbach, 2011). Therefore, ruling out a 15-gram increase is in line with the expected effects of a shock to health during the prenatal period. Finally, consistent with the result of no statistically significant change in birth weight, I find no change in the total number of prenatal visits as shown in Table 9 column (5).

Next, I estimate the effects of midwifery licensing on infant health outcomes that are indicative of complications with delivery and are unanticipated: assisted ventilation, neonatal ICU admissions, and seizures for a subset of states from 2010-2021.[25] In Table 10, I show the estimated effects of midwifery licensing on assisted ventilation, NICU admission, and neonatal seizures for all infants. I show no measurable effect on ventilation or NICU admissions. I do find an increase in neonatal seizures of 0.01 percentage points or 20 percent. Notably, neonatal seizures are around two times more likely to happen during a home birth at baseline and are an extremely rare outcome, only occurring in 0.05 percent of all births. This increase corresponds to around 300 additional births with neonatal seizures, assuming around four million births in a given year.[26]

[23] I also estimate the effects of midwifery licensing on abortions to understand the effect on childbearing decisions and find no evidence of a change in the number of abortions shown in Figure A2.

[24] Low birth weight is an indicator variable equaling one if the birth weight is smaller than 2500 grams and very low birth weight if smaller than 1500 grams. APGAR score measures health from 1 to 10 taken 5 minutes after birth.

[25] Variables indicating assisted ventilation, NICU admission, and neonatal seizures only became available with the 2003 change to birth certificate. However, because states rolled these changes out over time the only treated states included in Table 10 are IN, MD, MI, OR, and SD.

[26] However, I note that the effects on neonatal seizures only come from a subset of states and the results are not robust

Because vital statistics birth data only measures where the birth ended up occurring, not where it was intended to occur, it is possible that I am reporting some births with negative outcomes as hospital births instead of home births.[27] If this were to be the case, I would expect to see changes to health across in-hospital births as well. Because I estimate the effect of midwifery licensing on outcomes across all births regardless of where they occur, reduced form estimates suggest this is not occurring. To address the concern that home births are being transferred to the hospital immediately after delivery for emergencies, I use HCUP hospitalization data to estimate the effects of midwifery licensing on hospitalizations of infants 0 to 1 days old. Table 11 shows that while the estimates are imprecise, I can rule out increases in hospitalization greater than 86 per 1000 for infants 0 to 1 days old with 95 percent confidence. While I cannot directly tell if the birth occurred at home, I can estimate the hospitalizations for infants born prior to admission in Column 2. In this case, I can rule out increases greater than 0.21 per 1000 births.

Despite the lack of measurable effect on most reported measures of infant health, I also estimate the effect on the most severe outcome, fetal and infant deaths. Figure 10 shows that there is no measurable effect of midwifery licensing on either infant or fetal death rates. I can rule out effects greater than an increase of 0.33 infant deaths per 1000 births and 0.39 fetal deaths per 1000 births. For comparison, Kennedy-Moulton, Miller, Persson, Rossin-Slater, Wherry, and Aldana (2022) find that fetal death for mothers at the top of the income distribution is 3.4 deaths per 1,000 births and 7.1 for the bottom of the distribution.

In addition to the immediate health effects on infants, there could be longer-run effects on the child's health if having a home birth causes greater detachment from traditional medical care. For example, it's recommended that the Hepatitis B vaccination be given to an infant within 24 hours of birth so an increase in midwifery care could reduce vaccination. In all but one state that regulated non-nursing midwives, midwives are not licensed to give this vaccination. For this reason, the first dose of Hep B vaccination could be delayed or never given. Figure A3 shows estimates of the average hep B vaccination at the time of birth. I find no measurable effect of midwifery licensing

to multiple hypothesis testing.

[27] According to a systematic review 0–5.4 percent of all home births end in an emergency trip to the hospital.

on vaccination of Hep B at birth.

V.1.4. Maternal Health Effects

I have shown that home birth deregulation through midwife licensing does not lead to significant negative infant health effects outside of neonatal seizures. I also estimate the effects of midwifery licensing on maternal health. I do so by using HCUP hospitalization data to estimate the effect on rates of hospitalizations for delivery complications. Table 12 shows these estimates. While imprecise, I can rule out an increase of 49 hospitalizations per 1000 births for delivery complications. Notice that I do not study the effects on maternal mortality because the measurement of maternal mortality available in the NCHS multiple causes of death files is inaccurately reported with a 2003 change in death records (Hoyert and Miniño, 2020). For this reason, I do not include mortality as an outcome measure.

V.2. Sensitivity Checks

In this section, I test the sensitivity of results to the model choice by showing results that the estimates on home birth are robust to other estimators. Figure A7 shows event study estimates using Borusyak, Jaravel, and Spiess (2021), de Chaisemartin and D'Haultfoeuille (2019), Sun and Abraham (2021), Callaway and Sant'Anna (2021), and ordinary least squares. Regardless of the estimator, the estimates are all similar in magnitude and significance. In addition to other models, I estimate sensitivity to choices made within Callaway and Sant'Anna (2021). Firstly, for the main results, the event study estimates are calculated using varying base periods, but to match the event studies to traditional TWFE event studies, in Figure A5, I present results using a universal base period of the year prior to treatment. As Callaway and Sant'Anna (2021) describes, these are alternative methods of reporting the same information and should not change the conclusion about whether the parallel trends assumption was violated. To address concerns of violations of parallel pre-trends, I show the robust inference and sensitivity analysis created by Rambachan and Roth (2023) in Figure A6. The main result is robust to assuming the post-treatment violation of parallel trends is no bigger than half of the worst pre-treatment violation at the 10% significance level. Next, I show unweighted results and results where the control group consists only of "never-treated" states. Table 4 shows that estimates are robust to only using never treated states as the comparison group instead of including both not-yet and never treated. Estimates are also robust to excluding weighting by the number of births in each state and to including covariates for state level unemployment, poverty level, and median household income.

Next, in Panel A of Table A1, I show robustness to including states in which midwives are always allowed, but there is no formal regulation, as never treated.[28] Ex-ante I expect the effect to be smaller when including places with fewer restrictions of midwives in the comparison group. Table A1 shows that, in fact, the magnitude of the effect of licensing on home birth is slightly smaller but remains statistically significant. I also show robustness to including New York and New Hampshire which only license Certified Midwives in Panel B of Table A1. Panel C of Table A1 shows the robustness of the main estimates, excluding 2020 and 2021, to address concerns that COVID-19 is driving the increase in home births. Next, as Table A2 Table A3, Table A4, and Table A5 show, the results are robust to Group Time Aggregation.[29]. Lastly, Tables A6 and A7 report the significance for the main estimates on home birth and home birth heterogeneity adjusting for multiple hypothesis testing using a Bonferroni test (Bonferroni, 1935). Notably, the estimated effect on neonatal seizures is not robust to Bonferroni multiple hypothesis testing as shown in Table A8.

VI. Supplementary Analysis

VI.1. Additional Analysis on Hospital Closures

I have shown that the increase in home births after midwifery licensing is driven by mothers living in non-urban areas, suggesting that the initial availability of healthcare matters for mothers' behavior.

[28]The states that always allow non-nurse midwives but never regulate them are HI, ME, NV, and WV. These states are dropped from the main analysis.

[29]The Callaway and Sant'Anna (2021) estimator in Stata automatically reports p-values adjusted for multiple hypothesis testing for the group aggregations (Callaway and Sant'Anna, 2023)

To further explore the role that access to care matters for home birth, I study the effects of a reduction in provider choice. In recent years, maternity wards have closed in mostly rural counties, where home births are most salient. To explore the effect of the interaction between maternity ward closures and midwifery licensing legislation, I estimate the effects of maternity ward closures on home births, and then I estimate the interaction of the two treatments.

To identify a maternity ward closure, I use the method proposed in Fischer, Royer, and White (2024) where a county is defined as having a closure if in year n a hospital has 75 percent more hospital births than it does in year n+1. Counties of birth are identified based on occurrence county, not the mother's county of residence. Once a county is defined as having a closure, it remains coded as a closure for the rest of the study period. I use a Poisson specification because the number of home births within a county is a count and contains zeros. Callaway and Sant'Anna (2021) does not allow for nonlinear estimation strategies, so to allow for Poisson estimation, I employ a stacked difference-in-differences strategy proposed by Deshpande and Li (2019).[30] Estimates are robust to using the Wooldridge (2023) estimator which accounts for staggered treatment timing and allows for Poisson estimation.

First, I show evidence in Figure 11 that midwifery licensing does not induce maternity ward closures by using closures as an outcome variable.[31] Then, to estimate the effects of maternity ward closures on birth place, I compare changes in the number of home births for mothers giving birth in counties with a maternity ward closure to those giving birth in counties without a significant maternity ward closure. In Figure 12, I present a graph plotting the estimates and 95 percent confidence intervals of the effect of having a maternity ward closure on home births. Table 13 shows the Poisson estimates, which correspond to a 12 percent increase in the likelihood of home birth given a maternity ward closure.[32] The subset of mothers responding to a hospital closure by taking up home birth may be different in meaningful ways than in the case of midwifery licensing because the costs of hospital births are increasing for the group of mothers losing access to their

[30]Further details on this analysis are included in the appendix A.1.

[31]Midwifery licensing legislation does result in an increase in birthing facilities. This result is shown in Figure A4.

[32]For robustness, I also show estimates from the standard TWFE, which does not account for treatment timing, and Wooldridge (2023), which formally accounts for variation in treatment timing and allows poisson.

nearest hospital. Table 14 shows estimates of home births for subgroups of mothers. Unlike with the midwifery licensing legislation, I find an increase in home births for high risk and less educated mothers. This evidence suggests that while home birth may be safe if it's taken up as a choice when access to care increases, that may not be the case when women are losing access to care.[33]

Next, I explore the interaction between closures and midwifery licensing. To do so, I employ a two-way fixed effects design that accounts for two treatments with different treatment timings.[34] While this method does not account for the bias that may occur due to staggered treatment, it allows for an estimate of both midwifery licensing and maternity ward closure together. Table 15 reports the estimates of this regression. The effects when closures and midwifery licensing are interacted are not statistically different than when estimating the effect of only closures. This suggests that in places where midwives are legal and a closure occurs, midwives do not significantly change the likelihood of switching to home birth. Despite midwives often being considered a substitute for hospital care in rural areas, the interaction of the two policies suggests that the women switching to home birth from a closure will do so regardless of whether midwifery is available as a substitute.

While I hesitate to interpret the results from interacting midwifery licensing legislation and closures as causal because I am not accounting for the variation in treatment timing, the estimates are similar in magnitudes shown in Table 13. Noticeably, the estimated effects of closures alone in Table 15 on the number of home births is smaller than when accounting for staggered treatment timing in Table 13, but the estimates are not statistically different from one another. Taken together with the result that midwifery licensing leads higher SES and rural mothers to switch to home birth, this analysis provides suggestive evidence that midwifery licensing may not significantly improve access to care for vulnerable rural mothers, as advocates for midwifery licensing suggest. Instead, midwifery licensing offers high SES mothers an additional option for care.

[33]Because the definition of treatment is defined by a hospital closures in the county of residence and in the case of home birth the county of occurrence and residence are most likely the same, the Fischer, Royer, and White (2024) method for identifying health effects of a maternity ward closure is unfeasible.

[34]This specification includes county and state-by-year fixed effects.

VI.2. Costs of Home Birth

When discussing home births, an important consideration is the financial costs. Costs of birth differ vastly based on the place of delivery. In 2022, the average cost for vaginal delivery in hospitals was $\$14,768$ out of pocket and $\$2,655$ for those with insurance (KFF, 2022). On the other hand, the average cost of home birth was $\$4,650$. While the total cost is significantly lower for home birth, most insurance companies do not cover home birth. Private insurance coverage of CPMs is mandated in 6 states, and 13 states include CPMs in their Medicaid plans. Likely due to the lack of insurance, 61 percent of all home births are paid for out of pocket, 19 percent are covered by private insurance, and 17 percent are covered by public insurance.

The increase in home births caused by midwifery licensing is driven primarily by women paying for the birth out of pocket who are positively selected. Figure 7 shows these estimates by payment type, and panel (c) particularly reports estimates for self-payment. Because I find a limited measurable effect of midwifery licensing on most measures of infant health, providing private and public insurance coverage for low risk home births could reduce the overall costs of births without negatively impacting infant health. However, as Daysal, Trandafir, and van Ewijk (2015) find in the Netherlands, even after sorting on risk, low-income mothers have worse health outcomes when delivering at home as opposed to a hospital. Thus, instead of mandating insurance coverage of home births, if states allow people willing to pay for home births to up-take it out of pocket, it may increase access to hospital care for women who need it without negatively impacting the health of those who choose home births.

To determine the back-of-the-envelope potential cost savings, I consider the suggestive evidence of an increase in neonatal seizures, a rare but medically relevant outcome. A 20 percent increase in neonatal seizures, resulting in roughly 300 additional births with seizures, would increase healthcare expenditures by as much as 5.1 million dollars (Caron, Wheless, Patters, and Wheless, 2015).[35] When considering the increase in home births that do not result in negative health effects,

[35]The cost of a hospital visit due to neonatal seizures can be as expensive as $17,126, so an additional 300 births with neonatal seizures translates to an increase in costs of 5.1 million.

around 3,700, I show a cost savings of around 32 million dollars.[36] Taken together, the benefits of increasing provider choice with non-nurse midwives likely outweigh the costs. However, it is important to note that while some neonatal seizures are harmless, they can lead to later-life health conditions like epilepsy as well as high hospital costs. The additional costs are not considered in the back-of-the-envelope calculations.[37]

VII. Discussion and Conclusion

In this research, I show that mothers respond to an expansion of provider choice and healthcare access by having more home births. Particularly, when states increase access to alternative birthing options and prenatal care through licensing of non-nurse midwives, there is a 20-30 percent increase in home births. The increase is driven by positively selected mothers who are college-educated, low risk, and pay out of pocket. This increase in home births does not correspond to a significant negative impact on infant health, aside from a possible increase in the occurrences of neonatal seizures, an extremely rare outcome. These results suggest that increasing access to non-traditional medical professionals like non-nurse midwives can improve the welfare of mothers by increasing their choices and be substantially cost-saving for society by reducing the total cost of birth.

Further, I show that the licensing is most salient for non-urban mothers. When looking directly at mothers in rural counties who are affected by a negative shock to provider choice through maternity ward closures, I find that home births increase by 12 percent when a maternity ward closes. In contrast to midwifery legislation, high risk, and non-college-educated women switch to home birth in the case of a reduction in access. Regardless of midwifery licensing, when a maternity ward closes, vulnerable mothers increase home births. Taken together, my two sets of

[36]If we take a 10,000 healthcare savings for home birth, then 3,700*10,000 equals 37 million

[37]By 2019, 33 states were treated. Taking into account the baseline average number of home births for each state being 580, multiplying that by the treatment effect and number of treated states gives 0.21*580*33= 4,000 additional home births in 2019. If 0.05 percent of all births have a neonatal seizure, it gives 3millX0.0005= 1,500 seizures. Then, a 20 percent increase in seizures is .20X1,500=300. Assuming the cost of a hospital visit for a neonatal seizure is around $17,000, then we expect the total cost of the additional neonatal seizures to be 5.1 million. After subtracting 300 from the 4,000 additional home births, we have an increase of around 3,700 safe home births, and the cost savings of home births of around $10,000 gives 37 million cost saved per year.

analyses suggest that despite many states pushing for midwifery licensing to fill a gap in maternal healthcare in rural places, when midwives become available, it is not the most vulnerable mothers who take up this alternative.

Because midwifery licensing legislation and maternity ward closures cause different groups of mothers to give birth at home, whether the dramatic increase in home births shown in Figure 2 should concern policymakers depends on which shock has contributed more. I ask what proportion of the increase in home births comes from midwifery legislation and maternity ward closures to determine how much of the change I can attribute to each shock. I estimate that around 25 percent of the increase in home births from 1992 to 2019 comes from midwifery legislation, and maternity ward closures drive 2.5 percent.[38] Taken together, this shows that the increase in home births is driven by a positively selected group selecting home birth without substantial negative maternal or infant health effects. This movement to home births by low risk women with a high willingness to pay for home birth may relieve space in hospitals for high risk mothers who require obstetric attention.

[38] In 1992, the number of home births was around 25,000, and in 2019, it was up to 45,000. Of these 20,000 additional home births annually, midwifery legislation accounts for around 4,000. In contrast, maternity ward closures account for around 500.

A. Figures and Tables

Figure 1 — Timing of Midwifery Licensing Legislation

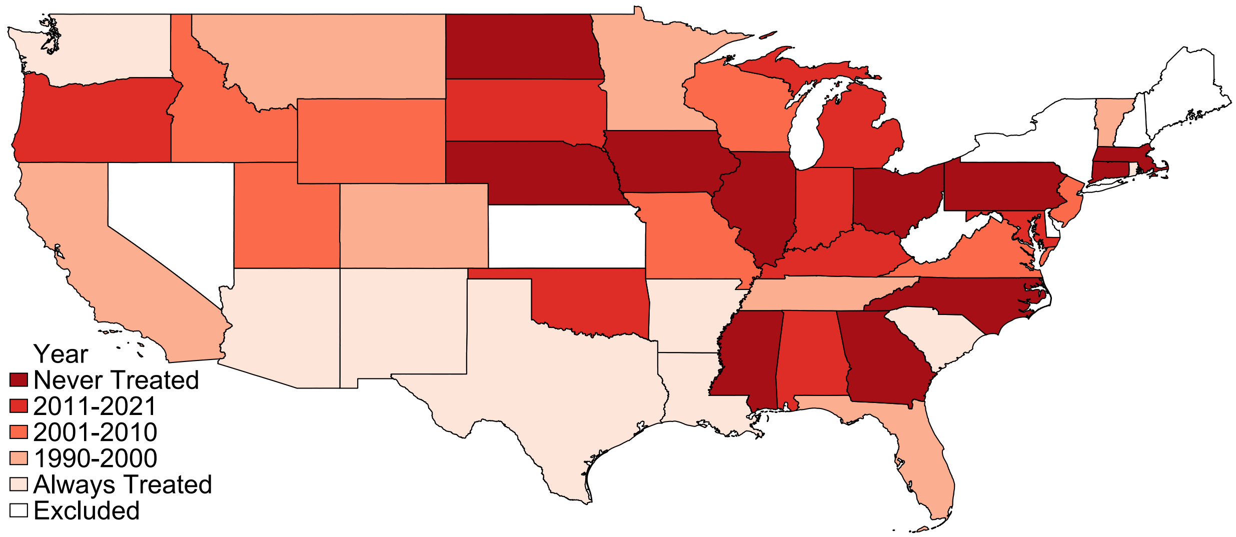


FIGURE 2 — Percent of Home Births in the U.S

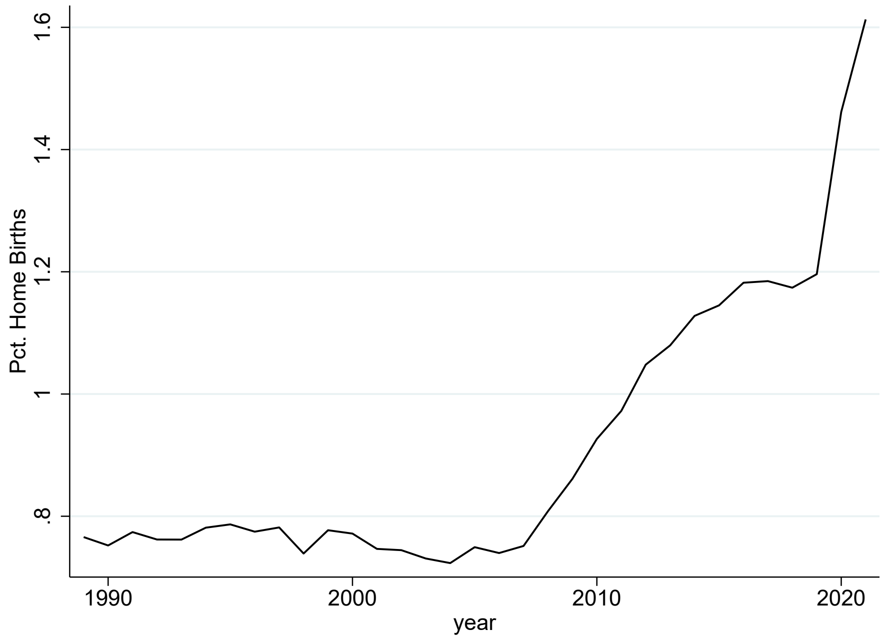
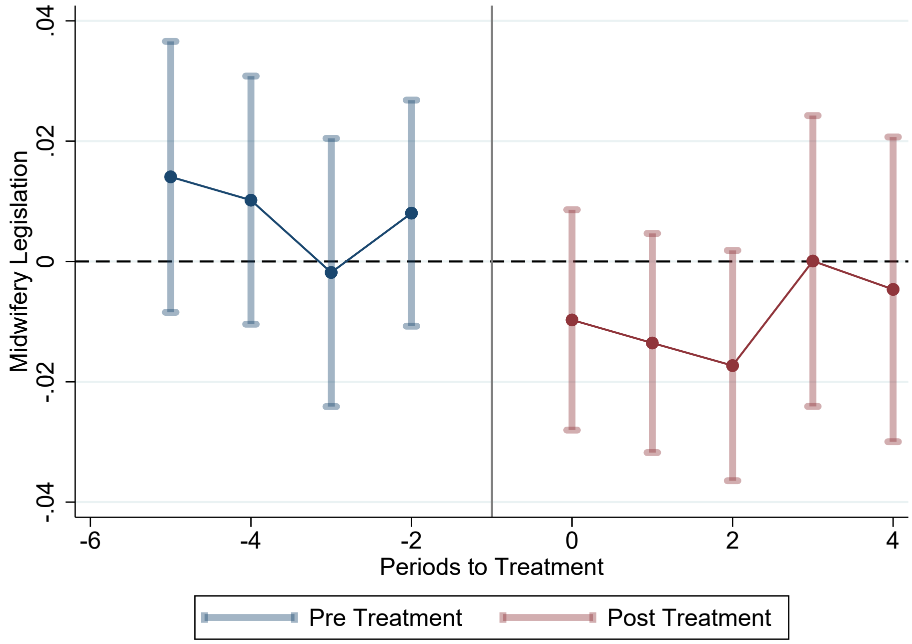


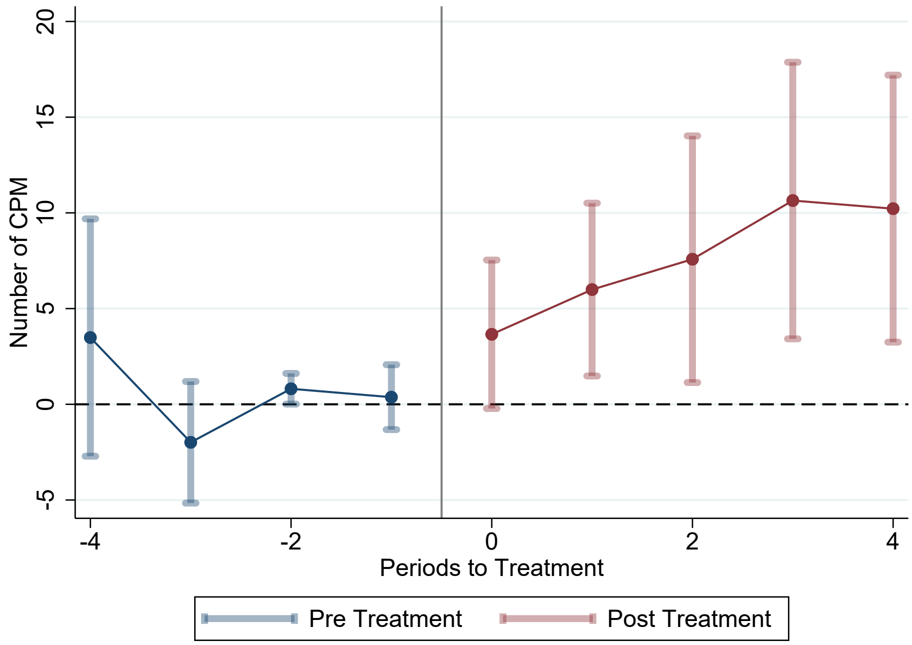
FIGURE 3 — Effect of Hospital Closures on Midwifery Licensing



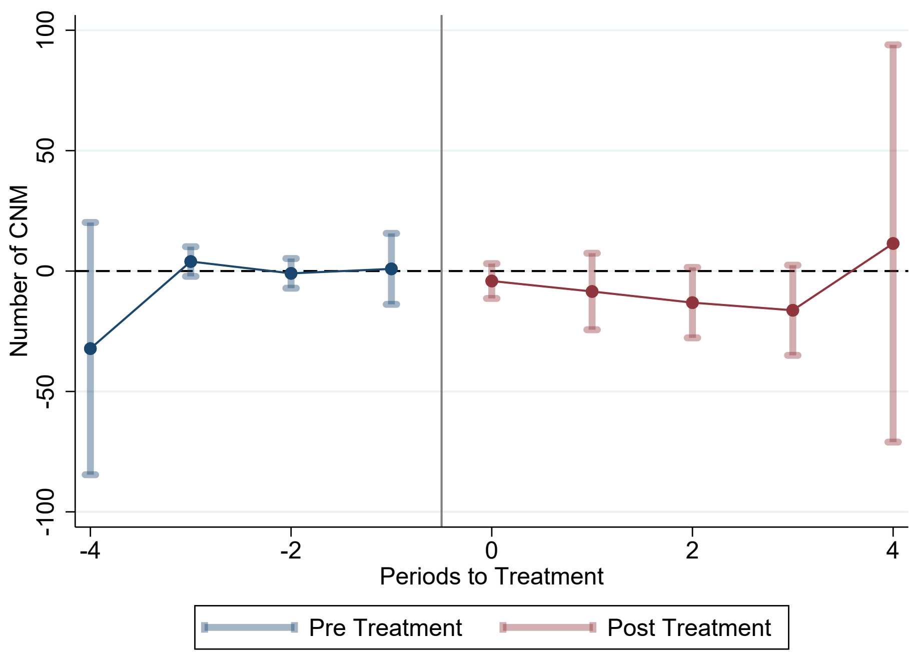
*Notes:*Natality data is from the NCHS from 1989–2021. The figure plots event estimates and their respective 95% confidence intervals from Equation (1). The treatment is hospital closures at the county level, and the outcome of interest is if a state has midwifery licensing.

Figure 4 — Effects of Midwifery Licensing on Supply of Midwives

Panel A. Certified Professional Midwives

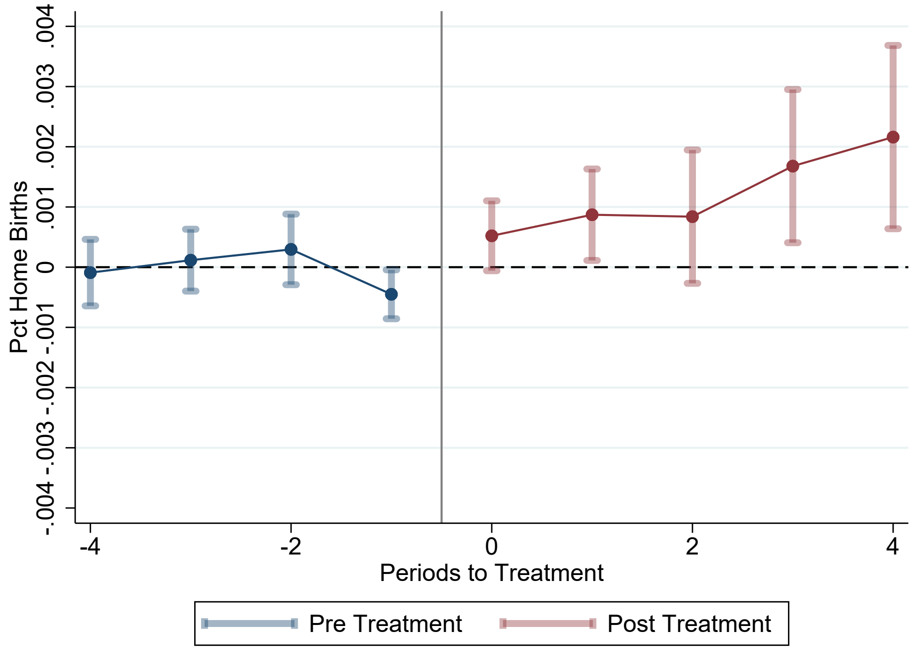


Panel B. Certified Nurse Midwives



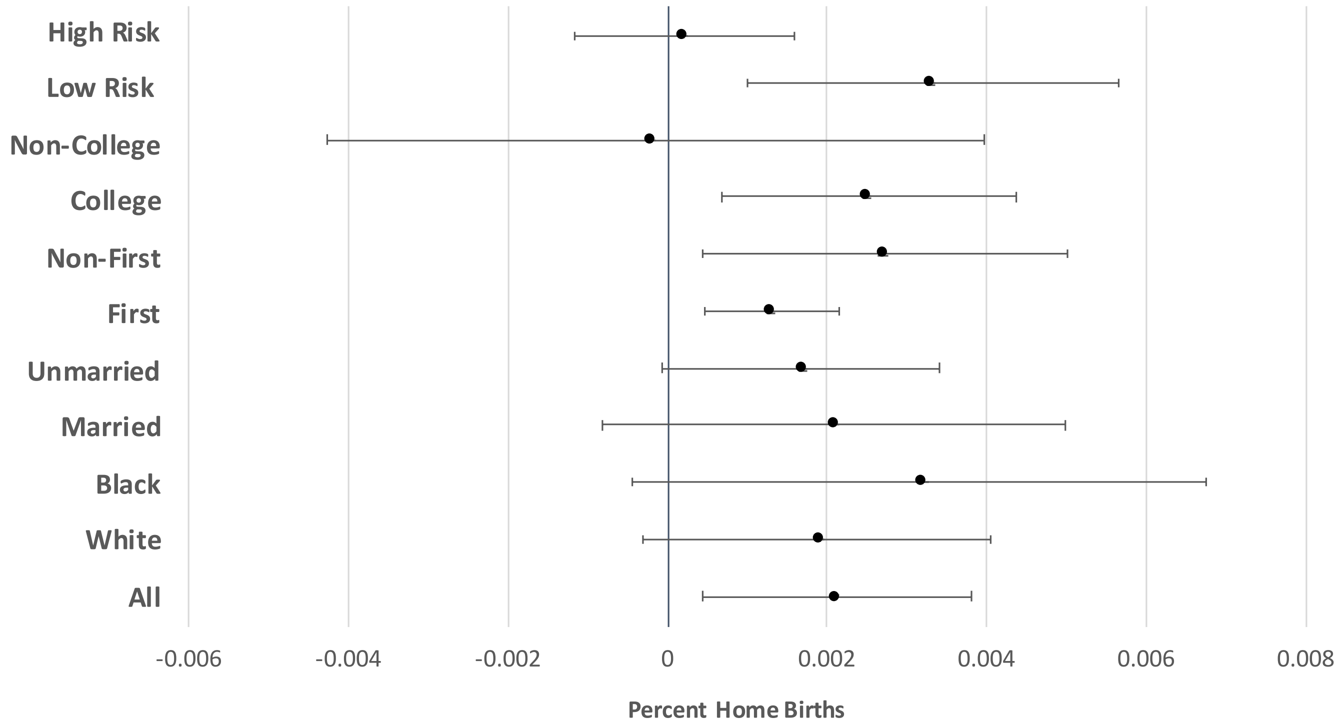
Notes: Data on the number of CNM in each state is from The Nurse Practioner's annual legislative update, which publishes counts of licensed CNM from 2000–2021. Data on the supply of CPM is from The North American Registry of Midwives (NARM) annual counts of CPM in each state from 2001–2020. This data is missing for 2011, 2017, and 2018, so results should be interpreted cautiously.

Figure 5 — Effects of Midwifery Licensing on Percent of Home Births



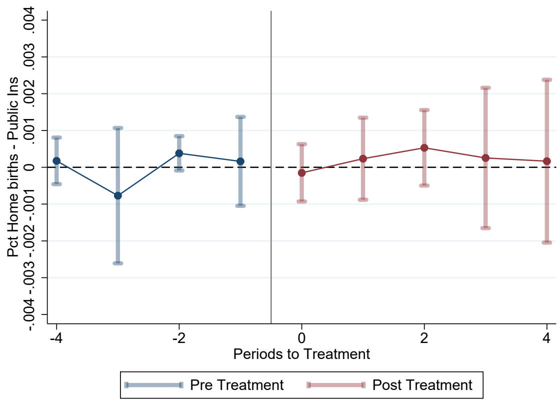
Notes: Natality data is from the NCHS from 1989–2021. The panel plots ATT event estimates and their respective 95% confidence intervals from Equation (1) where the outcome is percent of home births. The comparison group includes never treated and not yet treated states

Figure 6 — Effects of Midwifery Licensing on Percent of Home Births

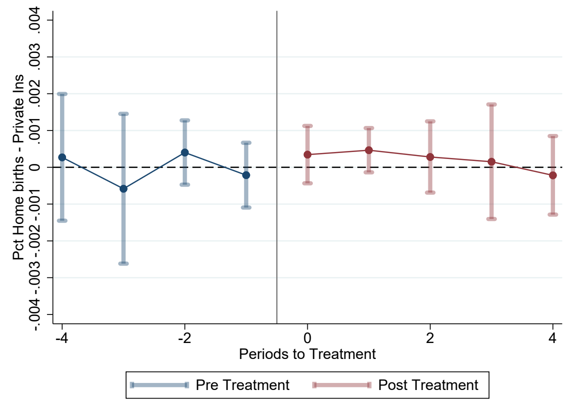


Notes: Natality data is from the NCHS from 1989–2021. Each point represents the simple ATT coefficient and their 95% confidence interval from Equation (1) for a subgroup of women. The comparison group includes never treated and not yet treated states

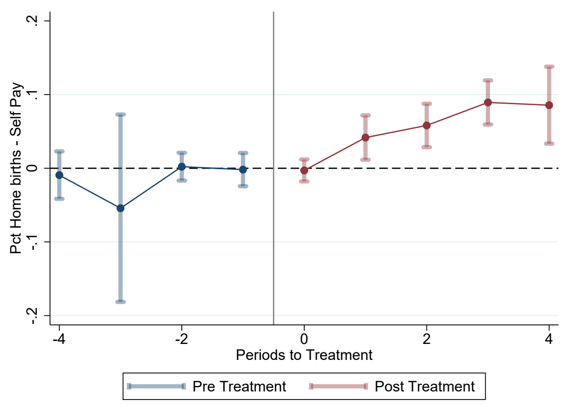
FIGURE 7 — Effects of Midwifery Licensing on Percent Home Births, by Payment Type



(A) Public Insurance



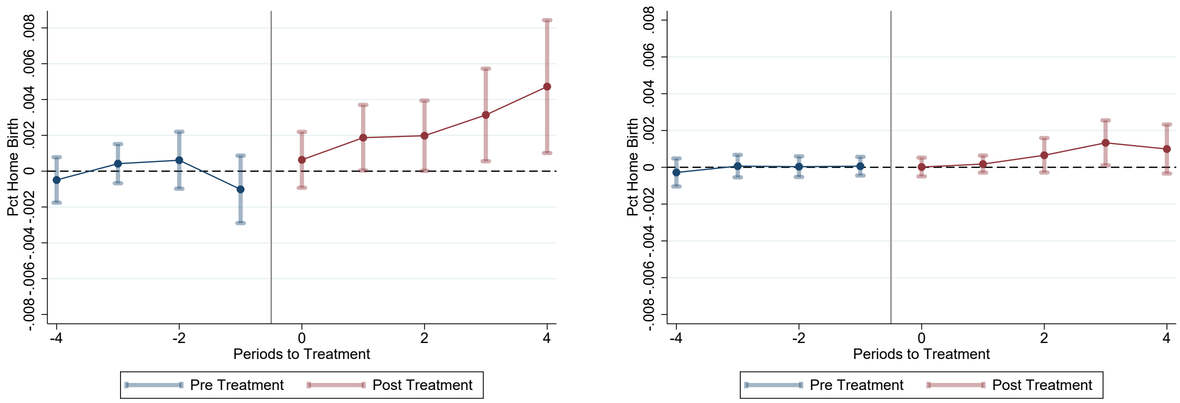
(B) Private Insurance



(C) Self Pay

Notes: Natality data is from the NCHS from 2009-2021. The panel plots ATT event estimates and their respective 95% confidence intervals from Equation (1) where treatment is midwifery licensing. The outcome is the percentage of home births for each payment type. The comparison group includes never-treated and not-yet-treated states.

Figure 8 — Effects of Midwifery Licensing on Percent Home Births, differing county characteristics

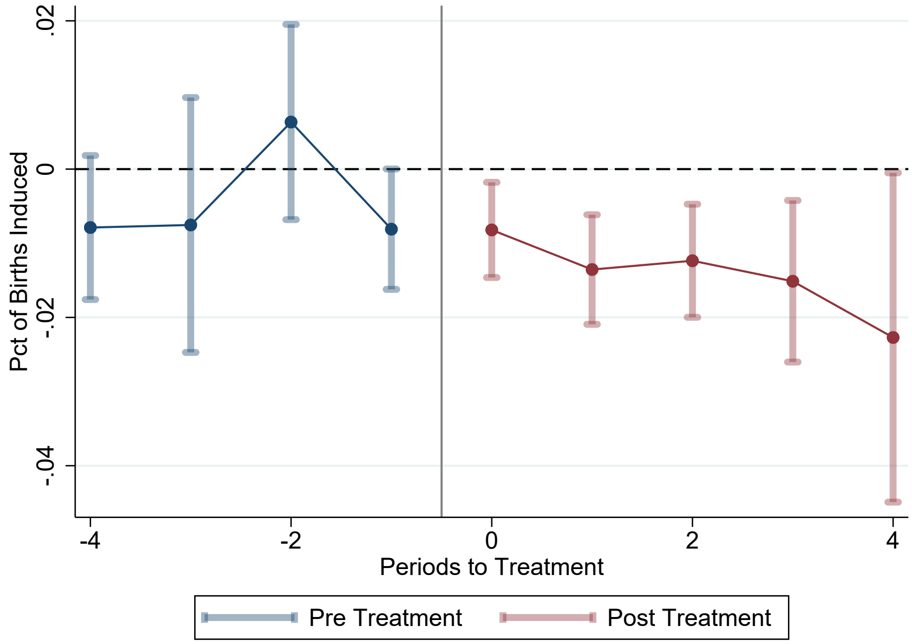


(a) Non-Metro Counties

(b) Metro Counties

Notes: Natality data is from the NCHS from 1989–2021. The panel plots ATT event estimates and their respective 95% confidence intervals from Equation (1), where the outcome is the percent of home births. The comparison group includes never treated and not-yet-treated states. The metro distinction is from the 2013 Urban-Rural Continuum from the USDA.

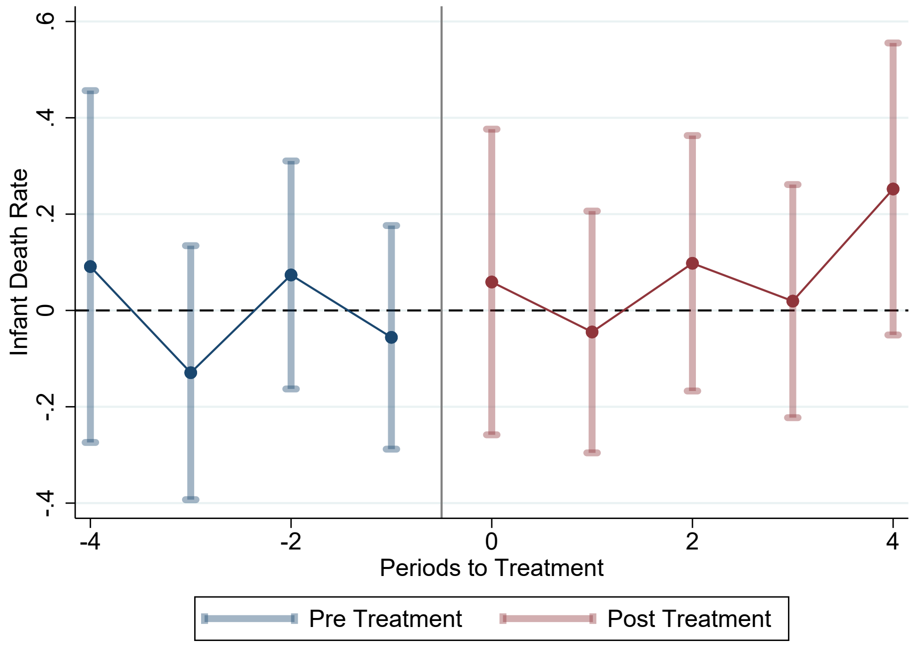
Figure 9 — Effects of Midwifery Licensing on Percent Induced Births



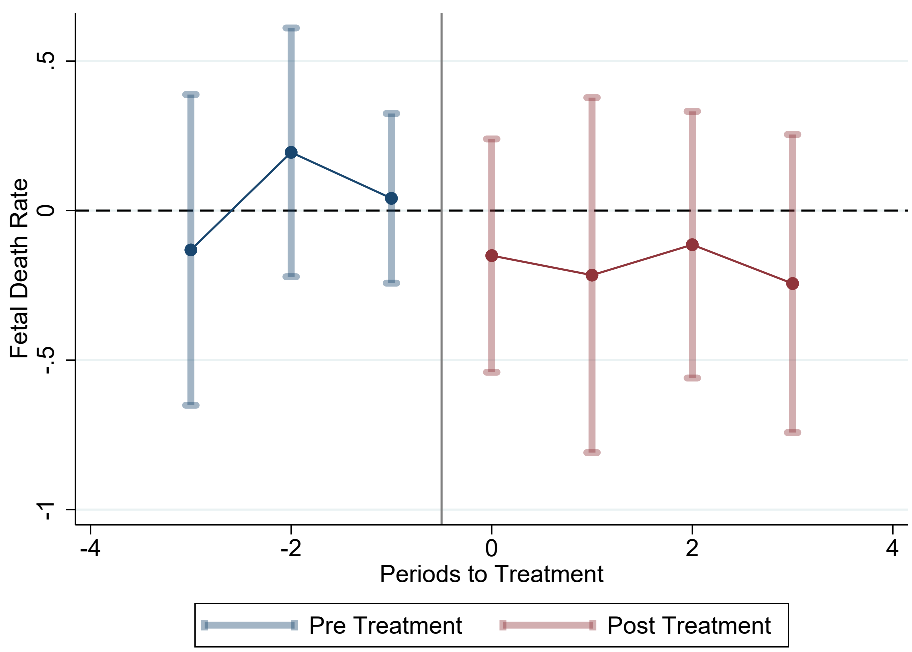
Notes: Natality data is from the NCHS from 1989–2021. The panel plots ATT event estimates and their respective 95% confidence intervals from Equation (1) where the outcome variable is percent inductions. The comparison group includes never treated and not yet treated states

Figure 10 — Effects of Midwifery Licensing on Death Rate

Panel A. Infant Death Rates

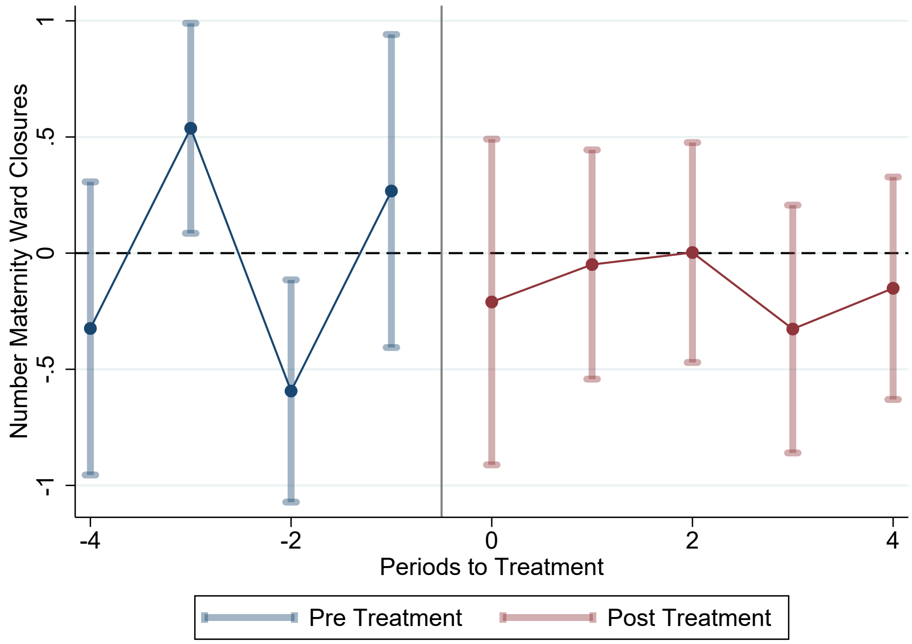


Panel B. Fetal Death Rates



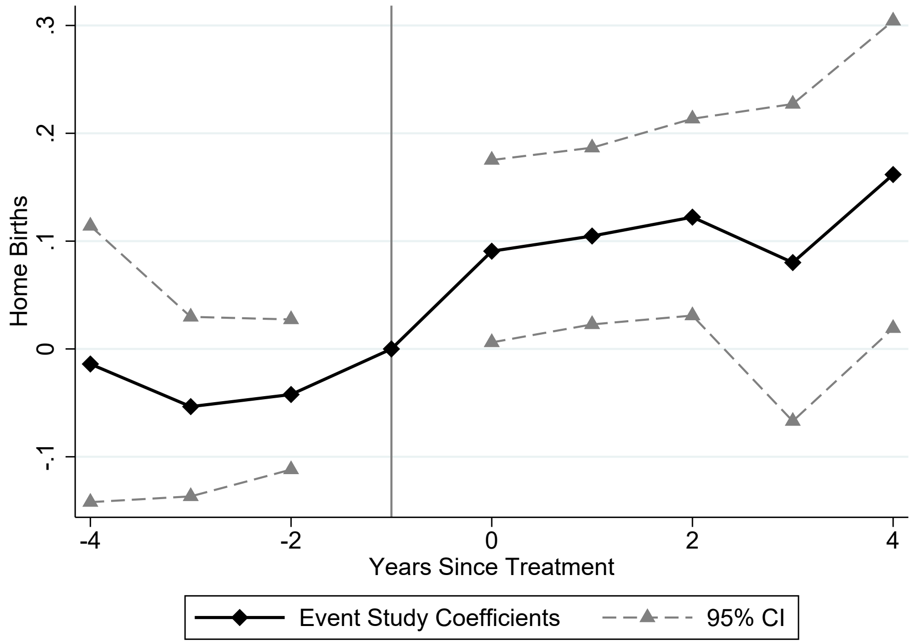
Notes: The figure plots ATT event estimates and their respective 95% confidence intervals from Equation (1). Infant death records are from NCHS mortality records from 1989–2021, and infant death is limited to deaths within 24 hours of birth. The death rate is per 1000 births. Fetal death records come from CDC Wonder 2005–2021. The comparison group includes never-treated and not-yet-treated states.

Figure 11 — Effect of Midwifery Licensing on Hospital Closures



*Notes:*Natality data is from the NCHS from 1989–2021. The figure plots event estimates and their respective 95% confidence intervals from Equation (3). The treatment is midwifery licensing at the state level, and the outcome of interest is the number of hospital closures in each state.

FIGURE 12 — Hospital Closure Effects on Home Births



Notes: Natality data is from the NCHS from 1989–2021. The panel plots Poisson event estimates and their respective 95% confidence intervals from Equation (3). The outcome is the number of home births in a county. The comparison group includes never-treated and not yet treated states

Table 1 — Descriptive Statistics for Treatment and Control States - Midwifery Licensing

	Eventually Treated States		Never Treated	
	Mean	Std. dev.	Mean	Std. dev.
	(1)		(2)	
Births per 1,000 females aged 15-44	0.072	0.010	0.066	0.003
Percent Home Births	0.006	0.003	0.006	0.003
Percent Hospital Births	0.990	0.006	0.992	0.004
Percent White	0.840	0.064	0.839	0.084
Percent Nonwhite	0.160	0.064	0.161	0.084
Percent Females aged 15-44	0.118	0.003	0.117	0.004
Median Household Income	34862	4819.289	34625	5265.817
Unemployment Rate	0.347	0.027	0.351	0.028
Below Poverty level	0.135	0.031	0.125	0.036
Observations	18		11	

Notes: Individual-level natality data is from NCHS from 1989–2021. Descriptive statistics include the means and standard deviations for the listed outcomes before any treatment from 1989–1992. Columns (1) and (2) present means and standard deviations for the 18 eventually treated states for each listed outcome, and Columns (3) and (4) present means and standard deviations for the 11 never treated states.

Table 2 — Effect of Midwifery Licensing Timing on observable characteristics

	Age	Married	White	Black	First Birth	College	CNM SOP	PQC est	Med.HH Income
Midwifery Leg	-0.0307	0.0043	-0.0094	0.0096	0.0059	-0.0079	0.0592	-0.0196	1,536
Std. Err.	(0.0379)	(0.0102)	(0.0109)	(0.0100)	(0.0056)	(0.0115)	(0.1120)	(0.2093)	(1,170)
Mean	4.0376	0.6728	0.8085	0.1356	0.4011	0.5333	0.1254	0.1781	50,807
Observations	837	837	837	837	837	837	837	690	837

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column reports estimates for a regression with a different time varying maternal or state characteristic where the treatment is midwifery licensing. CNM SOP refers to changes in the scope of practice for CNMs. PQC est refers to the timing of state-level initiatives called Perinatal Quality Collaboratives aimed at improving maternal and infant health.

Table 3 — Correlation Between Baseline Outcome Variables and Treatment Timing

	Treatment Timing
1992 Home births	0.4978
	(18.5538)
1992 Inductions	-0.6900
	(2.2479)
1992 Births by Nurse midwives	4.8406
	(3.5670)
1992 Birth by Other Midwives	-22.2590
	(21.4038)
Observations	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each row reports estimates for a regression where the outcome of a baseline outcome in 1992 and the treatment is midwifery legislation.

Table 4 — Effect of Midwifery Licensing on Home Births

	(1)	(2)	(3)	(4)	(6)
Midwifery Leg	0.0021**	0.0019**	0.0024***	0.0021**	0.0020**
Std. Err.	(0.0009)	(0.0008)	(0.0008)	(0.0009)	(0.0008)
Mean	0.0067	0.0067	0.0067	0.0067	0.0067
Observations	957	957	950	957	957
Comparison Group	Not Yet & Never	Not Yet & Never	Not Yet & Never	Never	Never
Weighted	Yes	No	Yes	Yes	No
Covariates	No	No	Yes	No	No

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents a Simple ATT estimate from Equation 1 where the outcome is percent home births. Columns (1), (2), and (3) present results where the comparison group includes both net yet treated and never treated states. Columns (3)and (4) present results where the comparison group includes only never treated states. Columns (1), (2), and (3) are weighted by number of births in a state. Column (3) includes state-level covariates of median household income, unemployment rate, and percent of the population below the poverty level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5 — Effect of Midwifery Licensing on Home Birth, Heterogeneity

	All	White	Black	Married	Unmarried	first	Non-first	college	non-college	low risk	high risk
Midwifery Leg	0.0021**	0.0019*	0.0032*	0.0021	0.0017*	0.0013***	0.0027**	0.0025***	-0.0002	0.0033***	0.0002
Std. Err.	(0.0009)	(0.0011)	(0.0018)	(0.0015)	(0.0009)	(0.0004)	(0.0012)	(0.0009)	(0.0021)	(0.0012)	(0.0007)
Mean	0.0089	0.0097	0.0050	0.0113	0.0045	0.0044	0.0116	0.0088	0.0092	0.0110	0.0034
Observations	957	957	957	957	957	957	957	957	957	956	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents Simple ATT estimates from Equation 1, where the outcome of interest is the percent of home births for a given subgroup.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 6 — Effect of Midwifery Licensing on Home Birth, County Heterogeneity

	Metro	Non-Metro
Midwifery Leg	0.0014*	0.0045**
Std. Err.	0.0008	0.0018
Mean	0.0057	0.0113
Observations	957	924

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents Simple ATT estimates from Equation 1, where the outcome of interest is the percent home births. Column 1 reports the estimate for metro counties, and column 2 reports the estimate for non-metro counties. The metro distinction is from the 2013 Urban-Rural Continuum from the USDA

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7 — Effect of Midwifery Licensing on Home Births - State Heterogeneity

	Medicaid	Non Medicaid	High Maternal Mortality	Low Maternal Mortality	Not-Strict States	Strict States
Midwifery Leg	0.0012	0.0008*	0.0014**	0.0020	0.0026**	0.0023**
Std. Err.	0.0019	0.0004	0.0006	0.0014	0.0013	0.0011
Mean	0.0081	0.0041	0.0042	0.0082	0.0059	0.0070
Observations	617	330	363	582	747	726

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents Simple ATT estimates from Equation 1, where the outcome of interest is the percent home births. Columns 1 and report estimates for the subset of states without Medicaid coverage of home births, respectively. Columns 2 and 3 report estimates for states with high and low rates of maternal mortality. Columns 3 and 4 report estimates on home births for states with strict and nonstrict regulations of midwives and home births prior to licensing legislation.

* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 8 — Effect of Midwifery Licensing on Delivery Outcomes

	Cesarean	Forcep	Induction	Total Births
Midwifery Leg	0.003	0.002	-0.036***	-933.491
Std. Err.	(0.006)	(0.003)	(0.014)	(3,671.397)
Mean	0.259	0.022	0.228	86,695
Observations	957	955	956	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents ATT estimates from Equation 1, where the outcome of interest is a delivery outcome.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9 — Effect of Midwifery Licensing on Infant Health Outcomes

	Birthweight	LBW	VLBW	5 Min Apgar	Total Visits	Premature
Midwifery Leg	0.34456	0.00011	0.00005	0.03458	0.13506	0.00116
Std. Err.	(7.77551)	(0.00159)	(0.00041)	(0.02947)	(0.22520)	(0.00305)
Mean	3,302	0.07692	0.01355	8.83866	11.36422	0.11335
Observations	957	957	957	924	957	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents ATT estimates from Equation 1, where the outcome of interest is an infant health outcome.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10 — Effect of Midwifery Licensing on Infant Health

	Ventilation	NICU	Seizure
Midwifery Leg	0.0020	-0.0042	0.0001**
Std. Err.	0.0037	0.0029	0.0000
Mean	0.0520	0.0904	0.0005
Observations	132	132	132

Notes: Individual-level natality data is from NCHS from 2010–2021. Each column presents Simple ATT estimates from Equation 1. The only treated states are IN, MD, MI, OR, and SD.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 11 — Effect of Midwifery Licensing on Infant Hospitalizations

	All Hosp	Non-hosp births	Delivery comp
Midwifery Leg	-28.7006	0.0436	-2.2630
Std. Err.	(59.2013)	(0.0849)	(2.1947)
Observations	203	203	203
Mean	250.7045	0.5710	2.5044

Notes: Individual-level natality data is from the HCUP National Inpatient Sample from 1998–2011. Each column presents Simple ATT estimates from Equation 1, where the outcome is the hospitalization rates per 1000 births. The estimates are weighted with weights provided by HCUP.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 12 — Effect of Midwifery Licensing on Maternal Hospitalizations

	All Hosp	Normal Delivery	Delivery comp	Hemorrhage	All Deliveries
Midwifery Leg	-73.0106	-6.6710	-13.5724	-0.9955	-88.1613
Std. Err.	(109.6862)	(6.8995)	(32.2914)	(1.7189)	(73.7938)
Mean	455.1402	16.7924	130.8430	6.0312	244.2150
Observations	268	268	268	268	268

Notes: Individual-level natality data is from the HCUP National Inpatient Sample from 1998–2011. Each column presents Simple ATT estimates from Equation 1, where the outcome is the hospitalization rates per 1000 births. The estimates are weighted with weights provided by HCUP.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 13 — Effect of Maternity Ward Closures on Home Births

	(1)	(2)	(3)	(4)	(5)	(6)
Closure	0.121**	0.118**	0.248***	0.236***	0.227***	0.206***
	(0.050)	(0.051)	(0.054)	(0.054)	(0.046)	(0.044)
Mean	109.144	9.285	108.923	9.199	108.923	9.199
Observations	559720	559720	95421	95421	95421	95421
Weighted	Yes	No	Yes	No	Yes	No
Method	Stacking	Stacking	TWFE	TWFE	Wooldrige	Wooldrige

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents a Poisson estimate, where the outcome is the number of home births.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14 — Effect of Maternity Ward Closures on Home Birth, Heterogeneity

	White	Black	Married	Unmarried	First	Non-first	College	Non-college	Low Risk	High Risk
Closure	0.120**	0.381***	0.126**	0.186**	0.166**	0.112**	0.182***	0.224***	0.122**	0.190***
	(0.049)	(0.122)	(0.052)	(0.091)	(0.065)	(0.054)	(0.059)	(0.036)	(0.061)	(0.066)
Mean	25.822	25.822	71.776	37.369	24.069	83.755	51.523	57.621	81.852	17.662
Observations	547097	252215	539770	458992	455865	550449	510496	520991	545545	443745

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents a Poisson estimate from Equation (2), where the outcome is the number of home births for a subgroup. Estimates weighted by the population of females aged 15–44 women in a county

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 15 — Effect of Maternity Ward Closures and Midwifery Licensing on Home Birth

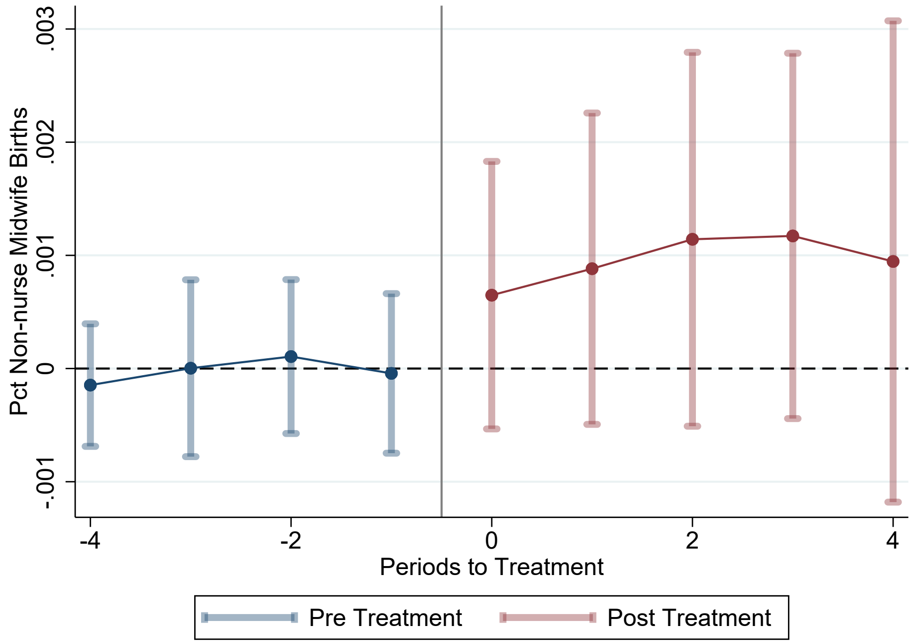
	(1)	(2)
Closure	0.100*	0.095
	(0.060)	(0.060)
ClosureXMidwife	0.088	0.086
	(0.076)	(0.076)
Mean	108.923	9.199
Observations	89648	89648
Weighted	Yes	No

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents a Poisson estimate. Column (1) is weighted by the population of females aged 15–44 women in a county.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

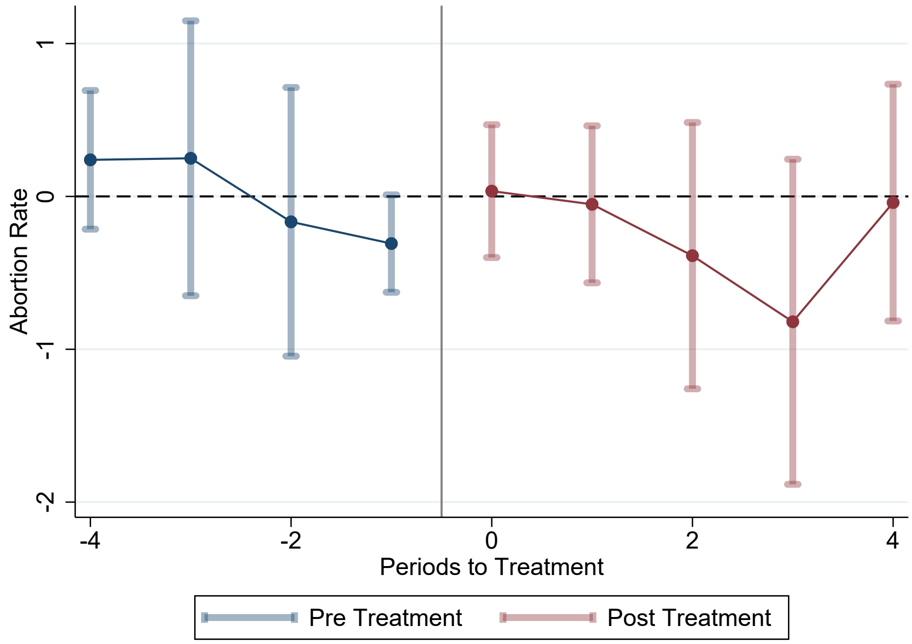
Appendix

FIGURE A1 — Effects of Midwifery Licensing on Percent Births by non-nurse midwives



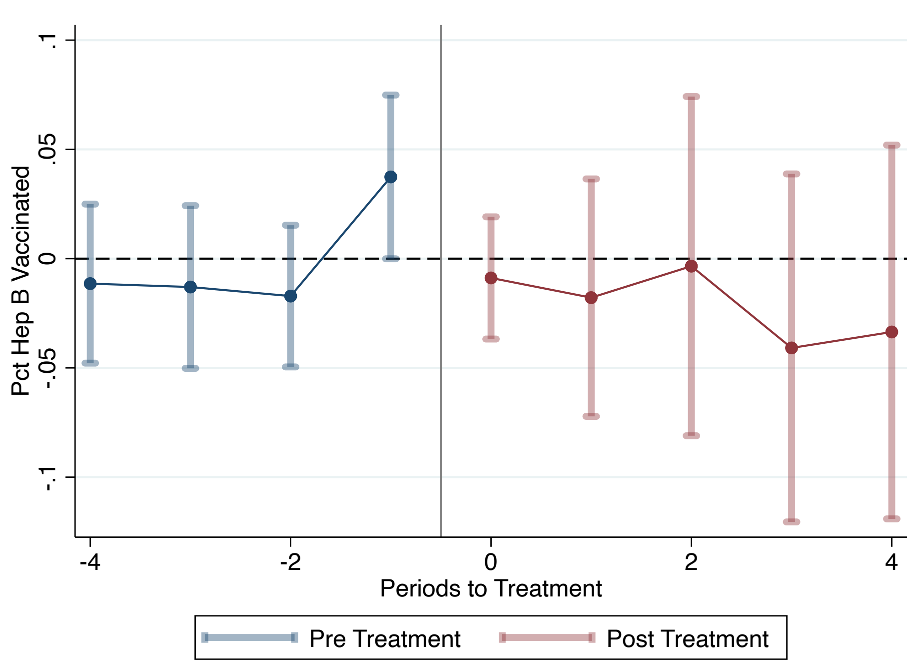
Notes: Natality data is from the NCHS from 1989–2021. The panel plots Event Study ATT estimates and their respective 95% confidence intervals from Equation (1) where the outcome is percent of births attended by a Non-nurse Midwife. The comparison group includes never treated and not yet treated states.

Figure A2 — Effects of Midwifery Licensing on Abortion



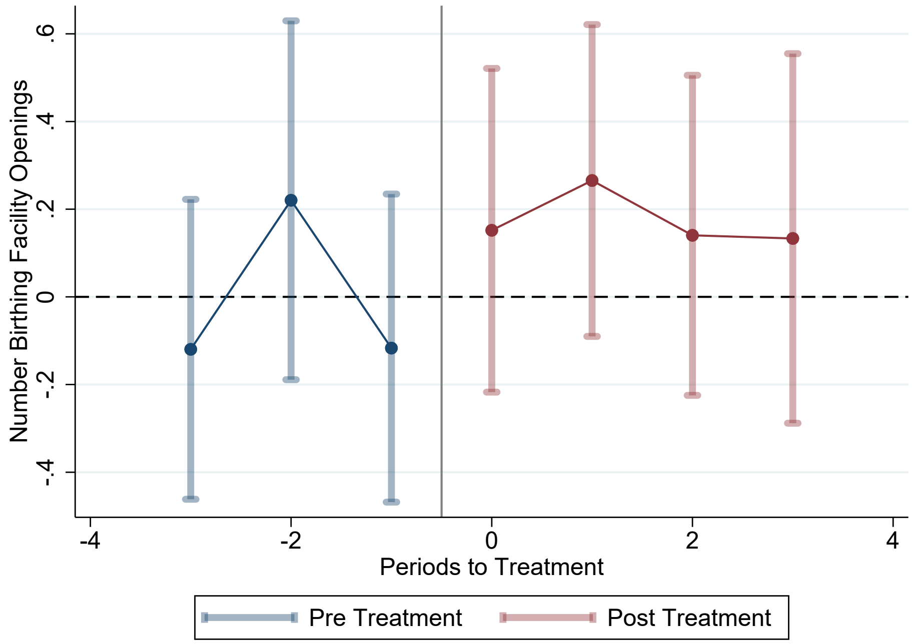
Notes: State level abortion data is from KFF from 2009–2020. The panel plots ATT event estimates and their respective 95% confidence intervals from Equation (1) where the outcome of interest is abortion rate. The comparison group includes never-treated and not-yet-treated states

FIGURE A3 — Effects of Midwifery Licensing on Hep B Vaccination



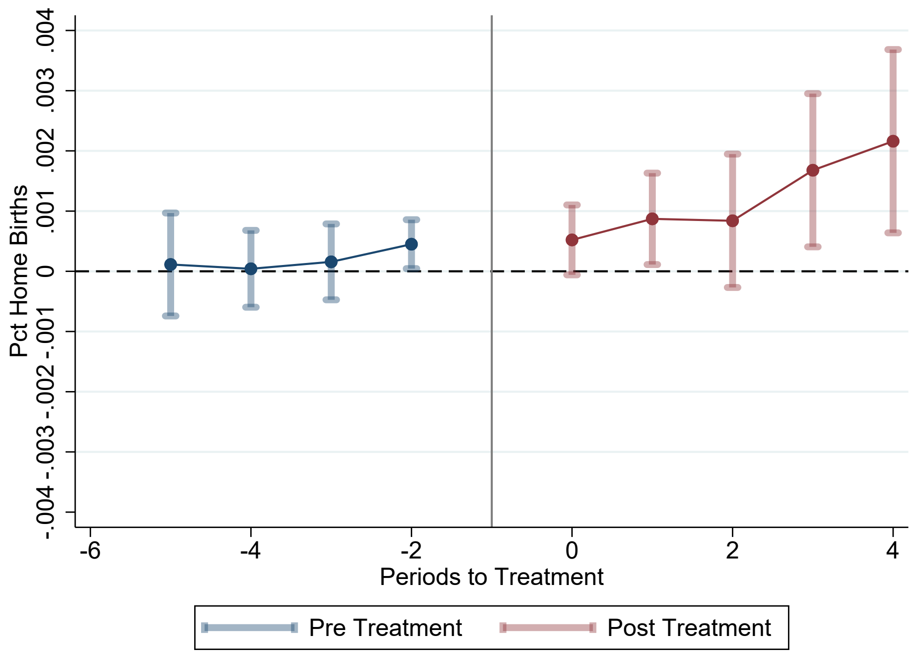
Notes: The outcome is the average hep B vaccination at birth from the National Immunization from 1992–2018. The panel plots Event Study ATT estimates and their respective 95% confidence intervals from Equation (1) where the outcome of interest is percent Hep B vaccinations. The comparison group includes never-treated and not-yet-treated states

Figure A4 — Effects of Midwifery Licensing on Birthing Facility Openings



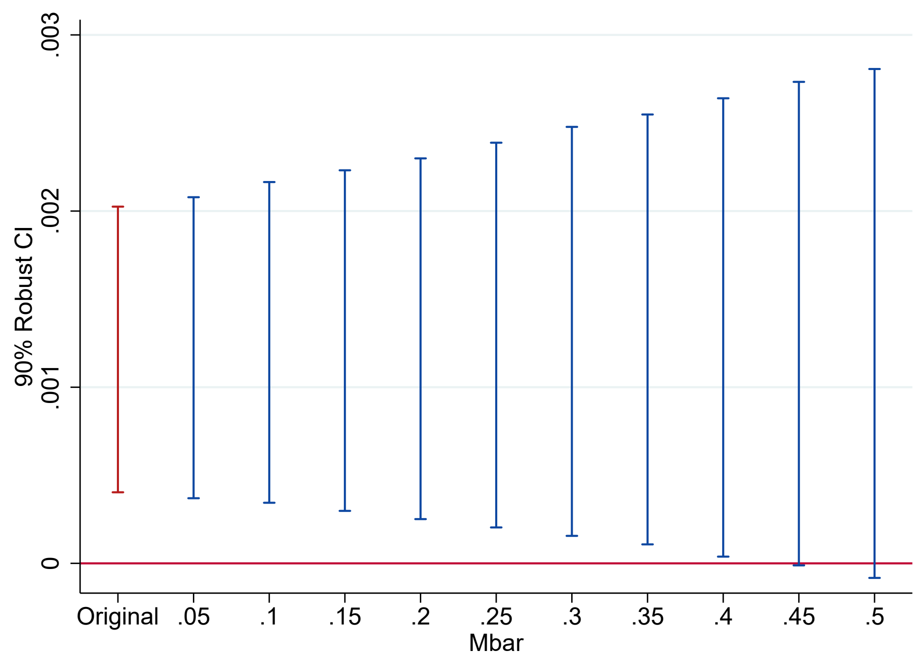
Notes: The outcome is the number of birthing facilities defined by Natality data. The panel plots Event Study ATT estimates and their respective 95% confidence intervals from Equation (1) where the outcome of interest is the number of birthing facility openings in each state. The comparison group includes never-treated and not-yet-treated states.

Figure A5 — Effects of Midwifery Licensing on Home Birth - Universal Base Period



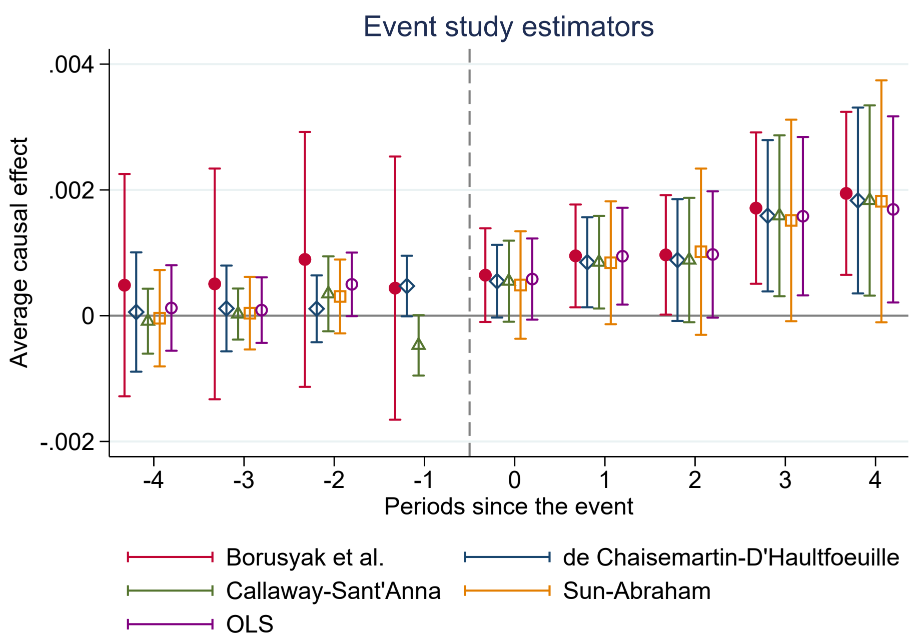
Notes: Natality data is from the NCHS from 1989–2021. The panel plots event estimates where the base period is always the year prior to treatment and their respective 95% confidence intervals. The comparison group includes never treated and not yet treated states.

Figure A6 — Rambachan and Roth (2023) Robust inference and Sensitivity analysis



Notes: Natality data is from the NCHS from 1989–2021. M = 0.5 represents half of the maximum violation of pretrends in the pre-period. The figure reports 90th percent confidence intervals for assuming a violation of M in the post-period.

FIGURE A7 — Effects of Midwifery Licensing on Home Birth - Five Estimators



Notes: Natality data is from the NCHS from 1989–2021. The panel plots event estimates from Borusyak, Jaravel, and Spiess (2021), de Chaisemartin and D'Haultfoeuille (2019), Sun and Abraham (2021), Callaway and Sant'Anna (2021), and ordinary least squares, and their respective 95% confidence intervals. The comparison group includes never treated and not yet treated states

Table A1 — Effect of Midwifery Licensing on Home Births - Sample Sensitivity

	(1)	(2)	(3)	(4)
Panel A				
Midwifery Leg	0.0017**	0.0014*	0.0016*	0.0014*
Std. Err.	(0.0008)	(0.0008)	(0.0009)	(0.0008)
Mean	0.0069	0.0069	0.0069	0.0069
Observations	1,122	1,122	1,122	1,122
Panel B				
Midwifery Leg	0.0015*	0.0014*	0.0015*	0.0015*
Std. Err.	(0.0009)	(0.0008)	(0.0009)	(0.0008)
Mean	0.0069	0.0069	0.0069	0.0069
Observations	1,023	1,023	1,023	1,023
Panel C				
Midwifery Leg	0.0018**	0.0016**	0.0020***	0.0018**
Std. Err.	(0.0008)	(0.0007)	(0.0008)	(0.0009)
Mean	0.0067	0.0067	0.0067	0.0067
Observations	899	899	894	899
Comparison Group	Not Yet & Never	Not Yet & Never	Never	Never
Weighted	Yes	No	Yes	No

*Notes:*Individual-level natality data is from NCHS from 1989–2021. Each column presents Simple ATT estimates from Equation 1. Columns (1) and (2) present results where the comparison group includes both net yet treated and never treated states. Columns (3)and (4) present results where the comparison group includes only never treated states. Columns (1) and (3) are weighted by number of births in a state. Panel A shows estimates when including HI, ME, NV, and WV, which all allow non-nurse midwives to practice without licenses and have no regulations, as never treated states. Panel B shows estimates when including NY and NH, which only license CM as treated states. Panel C shows estimates from the main specification excluding 2020 and 2021 to address concerns over the inclusion of years during the COVID 19 pandemic.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A2 — Effect of Midwifery Licensing on Home Birth, Heterogeneity - Group Time Aggregation

	All	White	Black	Married	Unmarried	first	Non-first	college	non-college	low risk	high risk
Point Estimate	0.0021***	0.0021***	0.0029***	0.0025***	0.0013***	0.0011***	0.0028***	0.0022***	0.0006	0.0032***	0.0003
Std. Err.	(0.0006)	(0.0007)	(0.0011)	(0.0009)	(0.0004)	(0.0003)	(0.0008)	(0.0006)	(0.0011)	(0.0008)	(0.0004)
Mean	0.0089	0.0097	0.0050	0.0113	0.0045	0.0044	0.0116	0.0088	0.0092	0.0110	0.0034
Observations	957	957	957	957	957	957	957	957	957	956	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents Group Time ATT estimates from Equation 1 where th,e outcome of interest is the percentage of home births for a given subgroup. Group ATT estimates adjust for multiple hypothesis testing.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3 — Effect of Midwifery Licensing on Infant Health Outcomes - Group Time Aggregation

	Birthweight	LBW	VLBW	5 Min Apgar	Total Visits	Premature
Point Estimate	-0.23147	0.00040	0.00015	0.03322	0.12046	0.00085
Std. Err.	3.89555	0.00081	0.00021	0.02381	0.09507	0.00146
Mean	3,302	0.07692	0.01355	8.83866	11.36422	0.11335
Observations	957	957	957	924	957	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents Group Time ATT estimates from Equation 1, where the outcome of interest is an infant health outcome. Group ATT estimates adjust for multiple hypothesis testing.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4 — Effect of Midwifery Licensing on Delivery Outcomes - Group Time Aggregation

	Cesarean	Forcep	Induction	Total Births
Point Estimate	0.000	0.001	-0.028***	-195.363
Std. Err.	0.003	0.001	0.007	1,892.900
Mean	0.259	0.022	0.228	86,694.915
Observations	957	955	956	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents Group Time ATT estimates from Equation 1, where the outcome of interest is a delivery outcome. Group ATT estimates adjust for multiple hypothesis testing.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5 — Effect of Midwifery Licensing on Delivery Outcomes - Group Time Aggregation

	Ventilation	NICU	Seizure
Midwifery Leg	0.0011	-0.0049**	0.0001**
Std. Err.	0.0015	0.0017	0.0000
Mean	0.0520	0.0904	0.0005
Observations	132	132	132

Notes: Individual-level natality data is from NCHS from 2010–2021. Each column presents Group Time ATT estimates from Equation 1. The only treated states are IN, MD, MI, OR, and SD. Group ATT estimates adjust for multiple hypothesis testing.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A6 — Effect of Midwifery Licensing on Delivery Home Birth, Adjusted for Multiple Hypothesis Testing

	(1)	(2)	(3)	(4)	(5)
Midwifery Leg	0.0021**	0.0019**	0.0024**	0.002	0.0020**
Std. Err.	(0.0009)	(0.0008)	(0.0008)	(0.0009)	(0.0008)
Mean	0.0067	0.0067	0.0067	0.0067	0.0067
Observations	957	957	950	957	957
Comparison Group	Not Yet & Never	Not Yet & Never	Not Yet & Never	Never	Never
Weighted	Yes	No	Yes	Yes	No
Covariates	No	No	Yes	No	No

Notes: Individual-level natality data is from NCHS from 2010–2021. Each column presents simple ATT estimates from Equation 1. Columns (1) and (2) present results where the comparison group includes both net yet treated and never treated states. Columns (3)and (4) present results where the comparison group includes only never treated states. Columns (1) and (3) are weighted by number of births in a state. P-values are adjusted for multiple hypothesis testing using a Bonferroni test.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE A7 — Effect of Midwifery Licensing on Delivery Home Birth, Heterogeneity - Adjusted for Multiple Hypothesis Testing

	White	Black	Married	Unmarried	first	Non-first	college	non-college	low risk	high risk
Midwifery Leg	0.0019	0.0032	0.0021	0.0017	0.0013**	0.0027	0.0025*	-0.0002	0.0033*	0.0002
Std. Err.	(0.0011)	(0.0018)	(0.0015)	(0.0009)	(0.0004)	(0.0012)	(0.0009)	(0.0021)	(0.0012)	(0.0007)
Mean	0.0097	0.0050	0.0113	0.0045	0.0044	0.0116	0.0088	0.0092	0.0110	0.0034
Observations	957	957	957	957	957	957	957	957	956	957

Notes: Individual-level natality data is from NCHS from 1989–2021. Each column presents simple ATT estimates from Equation 1 where th,e outcome of interest is home births for a subgroup. P-values are adjusted for multiple hypothesis testing using Bonferroni

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A8 — Effect of Midwifery Licensing on Delivery Outcomes - Group Time Aggregation

	Ventilation	NICU	Seizure
Midwifery Leg	0.0020	-0.0042	0.0001
Std. Err.	0.0037	0.0029	0.0000
Mean	0.0520	0.0904	0.0005
Observations	132	132	132

Notes: Individual-level natality data is from NCHS from 2010–2021. Each column presents Simple ATT estimates from Equation 1. The only treated states are IN, MD, MI, OR, and SD. Group ATT estimates adjust for multiple hypothesis testing.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

State	Type of Non-nursing Midwife	Year of passage	Source
Alabama	CPM	2017	Code of Ala. § 34-19-15(c)-(d) (2017).
Arizona	LM	1957	Laws 1957, Chapter 45
Arkansas	Direct Entry	1983, 1987	Act 838 of 1983
Alaska	Direct Entry	1992	Alaska Stat. § 08.65.050 (1992).
California	LM	1993	Licensed Midwifery Practice Act of 1993
Colorado	LM	1993	H.B. 1051, 59th Gen. Assemb., Reg. Sess. (Co. 1993)
Connecticut	None		
Delaware	CM, CPM	1978, 2001-2015, 2015	24 Del. C. § 1799FF(2)-(3) (2016).
Florida	LM	1992	FL ST §§ 467.001 et seq.
Georgia	None		Ga. Admin. R. 511-5-1-.02
Hawaii			
Idaho	LM	2009	House Bill 185 An Act Relating to Midwifery
Illinois	CPM	2023	Hundsdorfer, 2021
Indiana	Direct Entry	2013	IN ST 25-23.4-1-1 et seq.
Iowa	CPM	2023	House File 265
Kansas		drop	
Kentucky	CPM	2020	Walker, 2019
Louisiana	LM	1985	Acts 1984, No. 688, §1, eff. Jan. 1, 1985.
Maine	CPM	drop	Midwives of Maine
Maryland	CPM, Direct Entry	2015	MD HEALTH OCCUP §§ 8-6C-01 et seq.
Massachusetts	None		
Michigan	CPM	2016 passed	Section 33.17101
Minnesota	CPM, Direct Entry	1999 passed	Minn. Stat. Ann. § 147D.17
Mississippi	none		Miss. Code Ann. § 73-25-33
Missouri	LM	2008	Wolff, 2020
Montana	Direct Entry	1991	Laws 1991, ch. 550, § 1.
Nebraska	None		
Nevada		Drop	Assembly Bill 386 (in consideration)
New Hampshire	CM	1999	Section 326:D
New Jersey	CM, CPM	2010	2A:53A-26
New Mexico	LM	1980	N.M. Admin. Code Ch 11, Pt 3
New York	CM	1992	Article 140 of the Education Law, §6955(2)(b) and (c)
North Carolina	none		
North Dakota	none		
Ohio	none		Athens, 2021
Oklahoma	Direct Entry, CM	2021	Senate Bill 1823
Oregon	Direct Entry	2013	OR ST §§ 687.405 et seq.
Pennsylvania	none		
Rhode Island	CM, CPM	1978	RI ST § 23-13-9
South Carolina	Direct Entry	1987	SECTION 44-89-10
South Dakota	CPM	2017	36-9C-13

Tennessee	CPM	2000	Title 36 Ch 29
Texas	Direct Entry	1983	SB 238, 68th R.S.
Utah	Direct Entry	2005	Title 58 chapter 77
Vermont	Direct Entry	1999	VT ST T. 26 §§ 4181
Virginia	LM	2005	54.1 -2957.9
Washington	Direct Entry	1980/1981	RCW 18.50.010
West Virginia		Drop	
Wisconsin	CPM	2005	Wis. Stat. § 440.982
Wyoming	CMP	2010	Wyo. Stat. § 33-46-103 (2010).

A.1. Maternity Ward Closures Estimation

To estimate the effects of maternity ward closures on birth place, I compare the number of home births for mothers giving birth in counties with a maternity ward closure to those giving birth in counties without a significant maternity ward closure. To identify a maternity ward closure, I use the method proposed in Fischer, Royer, and White (2024) where a county is defined as having a closure if in year n a hospital has 75 percent more hospital births than it does in year n+1. Counties of birth are identified based on occurrence county, not the mother's county of residence. Once a county is defined as having a closure, it remains coded as a closure for the rest of the study period.

I use a Poisson specification because the number of home births within a county is a count and contains zeros. Callaway and Sant'Anna (2021) does not allow for nonlinear estimation strategies, so to allow for Poisson estimation, I employ a stacked difference-in-differences strategy proposed by Deshpande and Li (2019).

I organize my data into stacks, defining each stack by the year a county first experiences a maternity ward closure. For any given stack, the control group consists of counties that are "not yet treated" and "never treated." To ensure a clean post period within each stack, the not yet treated counties are defined as those treated at least 3 years after year y, where y is the year that a county is treated. Lastly, I append the stacks together and estimate a stacked difference-in-differences shown in equation (2).

$$Y_{acy} = \beta_1 D_{cy} + \gamma_{ac} + \gamma_{ay} + \epsilon_{acy} \tag{2}$$

Y_{asy} measures the number of home births in county c, year y, and stack a. D_{cy} is an indicator variable equaling one for counties after a closure. γ_{ac} and γ_{ay} are county and year fixed effects, respectively. The fixed effects allow for only within-stack comparisons. Standard errors are clustered at the county level, and estimates are weighted by population of females aged 15–44 in each county.

To understand how a maternity ward closure affects the number of home births over time, I also performed an event study specification using the stacking design:

$$Y_{a,c,y} = \delta_{ac} + \delta_{ay} + \sum_{t=-5}^{-2} \mu_t \mathbf{1}\{y - y_c^* = t\} * treat_{ac} + \sum_{t=0}^{4} \gamma_t \mathbf{1}\{y - y_c^* = t\} * treat_{ac} + \epsilon acy \tag{3}$$

where $\mathbf{1}\{y - y_c^* = t\}$ is an indicator for county c being t years away from a maternity ward closure and a is a stack. The event study provides testable implications of the parallel trends assumption.

References

Aizer, A., A. Lleras-Muney, and M. Stabile (2005): "Access to Care, Provider Choice, and the Infant Health Gradient," *American Economic Review*, 95(2), 248–252.

Almond, D., H. W. Hoynes, and D. W. Schanzenbach (2011): "Inside the War on Poverty: The Impact of Food Stamps on Birth Outcomes," *The Review of Economics and Statistics*, 93(2), 387–403.

AMA (2021): "Maternal Levels of Care Standards of Practice," *American Medical Association House of Delegates*, 022.

Anderson, D. A., and G. M. Gilkison (2021): "The Cost of Home Birth in the United States," *Int J Environ Res Public Health*, 18(19).

Anderson, D. M., R. Brown, K. K. Charles, and D. I. Rees (2020): "Occupational Licensing and Maternal Health: Evidence from Early Midwifery," *Journal of Political Economy*, 128(11).

Battaglia, E. (2022): "The effect of hospital closures on maternal and infant health," .

Bonferroni, C. (1935): "Il calcolo delle assicurazioni su gruppi di teste," .

Borusyak, K., X. Jaravel, and J. Spiess (2021): "Revisiting Event Study Designs: Robust and Efficient Estimation," *Working Paper*.

Callaway, B., and P. H. Sant'Anna (2021): "Difference-in-Differences with multiple time periods," *Journal of Econometrics*, 225(2), 200–230.

——— (2023): "Getting Started with the did Package," .

Caron, E., C. E. Wheless, A. B. Patters, and J. W. Wheless (2015): "The charges for seizures in the pediatric emergency room: a single center study," *Pediatric Neurology*, 52(5), 517–520.

CDC (2022): "Changes in Home Births by Race and Hispanic Origin and State of Residence of Mother: United States, 2019–2020 and 2020–2021," .

Corman, H., D. Dave, and N. E. Reichman (2019): "The Effects of Prenatal Care on Birth Outcomes: Reconciling a Messy Literature," *Oxford Research Encyclopedia of Economics and Finance*.

Currie, J., and P. Reagan (2003): "Distance to Hospital and Children's Access to Care: Is Being Closer Better, and for Whom?," *Economic Inquiry*, 41(3), 378–391.

Daysal, M., M. Trandafir, and R. van Ewijk (2015): "Saving Lives at Birth: The Impact of Home Births on Infant Outcomes," *American Economic Journal:Applied*, 7(3), 28—-50.

de Chaisemartin, C., and X. D'Haultfoeuille (2019): "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects," *w25904. National Bureau of Economic Research*.

Deshpande, M., and Y. Li (2019): "Who Is Screened Out? Application Costs and the Targeting of Disability Programs," *American Economics Journal: Economic Policy*, 11(4), 213–248.

Fischer, S., H. Royer, and C. White (2024): "Health Care Centralization: The Health Impacts of Obstetric Unit Closures in the US," *American Economic Journal: Applied Economics*, 16(3), 113–141.

Fletcher, J., and H. Noghanibehambari (2023): "Long-Term Health Benefits of Occupational Licensing: Evidence from Midwifery Laws," *Journal of Health Economics*, 92.

GAO (2023): "Information on Births, Workforce, and Midwifery Education," .

Goode, K., and B. K. Rothman (2017): "African-American Midwifery, a History and a Lament," *American Journal of Economics and Sociology*, 76(1), 65–94.

Goodman-Bacon, A. (2021): "Difference-in-differences with variation in treatment timing," *Journal of Econometrics*, 225(2), 254–277.

Hoehn-Velasco, L., D. R. Jolles, A. Plemmons, and A. Silverio-Murillo (2022): "Health Outcomes and Provider Choice under Independent Practice for Certified Nurse-Midwives," *Working Paper*.

Hoyert, D. L., and A. M. Miniño (2020): "Maternal Mortality in the United States: Changes in Coding, Publication, and Data Release, 2018," *National Vital Statistics Reports*, 69(2).

Jayachandran, S., A. Lleras-Muney, and K. V. Smith (2010): "Modern Medicine and the 20th Century Decline in Mortality: Evidence on the Impact of Sulfa Drugs," *American Economics Journal: Applied Economics*, 2(2), 118–146.

Kennedy-Moulton, K., S. Miller, P. Persson, M. Rossin-Slater, L. Wherry, and G. Aldana (2022): "Maternal and Infant Health Inequality: New Evidence from Linked Administrative Data," *NBER Working Paper 30693*.

KFF (2022): "Kaiser Family Foundation - Health System Tracker," .

Markowitz, S., E. K. Adams, M. J. Lewitt, and A. L. Dunlop (2017): "Competitive effects of scope of practice restrictions: Public health or public harm?," *Journal of Health Economics*, 55, 201—-218.

MOD (2022): "Maternity Care Deserts Report Nowhere to Go: Maternity Care Deserts Across the U.S.," .

NIS (2023): "National Immunization Survey, 1992–2018," .

Rambachan, A., and J. Roth (2023): "A More Credible Approach to Parallel Trends," *Review of Economic Studies*, 90, 2555–2591.

Reissig, M., C. Fair, B. Houpt, and V. Latham (2021): "An Exploratory Study of the Role of Birth Stories in Shaping Expectations for Childbirth among Nulliparous Black Women: Everybody is Different (but I'm Scared)," *Journal of Midwifery and Women's Health*, pp. 597–603.

Suarez, A. (2020): "Black midwifery in the United States: Past, present, and future," *Sociology Compass*.

Sun, L., and S. Abraham (2021): "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects," *Journal of Econometrics*, 255(2), 175–199.

Sánchez-Redondo, M. D., M. Cernada, H. Boix, et al. (2020): "Home births: A growing phenomenon with potential risks," *Spanish Association of Paediatrics*, 93(4).

Wooldridge, J. (2023): "Simple approaches to nonlinear difference-in-differences with panel data," *The Econometrics Journal*, 26, C31–C66.