Maternity Ward Crowding, Birth Outcomes, and Future Fertility-Related Choices: Evidence from California*

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Abstract

Our paper examines how overcrowding in maternity wards influences concurrent birth outcomes and mothers' future fertility and hospital choices. We leverage day-to-day fluctuations in birth counts at Californian hospitals as a proxy for overcrowding. We find a notable reduction in the use of procedures such as C-sections, epidurals, inductions, and augmentations on crowded days, without compromising maternal or infant health. While there is no effect on future fertility, mothers—particularly non-Black, more educated, and those in less deprived counties—are more likely to switch hospitals or to a non-hospital setting for their next birth after experiencing overcrowding. We do not find specific patterns in their choice of subsequent hospitals, attributing the decision to negative first-birth experiences.

Keywords: Maternity Ward, Overcrowding, Fertility, Hospital Choice, Medical Procedure, Birth Outcomes

JEL Codes: I11, J13, M50

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1 Introduction

Childbirth is one of the most critical healthcare events women face. However, maternity wards around the world are increasingly closing due to cost-cutting measures and declining fertility rates (Carroll, 2019; Battaglia, 2023; Avdic et al., 2024; Fischer et al., 2024). In the U.S. alone, approximately 300 birthing units closed between 2018 and 2023, creating "maternity care deserts."[1] Over the past 30 years, more than 400 counties have lost their only hospital-based obstetric unit (Fischer et al., 2024). Without careful management, these closures risk overcrowding in remaining facilities, potentially compromising the quality of healthcare and mothers' overall experience.

Existing research has shown that hospitals adjust their provision of medical procedures during periods of overcrowding (Maibom et al., 2021; Facchini, 2022). While hospitals have a strong incentive to provide high-quality treatment and retain patients for future care, overcrowding could stretch healthcare workers' capacities, resulting in a poorer overall experience for mothers. It remains unclear whether a mother's birth experience during these times influences her fertility decisions and choice of healthcare provider in the future.

These questions hold significant policy implications. Declining fertility rates often trigger the closure of maternity wards in developed countries; if these closures lead to overcrowding in remaining facilities, potentially deterring future births, there is a risk that cost-containment measures intended to address declining fertility could inadvertently accelerate the trend. After a bad experience, mothers may also be prompted to consider non-hospital settings for future births, which tend to be less safe and may carry greater risks for infant health (Lazuka, 2023).

In this paper, we investigate the effects of overcrowding on the use of medical procedures, its impact on maternal and infant health, and how these experiences shape mothers' future fertility and hospital choices. To address these research questions, we utilize the complete set of Californian birth records from 1989 to 2017, supplemented with hospital-level data from annual financial reports. We first analyze concurrent birth outcomes using the entire sample, and then focus on how first-time mothers make future decisions.

[1] For more details, see this news report.

For causal analysis, we leverage the inherent randomness in the timing of natural births and rely on variations in daily birth counts within hospitals. Unlike many other aspects of childbirth, mothers cannot choose the level of maternity ward crowding. This breaks the link between maternal characteristics, medical procedures, and subsequent choices. Our approach controls for hospital-year-quarter, day-of-week, and hour-of-birth fixed effects to account for other time-related birth patterns. To adjust for hospital size and predictable seasonal birth patterns (Darrow et al., 2009; Buckles and Hungerman, 2013), we standardize overcrowding by creating a z-score for daily birth counts at the hospital-year-quarter level, ensuring comparability across different times and locations. We also exclude weekends and holidays that may feature varying staffing arrangements. A balance test confirms the validity of this measure. It shows that the standardized birth count is uncorrelated with maternal covariates such as age, ethnicity, education level, and Medi-Cal usage, conditional on the fixed effects.

Our findings indicate that overcrowding can prompt changes in procedures adopted during childbirth: when the level of overcrowding increases, there is a decrease in induction and augmentation during labor as well as a shift away from using epidural anesthesia. Contrary to earlier studies (Maibom et al., 2021; Facchini, 2022), we also see a drop in usage of cesarean sections (C-sections), likely due to differences between U.S. and European healthcare systems. In particular, we find the decline in C-section usage is primarily driven by the unscheduled portion—C-sections after labor trial. These changes are broadly in line with the notion that healthcare providers are time-constrained and actively adjust their provision of services based on overall workload. Despite these provider responses, we detect limited effects on short-run maternal and infant health, ruling out the health channel on mothers' future fertility-related decisions.

How do mothers respond after their first birth? Our analysis reveals that overcrowding does not significantly impact subsequent fertility within our sample. Specifically, a one-standard-deviation increase in a hospital's daily birth count relative to the quarterly average reduces the likelihood of a mother having an additional child within 5 years by just 0.02 percentage points—a change that is not statistically significant. This result holds consistently across measures of extensive and total fertility over both 2- and 5-year periods.

While overcrowding does not affect future fertility, we find that first-time mothers who give birth on more crowded days are more likely to switch hospitals for their next birth. A one-standard-deviation increase in a hospital's daily birth count relative to the quarterly average raises the likelihood of choosing a different hospital for the second birth by 0.20 percentage points, resulting in approximately 3,000 hospital switches during our sample period. This effect remains, though smaller in magnitude, when focusing on mothers delivering their second child. We also observe interesting heterogeneity in this behavior: Black mothers, less educated mothers, and those from more socioeconomically deprived counties are less likely to switch hospitals in response to overcrowding, possibly reflecting disparities in healthcare access. Moreover, we find no significant impact of first-birth overcrowding on the characteristics of the second-birth hospital or the distance from home to the hospital, suggesting that mothers do not systematically choose a particular type of facility. We attribute this behavior to mothers' negative first-birth experiences, consistent with previous medical literature (Bernhard et al., 2014).

Furthermore, we show that mothers who experienced overcrowding during their first hospital birth were more likely to opt for a non-hospital setting for subsequent births, such as giving birth at home or in a birth center. This statistically significant effect is small in magnitude but meaningful: a one-standard-deviation increase in overcrowding accounts for about 5% of the decision to switch to a non-hospital setting. Such a shift toward out-of-hospital births could increase neonatal mortality rates and lead to more negative long-term outcomes (Lazuka, 2023).

We conduct several robustness checks, all of which confirm the consistency of our main findings. First, excluding covariates from the primary specification yields similar effects, consistent with the balance test. Second, we restandardize the birth count at the hospital-year-month level and include hospital-year-month fixed effects to capture more granular monthly variations. Third, we test alternative overcrowding measures, such as using the number of mothers instead of babies, extending the analysis to include weekends, applying a 2-day measure, and expanding the measure to include hospitals within a larger geographical area.

We contribute to three strands of literature. First, we add to research on the management process and healthcare provision within hospitals, particularly in the context of overcrowding. On procedure usage, studies such as Maibom et al. (2021) in Denmark and Facchini (2022) in Italy show increased C-sections and reduced epidural use on crowded days. Fitzsimons and Vera-Hernández (2022) report lower breastfeeding rates for children born around weekends in the UK. Marks and Choi (2019) analyze Californian data and observe reduced spending on at-risk infants during crowded days. Recent work on maternity ward closures further highlights these impacts on treatment provision and health status (Avdic et al., 2024; Battaglia, 2023; Fischer et al., 2024). Our study verifies a wide range of these effects in California but finds that overcrowding decreases C-sections, in particular unscheduled ones, a pattern consistent with provider discretion under constrained availability in the US (Corredor-Waldron et al., 2024). Building upon a unique feature of our data, we are able to extend the analysis to mothers' future fertility and hospital choices, thus providing a novel empirical characterization of these important long-run outcomes.

Our work also contributes to the literature on how health shocks influence healthcare decisions (Fadlon and Nielsen, 2019; Rellstab et al., 2020; Fadlon and Nielsen, 2021), specifically focusing on how past childbirth experiences shape women's fertility decisions. Studies show C-section usage is linked to lower future fertility due to both the physiological impacts and mothers' behavioral responses (Halla et al., 2020; O'Neill et al., 2013; Norberg and Pantano, 2016). Additionally, negative birth experiences are associated with fewer future births and longer intervals (Gottvall and Waldenström, 2002; Preis et al., 2020). We extend this research by examining overcrowding in maternity wards, an objective proxy for birth experience and independent of maternal characteristics.

Third, our work contributes to a larger literature on patients' healthcare choices. Previous studies have examined factors such as healthcare quality (Gutacker et al., 2016), financial incentives (Clemens and Gottlieb, 2014; Ho and Pakes, 2014), and shared identities between patients and doctors (Greenwood et al., 2018, 2020; Alsan et al., 2019; Ye and Yi, 2023). We focus on mothers' decisions about their place of birth among non-hospital settings as well as different options within the hospital system. This represents a broader but less explored decision margin compared to the medical literature on home versus hospital births (Boucher et al., 2009; Murray-Davis et al., 2014; Bernhard et al., 2014). The experience of overcrowding fits with situational factors discussed by Chandra et al. (2011). While previous research explores heuristic decision-making by physicians (Frank and Zeckhauser, 2007; Jin et al., 2023), we highlight patient heuristics, showing how mothers' past experiences influence their hospital choices.

The remainder of the paper proceeds as follows. We discuss the background and datasets in Section 2. Section 3 introduces our empirical strategy. Section 4 presents the main set of results and robustness checks. We conclude in Section 5.

2 Background and Data

2.1 Childbirth in California

Californian mothers choose hospitals and healthcare providers for childbirth based on their health insurance coverage.[2] However, even though women have such freedom, some providers operate on a rotating schedule, leaving mothers uncertain about which provider they will ultimately interact with. Furthermore, mothers cannot predict how busy their hospital will be on their actual birth date. In our empirical approach, we leverage the unpredictability of birth dates.

Medical procedures during childbirth are jointly decided by mothers and their doctors, considering factors such as the mother's health status, medical history, and any pregnancy-related risks. Common delivery methods include vaginal delivery and C-section, and vaginal delivery is preferred in uncomplicated cases. However, if safety concerns arise for either the mother or baby, a C-section may be recommended.[3] While decisions are typically based on maternal health, ear-

[2] A health insurance plan typically designates a list of providers considered "in network," which ensures more generous reimbursements from the plan. One health insurance program that is particularly relevant is Medi-Cal, the Californian version of Medicaid, a publicly funded health insurance program that supports the low-income population. Due to the more lenient income threshold, it is much easier for a pregnant woman to become eligible for Medi-Cal coverage than for other adults.

[3] Such as in cases of breech presentation, placenta previa, fetal distress, or if the mother had previously used C-sections.

lier research suggests that there may be unrelated considerations. When the occupancy rate is high, healthcare providers may be time-constrained, affecting the provision of certain procedures (Marks and Choi, 2019; Maibom et al., 2021; Facchini, 2022).

2.2 Main Data: Californian Birth Records

Birth Records Data The primary data source for this study is the Vital Records Data managed by the California Department of Public Health (CDPH). Specifically, we use the Static Birth Statistical Master File (BSMF) spanning the years 1989 to 2017, a comprehensive dataset that encompasses all births within California and comprises a large set of variables extracted from birth certificates.[4]

The birth records include detailed demographic and health information about mothers and infants, such as socioeconomic indicators, delivery method, some health conditions of the mother during pregnancy, and documentation of various medical complications encountered by mothers (such as blood transfusion and ICU admission) and by babies (such as birth injury and NICU admission) during the delivery process and immediately after birth. Importantly, we observe the time and location of each childbirth, enabling us to infer how busy each hospital is on a daily basis.

Linking Mothers over Time Of particular significance, the birth records allow us to uniquely identify each mother and link their birth over time.[5] It is important to note that some births may go unobserved if mothers moved out of California. While mothers are also likely to relocate within California, they can still be tracked, as demonstrated in Chyn and Shenhav (2021). In our analysis, we assume that the overcrowding experience does not prompt mothers to move out of California, meaning that any missing births are assumed to be missing at random. In Figure 1, we illustrate the average subsequent fertility of mothers against the time of their first childbirth. Panel (a)

[4]We use this time frame to keep the variables consistent over time. The format of birth certificates has undergone significant changes: new variables are introduced, and details change for some existing ones.

[5]The data includes details such as their first name, last name, maiden name, and date of birth. Furthermore, the records furnish information on the month and year of the mother's most recent previous birth, as well as the number of previous births a mother had, facilitating the tracking of mothers over time and the analysis of their subsequent fertility patterns. We segment the birth records by birth order and link each subsequent birth with the first birth using mothers' identifiers.

showcases the extensive margin of subsequent births (i.e., whether or not the mother has any later births), while panel (b) displays the total subsequent fertility (i.e., the total number of newborns in the future). These figures display fertility rate variables within 2, 3, 4 and 5 years thereafter. However, we cannot tell when mothers deliver their last ever child in our dataset.

The fertility rates are remarkably stable in the eligible years. In terms of the extensive margin, about 15% of first-time mothers gave subsequent births within 2 years, 30% within 3 years, 40% within 4 years, and 48% within five years. Total fertility rates are a bit higher than these figures, suggesting a small, but positive and stable intensive margin. On average, first-time mothers gave birth to 0.15 subsequent children within 2 years, 0.30 within 3 years, 0.41 within four years, and 0.50 within five years.

Sampling and Summary Statistics For the analysis of current birth, we start with mothers aged between 18 and 45, and drop mothers who deliver at home, at a birth center,[6] at hospitals with very low birth counts,[7] or whose place of delivery is unknown.[8] As will be discussed in Section 3.1, we additionally drop births on weekends and public holidays in our main empirical analysis.

In Table 1, we provide summary statistics on demographic information and birth conditions for three samples, all of which will be used for further empirical analysis. They are the full sample of mothers, a sample consisting of all first-time mothers, and a sample of all first-time mothers for whom we can link to a future birth. At the aggregate level, we observe high participation rates, about 40-50%, in the public welfare programs of Medi-Cal and WIC. Compared to the full sample of births, mothers of first-time births are younger, better educated, and less likely to be enrolled in the two programs. Overall, C-section and epidural anesthesia are prevalent: about 30% of the births involve a C-section, and more than half of the births, either vaginal or using C-section, involve epidural anesthesia. Additionally, induction and augmentation during delivery are present

[6] The practice of home births and birth centers is different from that of hospitals. Only a small proportion (about 1%) of mothers are dropped this way.

[7] We exclude births from hospitals with an average monthly birth count below 15, which account for 0.2% of all births. Such facilities are more likely to lack a regular maternity ward and are primarily handling emergency births.

[8] While we only consider mothers who deliver in a hospital in our later analysis on outcomes related to that birth, we tract mothers' future births in hospital as well as non-hospital settings for outcomes related to future fertility and hospital choice.

within 11% of all births.[9]

2.3 Supplementary Data: Hospital Annual Financial Disclosure Report

While birth records allow us to identify the location of each birth, there is limited information on hospital characteristics, such as the scale of operations. We turn to the Hospital Annual Financial Disclosure Report managed by the California Department of Health Care Access and Information (HCAI) for this purpose. This dataset includes information collected from all acute care hospitals licensed by the State of California, and is desk-audited to ensure data quality.

In this paper, we use reports from fiscal year 2002-2003 onward, and produce a crosswalk from hospitals in disclosure reports to hospitals in birth records for each year by matching on facility name, city, and street address. We then use the number of beds allocated for birthing purposes, and several variables recording revenues and net incomes as proxies for hospital size to examine hospital-level characteristics in our later analysis.[10]

3 Empirical Analysis

3.1 Proxies for Overcrowding

Maternity wards are more likely to be overcrowded when an unusually high number of births occur on the same day. While hospitals typically have regular staffing schedules and may anticipate demand,[11] an unexpectedly high number of births can still result in unpredictable crowding.

We exploit the inherent randomness of birth timing within one maternity ward as an exogenous shock. Mothers typically deliver via C-section or vaginal birth. Unlike C-sections, which can be

[9] Induction initiates labor artificially before it begins naturally, often via medication or mechanical methods to prompt uterine contractions. Augmentation involves bolstering the strength and frequency of contractions after labor has commenced to facilitate progression. Both procedures speed up the delivery process, but at different times.

[10] At some hospitals, a single fiscal year may be divided into several reporting periods. If so, for stock variables, such as bed counts, we take the weighted average across that year, where weights equal the length of each reporting period. For flow variables, such as revenues, we first calculate the daily average within each reporting period, and then calculate a similar weighted average within that year.

[11] For instance, Figure A1 shows a noticeable increase in both births and C-sections around 8 AM each day, consistent with a typical workday schedule.

emergencies but can also be scheduled, vaginal births occur naturally and unpredictably. Despite a normal gestation length of 40 weeks, actual lengths vary widely (mean 275.2 days, SD 13.2 days for vaginal births in our data). Mothers are usually advised to call the hospital when contractions start or water breaks, and have limited control over the level of maternity ward crowding in this process.

We use the daily number of births at each hospital as a proxy for crowding, following the approach of prior studies (Marks and Choi, 2019; Maibom et al., 2021). On average, 5.06 mothers give birth at a hospital per day, as shown in Table A1. This figure is slightly lower than the total birth count (5.13), which includes multiple births. The standard deviation of daily birth count at the hospital-quarter level has mean 2.14, about 40% of the mean total birth count.

Using the raw birth counts could lead to three major concerns. First, the daily number of deliveries varies widely across hospitals, and the impact of an additional mother differs between small and large hospitals. Second, staffing levels tend to be lower on weekends and holidays, which affects birth outcomes (Evans and Kim, 2006; Halla et al., 2020; Facchini, 2022; Jacobson et al., 2021). Our data also show fewer births on these days. Third, there are significant seasonal fluctuations in daily births within a year, with a peak in the fall as we observe in Figure A2, possibly leading to pre-determined staffing adjustments. These concerns motivate us to focus on births within a typical working day and normalize the daily number of mothers at the hospital-year-quarter level to account for differences in hospital size and seasonality.

$$\text{Standardized Birth Count}_{h,d} = \frac{\text{Birth Count}_{h,d} - \overline{\text{Birth Count}_{h,yq}}}{\sigma(\text{Birth Count}_{h,yq})} \tag{1}$$

To be specific, we calculate a z-score for each hospital-day (subscript h,d), as shown in Equation 1, by subtracting the average daily number of births within the hospital-year-quarter (subscript h,yq) from that number on each day, and then dividing this difference by the standard deviation of the daily number of births within that hospital-year-quarter. Interim days with zero births are included in the calculation. This approach enables us to account for daily variation and make interpretations in terms of standard deviations of the daily number of mothers at the hospital-year-month level. We refer to this as the *Standardized Birth Count*. Such measure ranges from -3.5 to 7.9, with a mean of zero.

Alternatively, we produce five different measures as robustness checks, as will be discussed in Section 4.4: include weekends into the calculation; standardize at the hospital-year-month level; standardize based on the number of mothers instead of the number of births to account for non-singleton births (twins, triplets, etc.); standardize based on a 2-day average of birth counts; and standardize based on the number of births within 15 miles (24.1 km) of the mother's residence.

3.2 Regression Specification

$$Y_{ihd} = \alpha + \beta \text{Standardized Birth Count}_{hd} + \gamma \mathbf{X}_{ihd} + \theta_{h,yq} + \zeta_{DoW} + \kappa_{hour} + \varepsilon_{ihd} \tag{2}$$

We outline our regression specification in Equation 2, where i stands for mother [12], h stands for hospital, d stands for date, yq stands for year-quarter, DoW stands for day-of-week, and $hour$ stands for hour of birth within each calendar day. In the baseline specification, we standardized the daily birth count at the hospital-year-quarter level, as specified above. We examine a variety of outcomes Y_{ihd}, including medical procedures such as C-sections and epidural, health outcomes for mothers and babies during delivery and immediately after birth, mothers' future fertility, and choice of hospital at future births. We cluster standard errors at the hospital level.

We incorporate several fixed effects to account for potential confounders in our analysis. First, we control for a hospital-year-quarter fixed effect to control for differences in hospital size, practice styles, and their evolution over time. For example, some hospitals perform more C-sections than others (Card et al., 2023), which can affect health outcomes and subsequent fertility decisions. Additionally, hospitals may vary in their ability to handle complicated births, influencing mothers' future fertility choices. This fixed effect also captures seasonal variations in child health (Currie and Schwandt, 2013; Isen et al., 2017) and maternal characteristics (Buckles and Hungerman,

[12] Our main analyses are at the mother level, and for non-singleton births (twins, triplets, etc.), we focus on information recorded for the first child in that birth sequence.

2013; Darrow et al., 2009).

We also control for day-of-week fixed effects to account for potential fluctuations in birth characteristics as well as staffing patterns across different weekdays. Lastly, we include a fixed effect for the hour of birth to control for variations in birth timing within a day, as we observe in Figure A1, which can be influenced by work shifts and has been shown to be a risk factor for mothers (Gijsen et al., 2012).

We incorporate a comprehensive set of control variables to mitigate potential bias in our analysis. These controls include a mother's age, educational attainment, race and ethnicity, and income level (via Medi-Cal participation). Additionally, we account for the presence of plural births (e.g., twins or triplets), which can directly impact a mother's medical conditions and family planning.

3.3 Validity of the Strategy

Despite the randomness in birth timing, concerns remain that overcrowding may not be entirely random for mothers. To address this, we conduct a balance test on key demographic variables to validate our empirical strategy. Specifically, we examine whether the demographic characteristics of first-time mothers jointly predict the level of overcrowding, controlling for the fixed effects for hospital-year-quarter, day of the week, and hour of birth. Importantly, we use the same set of demographic variables in the balance test as in our main regression specification, Equation 2. Since plurality births are mechanically correlated with the daily birth count at a specific hospital, we perform the test separately for mothers giving birth to singletons and mothers giving birth to non-singletons.

We present the results in Table 2 for mothers of singletons and in Table A2 for mothers of non-singletons. Interestingly, the latter mothers are on average older, better educated, and less likely to be Hispanic. Only high school education (for mothers of singletons) and Medi-Cal participation (for mothers of non-singletons) predict overcrowding on the delivery date. However, the F-tests fail to reject the null that these demographic variables do not affect the level of overcrowding. These patterns suggest that the level of overcrowding for mothers can be seen as conditionally random. Additionally, in Section 4.4, we present our main outcomes of interest from a regression without these demographic controls, and show that they are very similar to what we obtain from the main regression specification.

4 Results

4.1 Outcomes at Birth

We first examine how overcrowding affects medical procedures and whether this, in turn, influences health outcomes of the current birth. For this analysis, we present results using both the full sample and a subsample of first births.

Medical Procedures Previous literature has shown that overcrowding in maternity wards could lead to changes in medical procedure usage in European settings (Maibom et al., 2021; Facchini, 2022). We illustrate the impact of crowding in California on medical procedures in Table 3. Panel A consists of the sample of all births, and Panel B consists of the sample of first-time births.

Our estimates in columns (1) and (6) show that C-section usage decreases with the level of maternity ward crowding. This contrasts with findings from Europe (Maibom et al., 2021; Facchini, 2022), where C-section usage increases on crowded days to expedite delivery. This discrepancy may be attributed to differences in the medical systems between the U.S. and Europe. The C-section rate is significantly higher in the U.S. (approximately 32% as of 2020) compared to Europe (about 25% on average). Additionally, American hospitals are predominantly private, while European hospitals are largely public. In the American context, qualified surgeons and anesthesiologists may be more occupied on busier days.

Notably, in columns (2) and (7), we find that a significant portion of the decline in C-section usage can be attributed to C-sections following a trial of labor. While these C-sections make up only 13% of all C-sections in the full sample (and 26% in the first-birth sample), their effect size represents 60% of the total reduction in C-section rates. Because C-sections after labor trial are primarily unscheduled, this pattern suggests a significant level of physician discretion in determining C-section usage, similar to findings in Corredor-Waldron et al. (2024).

We further observe that overcrowding leads to reduced utilization of labor induction and labor augmentation during the delivery process, as shown in columns (3)-(4) and (8)-(9) of Table 3. This pattern is consistent with findings in Maibom et al. (2021). Induction and augmentation are performed at different points in time during delivery, and both serve to expedite the laboring process. A reduction in their usage could potentially lead to a longer labor process, which may be an unpleasant experience for mothers and could possibly affect mothers' decisions on their subsequent births.

In line with Maibom et al. (2021), we find that overcrowding leads to a decrease in the use of epidural anesthesia, which is administered to alleviate childbirth pain (column (5) and (10) in Table 3).[13] It suggests that anesthesiologists are less available on busier days.

The across-the-board decrease in procedure use persists when we exclude likely scheduled deliveries and focus on likely unscheduled deliveries - mothers who either had a vaginal birth or had a C-section after labor trial - as shown in Table A4. This further lends support to our interpretation that providers have discretion in determining the level and type of services to provide when their availability is low under high demand.

Additionally, we document a non-linear effect. In Panel A of Table A3, we show that the overall decrease in procedure use is most predominant among days within the upper quartiles of overcrowding, suggesting that the effects we detect are more concentrated within the busiest days.

We present the heterogeneity results by race and ethnicity and socioeconomic deprivation of counties in Table A5, and by mother's Medi-Cal usage and education level in Table A6. We find that Black and Hispanic mothers experience a larger decrease in epidural usage, but we cannot conclude whether there are heterogeneous effects on overall C-section usage. However, we detect a Black-white gap in C-section after labor trial, where the decrease in C-section usage from overcrowding is completely offset for non-Hispanic Black mothers; this pattern is in line with the role

[13]Epidural anesthesia is recorded in our data for both vaginal births and C-sections.

of physical discretion in higher C-section rates experienced by Black mothers (Corredor-Waldron et al., 2024). Additionally, we find that mothers from more socioeconomically deprived counties, Medi-Cal mothers, and non-college-educated mothers experience a smaller decrease in C-section usage and the latter two groups also experience a bigger decrease in epidural usage. Because high C-section usage is generally undesirable and epidural is considered safe and comforting for mothers, these patterns can indicate women from low SES groups are more inversely affected by overcrowding than their better-off counterparts.

Maternal and Infant Health One concern directly related to overcrowding is that mothers and infants may receive less attention from their healthcare providers, and receive less intensive or less customized treatment for their conditions on crowded days. This could impact important health outcomes, as well as a mother's perception of their childbirth experience. While we are not able to speak to the psychological effect, information on certain maternal medical conditions is available within birth records, allowing us to provide some characterization of the impacts on physical well-being around birth.

In columns (1) and (6) of Table 4, we examine the impact of maternity ward overcrowding on the incidence of prolonged labor among all mothers as well as first-time mothers, where the labor process lasts for more than 20 hours. In columns (2) and (7), we examine whether the mother has been documented to have a fever during delivery, defined as a temperature above 38°C or 100°F. Both conditions are considered unpleasant and may elevate health risks for mothers and their babies. We do not detect any impact of overcrowding on the incidence of prolonged labor, and if anything, we find that a higher level of crowding slightly decreases the probability that mothers have a documented fever during the delivery process.[14] Similarly, in columns (3)-(4) and (8)-(9), we find a small decrease in antibiotics use and blood transfusion, which could be associated with the decrease in C-section usage. However, overcrowding has a limited impact on the likelihood of severe medical conditions, and the incidence of morbidity conditions is not affected.[15]

[14]This may be related to the decrease we see in other medical procedures. For example, there is some observational evidence that mothers who had an epidural are more likely to develop a fever (Jansen et al., 2020).

[15]Following the classification of maternal health conditions in birth records, we include third or fourth degree per-

An additional outcome of interest within our context is infant health - poor infant health at first birth may causally affect a woman's decision regarding subsequent fertility and child investment choices (Wolpin, 1997). In columns (1)-(2) and (7)-(8) of Table 5, we find overcrowding leads to a small decrease in incidences of MSAF and fetal intolerance treatment, which are related to the laboring process. However, we detect null effects on birth injury in columns (3) and (9), and we do not detect any meaningful impact of overcrowding on post-birth outcomes including a class of several health conditions in columns (4)-(10)[16] and Apgar scores[17] in columns (5)-(6) and (11)-(12). These results are in line with previous literature where effects on infants' health were found to be negligible (Maibom et al., 2021; Facchini, 2022).

4.2 Subsequent Fertility

We further investigate whether overcrowding during a mother's first birth influences her subsequent fertility decisions. The expected outcome is ambiguous ex ante. While we observe a reduction in medical procedures due to overcrowding, there is no evidence of adverse effects on maternal or infant health that may affect a mother's fertility decisions.

By linking mothers across multiple births, we can track fertility patterns following their first birth. We present results on subsequent fertility in Table 6. We focus on first-time mothers who had their first child in or before 2012, allowing us to track a full five-year period post-birth. We then analyze whether these mothers had additional births within two or five years that we can link in our data. The findings are consistent across different fertility measures: the impact of overcrowding on future fertility is minimal, with none of the coefficient estimates reaching statistical significance.

We now focus on column (4) in Table 6 and interpret the effect size. The lower bound of a

ineal laceration, ruptured uterus, unplanned hysterectomy, admission to ICU, and unplanned operating room procedure following delivery into the morbidity category.

[16]Following the classification of infant health conditions in birth records, we include assisted ventilation immediately after birth, NICU admission, seizure or serious neurological dysfunction, and newborn being transferred to another facility within 24 hours of delivery into the severe conditions category.

[17]The Apgar score serves as a rapid assessment tool for evaluating the health and vigor of newborns. Scores range from 0 to 10, with higher values indicating better infant health. A score of 7 or above is considered normal. On average, the Apgar scores in our sample have an average of 8 to 9, as shown in Panel C of Table 1.

95% confidence interval is -0.001, so we can largely rule out negative coefficient estimates that are beyond this value. Recall we standardized birth counts at the hospital-year-quarter level, so a one-unit increase in this measure translates into a one standard deviation increase in daily birth count at a hospital relative to its average within that quarter. For context, one standard deviation in daily birth counts is about 3 births across all hospital-days, and is about 2 births at a medium-sized hospital in our data. For a hospital with an average level of overcrowding, with each increase of roughly 2-3 births per day, total fertility of each first-time mother up to 5 years in the future decreases by no greater than 0.001 children. Each year in California, there are a total of roughly 122,000 first births. Consequently, a one standard deviation change in overcrowding translates into a decrease of at most $1.22 \times 10^5 \times 0.001 = 122$ subsequent births, so we can rule out effect sizes of future fertility that are beyond a decrease of about 120 children per year.

We further conduct analyses on heterogeneous effects on future fertility. In Panel B of Table A3, we find null effects across all four quartiles of overcrowding 5 years after first birth, effectively ruling out any impact on long-run fertility at any level of overcrowding. In Table A7 and Table A8, We observe that overcrowding has a statistically significantly negative effect on the future fertility of non-college-educated mothers within five years and a positive effect for college-educated mothers. However, the effect sizes are negligible, with one standardized birth count leading to a decrease (or increase) of 0.001 total births. We do not detect a statistically significant effect within any of the sub-groups along race and ethnicity, socioeconomic deprivation of county, and Medi-Cal usage dimensions.

The main analysis focuses on the effect of overcrowding on the first-birth sample. We also provide results using the second-birth sample, mothers who are giving birth to their second child, to investigate the subsequent fertility. In column (1)-(4) of Table A11, we show that the results using the second-birth sample align with the main findings. We still find a precisely estimated null effect on subsequent fertility.

4.3 Hospital Choice at Subsequent Birth

Given the null effects observed on subsequent fertility, we now turn to examining how mothers choose their place of birth for their second birth. Although we find no impact on health outcomes or subsequent fertility, the reduction in procedures on busier days could still prompt mothers to switch the place of second birth due to a negative experience (Bernhard et al., 2014).

This analysis focuses on first-time mothers whose second births are also recorded in our dataset. First, we demonstrate that experiencing overcrowding during the first birth leads mothers to select a different place for their second delivery, including switching to a non-hospital setting.[18] Next, we study whether mothers prefer certain types of hospitals by examining hospital characteristics at second birth, such as hospital size and travel distance. Finally, we present the heterogeneity in our results on switching place of birth.

Effects on Switching the Place of Birth Choice at Subsequent Birth The main results in switching the place of birth are presented in Table 7. Specifically, we find in column (1) that mothers who experience a higher level of crowding during their first birth are more likely to change to a different place when they give birth to their second child. The coefficient means that a one-standard-deviation increase in daily birth counts, about 2-3 births at an average hospital, increases a mother's likelihood of switching to a different place for second birth by 0.20 percentage points. Each year in California, there are a total of roughly 122,000 first births, and about 50% of these mothers give birth to a second child within 5 years. Consequently, a one standard deviation increase in overcrowding translates into an increase of $1.22 \times 10^5 \times 50\% \times 0.0020 = 122$ mothers per year who make the switch at second birth, for a total of about 3,000 mothers across our sample period.

We also observe that the effect is non-linear, as demonstrated in the results presented in columns (2) and (3). In column (2), we decompose the level of crowding into four quartiles and interact the quartile indicators with the standardized birth count, alongside the standardized birth count itself.

[18] An advantage of using birth records data is that hospital codes remain consistent across different years, eliminating the need for a crosswalk of hospitals over time.

The coefficient for the standardized birth count in this model is 0.0005, indicating no effect for the lowest quartile group. Conversely, the interaction with the highest quartile shows a significantly positive coefficient of 0.0023. Similarly, the interaction with the third quartile has a positive coefficient of 0.0021, though it is not statistically significant. The interaction with the second quartile shows no effect, with a coefficient of -0.0029. These results suggest that maternal hospital switching is primarily driven by mothers who experienced above-median levels of overcrowding. In column (3), we introduce a quadratic term for the standardized birth count, in addition to the linear term. The quadratic term has a significantly positive coefficient of 0.0004, further confirming the non-linearity of the relationship. We also visualize this relationship in Figure A3, after controlling for fixed effects and covariates as specified in Equation 2. The figure reveals a non-linear relationship, with steeper slopes at higher levels of overcrowding.

Furthermore, we investigate whether mothers who experienced overcrowding during their first hospital birth were more likely to opt for a non-hospital setting for subsequent births, such as giving birth at home or in a birth center. Previous medical research suggests that negative hospital experiences can prompt mothers to choose home births in the future (Bernhard et al., 2014). In our causal analysis, we find a small but statistically significant effect. As shown in column (4), the coefficient is 0.0002. The faction of mothers switching to a non-hospital birth after a hospital birth in our sample is 0.0047 (or 0.47%), indicating that a one-standard-deviation increase in overcrowding accounts for about 5% of the decision to switch to a non-hospital setting. Such a shift toward out-of-hospital births could increase neonatal mortality rates and lead to more negative long-term outcomes (Lazuka, 2023).

Our main analysis focuses on the effect of overcrowding on the first-birth sample. We also provide results on the second-birth sample to investigate whether the results differ from those of the first-birth sample. The findings, presented in the column (5) of Table A11, show that the results are consistent, though the coefficients are much smaller. Mothers who experienced overcrowded maternity wards during their second birth are more likely to switch hospitals for future deliveries. The effect size is smaller at 0.0007, indicating that a one-unit increase in the standard birth count leads to a 0.07 p.p. increase in the likelihood of switching hospitals. The reduction in effect size suggests that mothers are less sensitive to overcrowding during their second birth compared to their first.

Characterization of Hospital at Subsequent Birth We further examine how experiencing overcrowding during the first birth affects medical procedures and hospital characteristics of the second birth. We find that mothers who deliver on crowded days are less likely to have C-sections for their second birth, as shown in column (1) of Table 8. This is consistent with the lower usage of C-sections during their first birth, as a C-section delivery is preferred if a woman has had it before.

We then characterize hospitals at second birth in columns (2)-(9) of Table 8. In columns (2)-(3), we proxy the travel distance between the mother's residence and the hospital of delivery by the distance between zipcode centroids, and find null effects of first-birth overcrowding on the travel distance to the hospital for the second birth, whether measured from the residence at the first or second birth. We also fail to detect differences in the socioeconomic status of the patient pool at the hospital of delivery (proxied by the share of Medi-Cal mothers), in hospital ownership, or in hospital size (proxied by the number of obstetric beds and total revenues). These patterns suggest that mothers are inclined to change to a different hospital for future births if they experience a high level of crowding during the first birth, but they may not be targeting a specific type of hospital in the process. Rather, they are choosing the hospital for their second birth as if at random within their local area.

Heterogeneous Effects in Hospital Switching We further examine the heterogeneity in hospital choice based on mothers' racial and socioeconomic backgrounds and show the results in Figure 2, Table A9 and Table A10. In the first analysis, we categorize our sample into four subgroups—non-Hispanic White, non-Hispanic Black, Hispanic, and Others—using the mother's primary race indicator. We then perform a similar regression analysis on each of the other three groups of sub-samples.

Our findings in the Panel A of Table A9 reveal that mothers from non-Hispanic White, Hispanic, and Other racial groups are more likely to switch hospitals for their second birth in response to overcrowding during their first birth. In contrast, Black mothers do not exhibit a similar response, suggesting that they are less sensitive to the effects of overcrowding. To further explore this, we examine how the racial composition of the patient pool on the day of birth influences hospital-switching behavior. We include a control for the proportion of mothers from each racial group and interact it with the Standardized Birth Count in our regression. As shown in Table A12, we do not find significant effects of racial interaction, indicating that interactions across racial groups are unlikely to explain the heterogeneity in our results.

We also observe disparities in hospital switching behavior along socioeconomic lines. For this analysis, we use data from the Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry's Social Vulnerability Index (SVI) for the year 2000.[19] Our focus is on first-time mothers between 2000 and 2009 who have a documented county of residence in California. In column (4) of Table A9, we find a similar pattern in hospital switching between births in this sub-sample as in our main analysis sample, and the coefficient magnitudes are the same. However, the results differ when we split these mothers into two groups: those residing in counties that are less socioeconomically deprived than the median, and those in counties more socioeconomically deprived than the median. Columns (5) and (6) indicate that the aggregate response to overcrowding is primarily driven by mothers from less socioeconomically deprived counties, whereas mothers from more deprived counties do not appear to alter their hospital choice for their second birth based on the level of crowding experienced during the first birth.

We also distinguish mothers by their Medi-Cal usage and college education status in Table A10. While we do not observe a heterogeneous effect based on Medi-Cal usage, we find that mothers with a college degree are more likely to switch to a different hospital in response to overcrowding.

Overall, mothers with higher socioeconomic status (SES) appear to be more responsive to overcrowding and have greater flexibility in choosing hospitals. Since the ability to switch hospitals

[19] We use the socioeconomic domain of the 2000 SVI, which includes four components: the proportion of individuals below the poverty level, the proportion of civilians aged 16 and older who are unemployed, per capita income in 1999, and the proportion of people aged 25 and older without a high school diploma.

also depends on the availability of local hospital options for a specific demographic group, the patterns we document above may be linked to broader concerns about racial and socioeconomic disparities in healthcare access.

4.4 Robustness Check

We conduct three sets of robustness checks. First, we remove demographic covariates from our regression to see if our main results hold. Second, we modestly change the standardization of daily birth counts in three ways: standardize at the hospital-year-month level for finer seasonality control, use the number of mothers instead of babies, and extend the analysis to include weekends. Lastly, we test two alternative overcrowding measures: using a 2-day average birth count for standardization, and expanding the measure to include hospitals within a larger geographical area.

Exclude Covariates on Maternal Demographics In this analysis, we follow our main regression specification but exclude control variables related to maternal demographics. This serves as an alternative test to determine whether overcrowding is uncorrelated with maternal characteristics, thereby validating our assumption that it can be considered conditionally random. If overcrowding were correlated with demographic characteristics, we would expect to see changes in the regression results.

Specifically, we only keep the overcrowding measure, the binary indicator for plural births, and the hospital-year-quarter, day-of-week and birth hour fixed effects in the regression, and exclude all other control variables we previously used. Results are presented in Table A13 for usage of medical procedures at birth and in Table A14 for subsequent fertility and hospital switching at second birth. The overall results are very similar to our main regression specification - we see an across-the-board decrease in procedure use, but do not detect any effects on future fertility in most fertility outcomes. This lends some support to our identifying assumption that the effects of overcrowding on the main outcomes of interest we detect are not confounded with effects from other maternal characteristics.

Standardize Daily Birth Counts at the Monthly Level In the main analysis, we normalize daily birth counts at the hospital-year-quarter level to account for both differences in hospital size, which may imply differential impacts of a marginal birth, as well as seasonality of births over the course of a year. Here, we adopt a regression specification that features birth count standardized at the hospital-year-month level and includes hospital-year-month fixed effects instead of hospital-year-quarter fixed effects as a finer approach to adjust for the seasonality of births within a year.

Results are presented in Table A15 for usage of medical procedures at birth and in Table A16 for subsequent fertility and hospital switching at second birth. They are also very similar to the results we obtained using the main regression specification.

Measure Overcrowding based on Number of Mothers In the main analysis, we measure overcrowding based on the number of babies born each day at each hospital. Here, we use an alternative measure based on the number of mothers, and perform the standardization at the same hospital-year-quarter level. The number of babies and mothers differ when non-singleton births (twins, triplets, etc.) are present. The latter captures total demand for maternity care services.

Results are presented in Table A17 for usage of medical procedures at birth and in Table A18 for subsequent fertility and hospital switching at second birth. They closely resemble the empirical results from our analysis.

Include Weekends in the Analysis In the main analysis, we exclude weekends and holidays to avoid potential confounding factors related to staffing pattern changes. Weekends may pose a threat to our analysis if hospitals operate on different schedules. Here, we conduct a robustness check by including weekends to compare the results with those from the main analysis.

Results are presented in Table A19 for usage of medical procedures at birth and in Table A20 for subsequent fertility and hospital switching at second birth. Again, these results are similar to what we obtain from the main specification.

Calculate Birth Count based on 2-day Average Mothers may stay at the hospital for childbirth for more than 1 day, especially when they had a C-section, and this could potentially affect the hospital's capacity to serve new patients. Because we do not directly observe admission or discharge dates from birth records, in this robustness check, we calculate the standardized birth count using a 2-day average, capturing births occurring on the mother's day of delivery or the previous day, to account for potential spillovers across consecutive calendar days.[20]

Results are presented in Table A21 for usage of medical procedures at birth and in Table A22 for subsequent fertility and hospital switching at second birth. While we see similar results on usage of other procedures and hospital switching at second birth, the effect size on total C-sections is now much diluted and smaller than that for C-sections after labor trial. This suggests that hospitals are adjusting across different days by shifting pre-scheduled C-sections from a busy day to a nearby day that is less busy to smooth out the workload of physicians.

Measure Overcrowding within a Larger Geographical Area We consider overcrowding at the individual hospital level in our main specification. To address concerns that mothers may be diverted away from busy hospitals and overcrowding at one hospital may have spillover effects on other hospitals nearby, we consider a standardized birth count measure based on births on the same day, but aggregated from all hospitals within 15 miles (24.1 km) of the mother's residence. At the mother level, the correlation between this overcrowding measure and the main measure is 0.35, suggesting a close relationship between aggregate local childbirth demand and a mother's actual childbirth experience.

Results are presented in Table A23 for usage of medical procedures at birth and in Table A24 for subsequent fertility and hospital switching at second birth. Results on procedure usage are similar to those in the main specification; however, the coefficient magnitudes are now smaller and the effect on C-section usage is instead a precisely estimated zero. To the extent that variation in birth counts (relative to the mean) is larger for a single hospital than for an entire local area, the smaller magnitudes are expected. At the same time, the differences, particularly in the effects on

[20] We exclude births from the analysis if either the day of birth or the preceding day falls on a weekend or holiday.

C-section usage, may point to a non-eligible adjustment margin where some mothers are diverted away from the busiest hospitals, and thus aggregate C-section usage remains constant.

5 Conclusion

Complementing the extensive literature on how underlying supply and demand factors shape people's healthcare choices, our paper examines a "situational" factor highlighted by Chandra et al. (2011)—how overcrowding in maternity wards during childbirth affects subsequent fertility and hospital choices among first-time mothers.

We standardize daily birth counts at each hospital and find that overcrowding prompts across-the-board reductions in medical procedures—C-section (and predominantly unscheduled ones), labor induction, labor augmentation, and epidural anesthesia—likely to alleviate physician workload. Despite these adjustments, there are no significant effects on immediate maternal and infant health outcomes. Regarding post-birth decisions, we find that overcrowding does not affect subsequent fertility within five years after first birth. However, mothers who experience overcrowding are more likely to choose a different place for their second birth, including non-hospital settings, potentially resulting in nearly 3,000 switches within our sample period. Furthermore, non-Hispanic Black mothers, those with lower education levels, and residents of socioeconomically deprived counties are less likely to respond to overcrowding by switching hospitals in the future, reflecting inequalities in healthcare access.

This study has several limitations. Our data is limited to California, so we are unable to track mothers who move out of state. The analysis of maternal and infant health is also restricted to information available on birth certificates, and we lack a subjective measure of negative experiences. Additionally, we cannot determine the "optimal" level of maternity ward utilization from our current analysis.

Despite these constraints, our findings provide valuable insights into how past experiences influence mothers' subsequent fertility-related healthcare decisions. Additionally, the implications of our study are relevant to the recent trend of maternity ward closures in the U.S., a development that may exacerbate overcrowding in the remaining facilities (Avdic et al., 2024; Battaglia, 2023; Fischer et al., 2024). Our results suggest that this trend could significantly impact mothers' healthcare-seeking behavior. It is especially concerning that mothers may opt for non-hospital settings, which could pose risks for subsequent births. We suggest that policymakers carefully weigh the efficiency gains against potential risks when making decisions about maternity ward closures.

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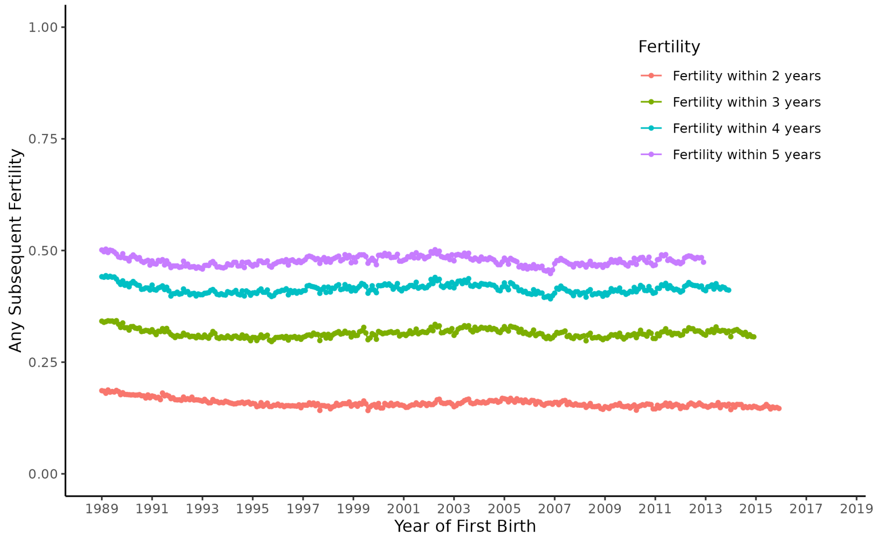
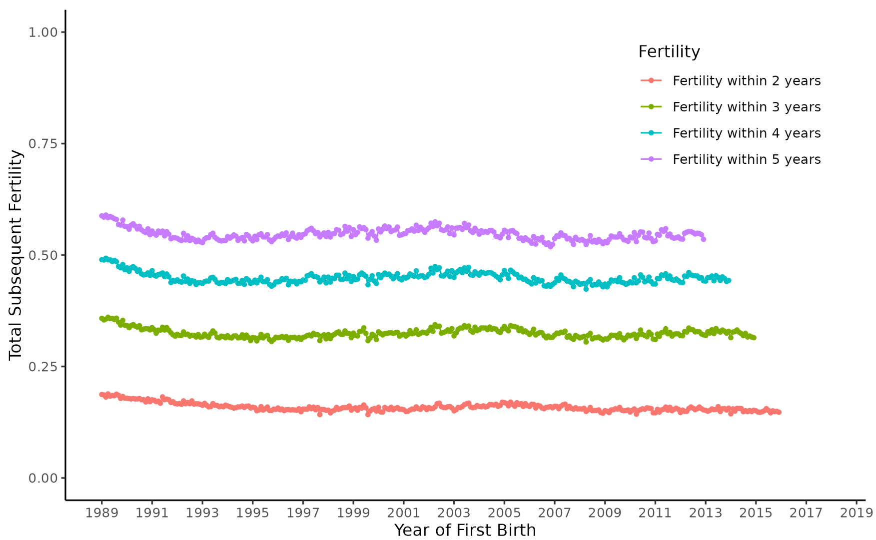
Figures

Figure 1: Average Subsequent Fertility of First-time Mothers



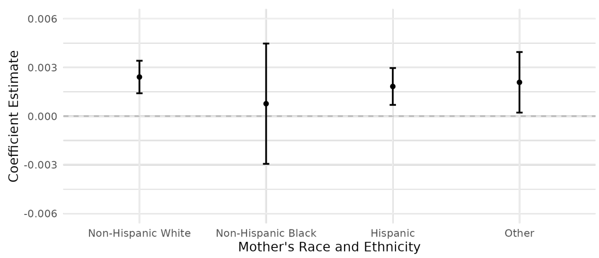
(a) Any Subsequent Fertility



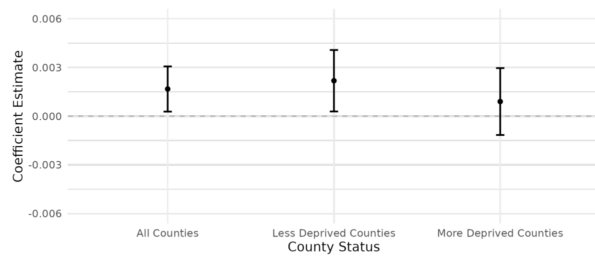
(b) Total Subsequent Fertility

Notes: In this figure, we track the average subsequent fertility of first-time mothers from California birth records between 1989 to 2017.

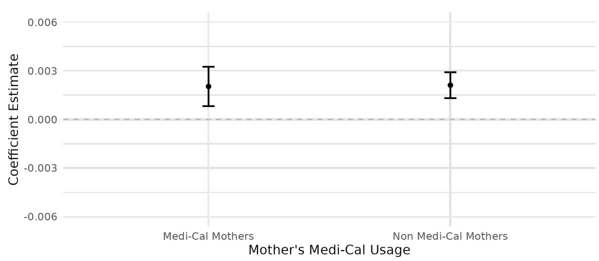
Figure 2: Heterogeneous Effects of Switching Place of Birth



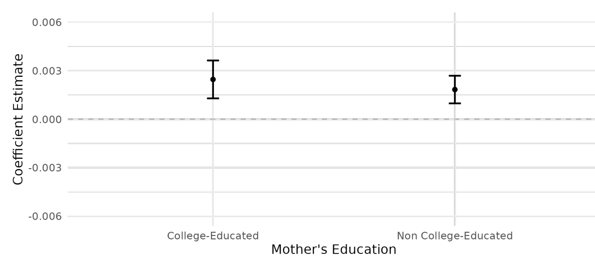
(a) By Mother’s Race and Ethnicity



(b) By County’s Social Vulnerability Index



(c) By Mother’s Medi-Cal Usage



(d) By Mother’s Education

Notes: We present the heterogeneous coefficients of standardized birth count from Equation 2. The error bars represent the 95% confidence interval. We restrict the sample to mothers whose first and second births are both observed in our dataset. In the last figure, we additionally restrict to mothers with first birth between 2000 and 2009 and a Californian county of residence. The socioeconomic deprivation measure for counties is based on the CDC/ATSDR Social Vulnerability Index (SVI) for year 2000, and a lower index value implies less deprivation. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude first births on weekends and holidays.

Tables

Table 1: Summary Statistics

	Full Sample		First Birth Sample		Linked Sample		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Years Available
Panel A: Mother's Characteristics							
Mother's Age	28.34	5.91	26.39	5.87	25.55	5.34	1989-2017
Mother is Hispanic	0.48	0.50	0.41	0.49	0.42	0.49	1989-2017
Mother is Black	0.06	0.24	0.06	0.23	0.05	0.22	1989-2017
$\geq$ High school education	0.74	0.44	0.83	0.38	0.81	0.39	1989-2017
$\geq$ College education	0.23	0.42	0.30	0.46	0.29	0.46	1989-2017
Medi-Cal is principal source of payment	0.43	0.49	0.37	0.48	0.37	0.48	1989-2017
Mother uses WIC program	0.51	0.50	0.45	0.50	0.44	0.50	2007-2017
Panel B: Birth Condition and Health Procedure							
Gestation Length (days)	274.53	13.80	275.55	14.20	276.31	13.47	1989-2017
All C-sections	0.29	0.45	0.29	0.45	0.30	0.46	1989-2017
C-section after labor trial	0.04	0.19	0.07	0.26	0.07	0.26	2005-2017
Epidural anesthesia	0.55	0.50	0.62	0.49	0.59	0.49	2006-2017
Labor Induction	0.11	0.31	0.14	0.34	0.13	0.33	1989-2017
Labor Augmentation	0.11	0.32	0.15	0.36	0.14	0.35	1989-2017
Presence of breech position	0.03	0.18	0.04	0.20	0.04	0.19	2005-2017
Prolonged Labor	0.01	0.09	0.02	0.13	0.01	0.12	1989-2017
Panel C: Maternal and Infant Health Outcomes							
Presence of maternal fever	0.012	0.110	0.025	0.155	0.024	0.152	1989-2017
Antibiotics used during labor and delivery	0.158	0.365	0.177	0.382	0.152	0.359	2006-2017
Maternal blood transfusion	0.002	0.046	0.002	0.046	0.002	0.046	1989-2017
Maternal morbidity conditions	0.009	0.097	0.015	0.124	0.015	0.123	2006-2017
MSAF	0.043	0.203	0.054	0.226	0.053	0.223	1989-2017
Fetal intolerance treatment	0.027	0.162	0.048	0.214	0.045	0.208	2006-2017
Birth injury	0.001	0.034	0.002	0.040	0.002	0.043	1989-2017
Several infant conditions	0.048	0.213	0.057	0.233	0.046	0.209	1989-2017
Apgar score (1 min)	8.17	1.15	8.03	1.30	8.07	1.25	2007-2017
Apgar score (5 min)	8.90	0.59	8.86	0.66	8.88	0.61	2007-2017
Observations	10,638,784		3,923,045		2,095,499		

Notes: In this table, we restrict the sample to mothers aged between 18 and 45 who gave birth at a hospital with on average at least 15 births per month, and on a non-holiday weekday between 1989 and 2017. The first birth sample consists of mothers who have no reported previous births, and the linked sample consists of first-birth mothers we are able to link to a future birth. Maternal morbidity conditions consist of third or fourth degree perineal laceration, ruptured uterus, unplanned hysterectomy, admission to ICU, and unplanned operating room procedure following delivery. MSAF stands for moderate or heavy meconium staining of the amniotic fluid. Severe infant conditions consist of assisted ventilation immediately after birth, NICU admission, seizure or serious neurological dysfunction, and newborn being transferred to another facility within 24 hours of delivery.

Table 2: Balance Test on First-time Mothers - Singleton Births

		Dependent Variable: Standardized Birth Count	
Variable Name	Mean	Coefficient	S.E.
Mother's Age	26.31	-0.0002	(0.0001)
Mother is Hispanic	0.41	0.00003	(0.0015)
Mother is Black	0.06	-0.0014	(0.0025)
$\geq$ High School	0.82	0.0016	(0.0017)
$\geq$ College	0.29	-0.0009	(0.0016)
Uses Medi-Cal	0.38	0.0019	(0.0015)
F-statistic of joint F-test		1.440	
p-value of joint F-test		0.199	

Notes: We restrict the sample to mothers in our dataset who have no reported previous births and are giving birth to singletons. We regress the birth count measure on all the control variables presented in this table. In the regression, we include hospital-quarter, day-of-week, and hour-of-birth fixed effects.

Table 3: Effect of Standardized Birth Count on Medical Procedure Usage

	Panel A: All Births				
	(1)	(2)	(3)	(4)	(5)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0015***	-0.0009***	-0.0040***	-0.0021***	-0.0050***
	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0003)
Observations	10,638,784	4,584,564	10,638,784	10,638,784	4,204,037
Dependent Mean	0.2904	0.0384	0.117	0.1225	0.5461
Adjusted R^2	0.0990	0.0529	0.1262	0.1961	0.4219
	Panel B: First-time Births				
	(6)	(7)	(8)	(9)	(10)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0026***	-0.0016***	-0.0032***	-0.0025***	-0.0042***
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0004)
Observations	3,923,045	1,704,185	3,923,045	3,923,045	1,565,839
Dependent Mean	0.2913	0.0753	0.1436	0.1604	0.6173
Adjusted R^2	0.0791	0.1024	0.1400	0.2232	0.4673

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 4: Effect of Standardized Birth Count on Maternal Health

Panel A: All Births					
	(1)	(2)	(3)	(4)	(5)
	Prolonged Labor	Maternal Fever	Antibiotics Use	Blood Transfusion	Any Morbidity
Standardized Birth Count	-0.0001	-0.0002***	-0.0018***	-0.00005***	-0.0001
	(0.00003)	(0.00004)	(0.0003)	(0.00002)	(0.00005)
Observations	10,638,784	10,638,784	4,204,037	10,638,784	4,204,037
Dependent Mean	0.0083	0.0122	0.1578	0.0021	0.0094
Adjusted R^2	0.0331	0.0401	0.2177	0.3952	0.0502
Panel B: First-time Births					
	(6)	(7)	(8)	(9)	(10)
	Prolonged Labor	Maternal Fever	Antibiotics Use	Blood Transfusion	Any Morbidity
Standardized Birth Count	-0.0001	-0.0005***	-0.0014***	-0.0001**	-0.00001
	(0.0001)	(0.0001)	(0.0004)	(0.00002)	(0.0001)
Observations	3,923,045	3,923,045	1,565,839	3,923,045	1,565,839
Dependent Mean	0.0164	0.0247	0.1773	0.0021	0.0155
Adjusted R^2	0.0548	0.0598	0.2177	0.4105	0.0649

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Records for antibiotics use and morbidity conditions began in 2006. Morbidity conditions consist of third or fourth degree perineal laceration, ruptured uterus, unplanned hysterectomy, admission to ICU, and unplanned operating room procedure following delivery. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 5: Effect of Standardized Birth Count on Infant Health

	(1)	(2)	(3)	(4)	(5)	(6)
	MSAF	Fetal Intolerance	Birth Injury	Severe Con.	Apgar (1 min)	Apgar (5 min)
Panel A: All Births						
Std. Birth Count	-0.0007***	-0.0004***	-0.00001	-0.0001	0.0012*	0.00004
	(0.0001)	(0.0001)	(0.00001)	(0.0001)	(0.0007)	(0.0003)
Observations	10,638,784	4,204,037	10,638,784	10,638,784	3,787,645	3,783,536
Dependent Mean	0.0432	0.0269	0.0012	0.0478	8.17	8.90
Adjusted R^2	0.0636	0.0446	0.0681	0.0853	0.0694	0.0216
Panel B: First-time Births						
	(7)	(8)	(9)	(10)	(11)	(12)
	MSAF	Fetal Intolerance	Birth Injury	Severe Con.	Apgar (1 min)	Apgar (5 min)
Std. Birth Count	-0.0009***	-0.0005***	-0.00001	-0.0002	0.0016	0.0001
	(0.0001)	(0.0002)	(0.00002)	(0.0001)	(0.0010)	(0.0006)
Observations	3,923,045	1,565,839	3,923,045	3,923,045	1,412,663	1,411,217
Dependent Mean	0.0540	0.0482	0.0016	0.0574	8.03	8.86
Adjusted R^2	0.0737	0.0751	0.0865	0.0960	0.0624	0.0226

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Fetal Intolerance means one or more of the following actions were taken to treat the condition: in-utero resuscitative measures, further fetal assessment, or operative delivery. MSAF stands for moderate or heavy meconium staining of the amniotic fluid. Severe Con. refer to severe conditions that consist of assisted ventilation immediately after birth, NICU admission, seizure or serious neurological dysfunction, and newborn being transferred to another facility within 24 hours of delivery. Records began for Fetal Intolerance in 2006, and for Apgar scores in 2007. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 6: Effect of Standardized Birth Count on Future Fertility

	Dep Var: Subsequent Fertility			
	(1)	(2)	(3)	(4)
	Any, 2 Years	Total, 2 Years	Any, 5 Years	Total, 5 Years
Standardized Birth Count	0.0001	0.0001	-0.0002	-0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0003)
Observations	3,294,994	3,294,994	3,294,994	3,294,994
Dependent Mean	0.1593	0.1600	0.4765	0.5468
Adjusted R^2	0.0087	0.0087	0.0433	0.0389

Notes: We restrict the sample to first births from 1989 to 2012. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 7: Effect of Standardized Birth Count on Future Place of Birth Choice

	Dep Var: Switched the Place of Birth			Switched to non-Hospital
	(1)	(2)	(3)	(4)
Standardized Birth Count	0.0020***	0.0005	0.0017***	0.0002***
	(0.0004)	(0.0008)	(0.0004)	(0.00005)
Standardized Birth Count × 4th Quartile		0.0023**		
		(0.0011)		
Standardized Birth Count× 3rd Quartile		0.0021		
		(0.0017)		
Standardized Birth Count× 2nd Quartile		-0.0029		
		(0.0031)		
Standardized Birth Count^2			0.0004	
			(0.0002)	
Observations	2,097,475	2,097,475	2,097,475	2,097,475
Dependent Mean	0.4149	0.4149	0.4149	0.0047
Adjusted R^2	0.1148	0.1148	0.1148	0.0080

Notes: We restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We include the 4th, 3rd, and 2nd quartile indicators of the standardized birth count to capture the non-linear effect. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 8: Effect of Standardized Birth Count on the Second Birth

Panel A: Characterization of Second Birth - Birth Records Data

	(1)	(2)	(3)	(4)	(5)
	C-section	Home 2 to Hospital 2	Home 1 to Hospital 2	Daily # of Births	% Medicaid Moms
Standardized Birth Count	-0.0025***	-0.0009	0.0236	0.0005	0.0003
	(0.0004)	(0.0269)	(0.0530)	(0.0028)	(0.0169)
Observations	1,063,118	1,919,777	1,909,525	2,086,217	2,086,217
Dependent Mean	0.34	10.31	22.97	8.42	39.60
Adjusted R^2	0.0459	0.0168	0.0252	0.4169	0.5156

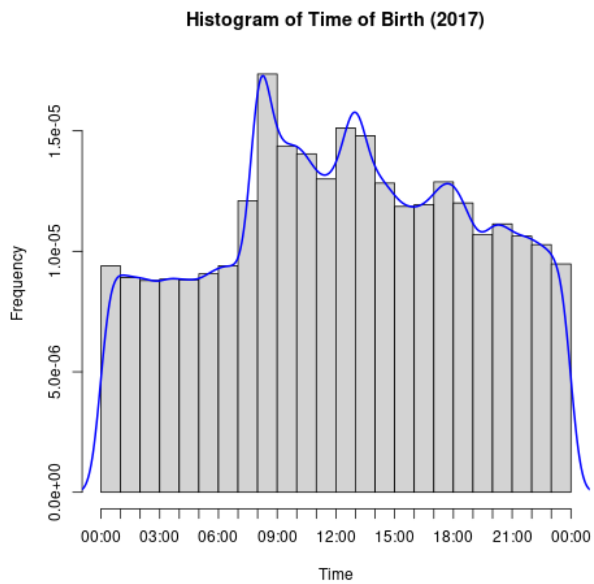
Panel B: Characterization of Second Birth - Financial Reports Data

	(6)	(7)	(8)	(9)
	# of Staffed Beds	Investor Control	$\ln(\mathit{Gross\ Revenues})$	$\ln(\mathit{Birth\ Revenues})$
Standardized Birth Count	0.0135	0.00004	-0.0001	-0.0006
	(0.0147)	(0.0003)	(0.0007)	(0.0008)
Observations	1,104,934	1,120,234	970,876	803,631
Dependent Mean	28.50	0.16	14.62	10.67
Adjusted R^2	0.4577	0.4339	0.5277	0.5276

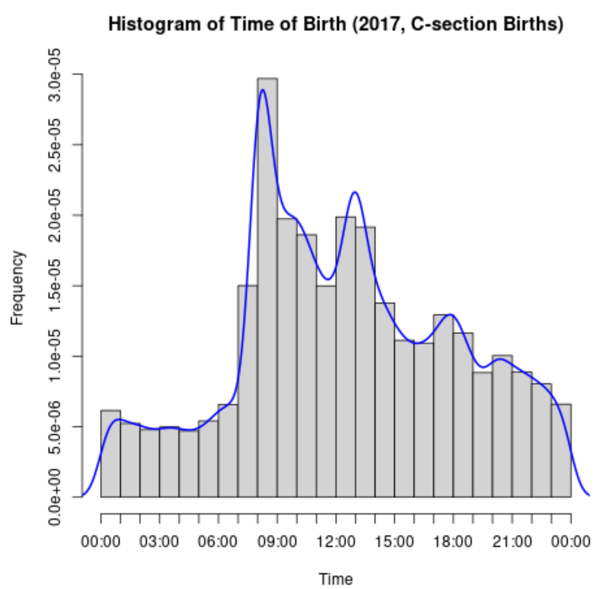
Notes: We restrict to mothers with a second birth. Outcomes in panel A are from the California birth record data. Outcomes in panel B are based on the Hospital Annual Financial Disclosure Report, available after 2002. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. Outcomes in columns (1)-(3) are at the mother level, and outcomes in columns (4)-(9) are at the hospital level. Outcomes in columns (2)-(3) stand for the distance between the mother's residence at second birth (or at first birth) and the second-birth hospital, as measured by the distance between zipcode centroids in miles. Outcomes in columns (6)-(9) stand for the number of staffed obstetric beds, a binary indicator for whether the hospital is controlled by investors, the log of average daily gross patient revenues, and the log of average daily gross revenues from labor and delivery services respectively. * significant at 10%, ** significant at 5%, *** significant at 1%.

Appendix

Figure A1: Timing of Birth and Procedure



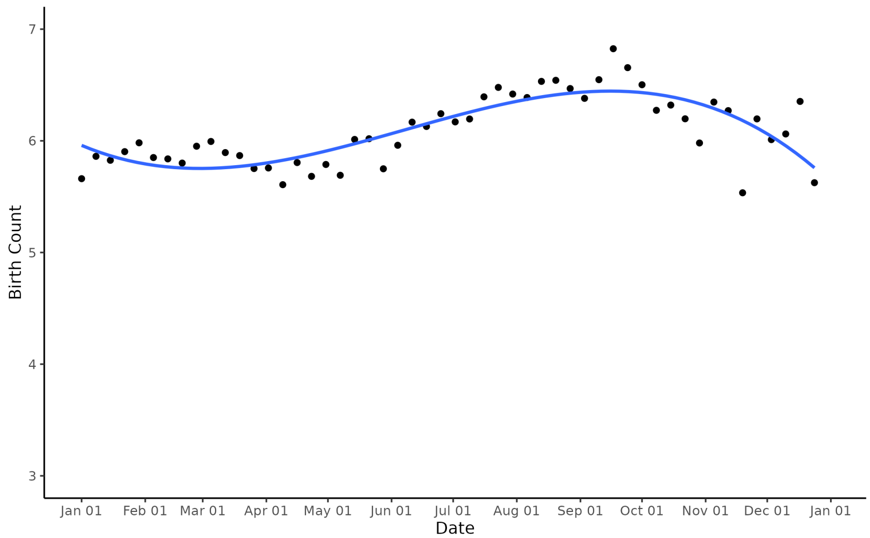
(a) Birth



(b) C-section

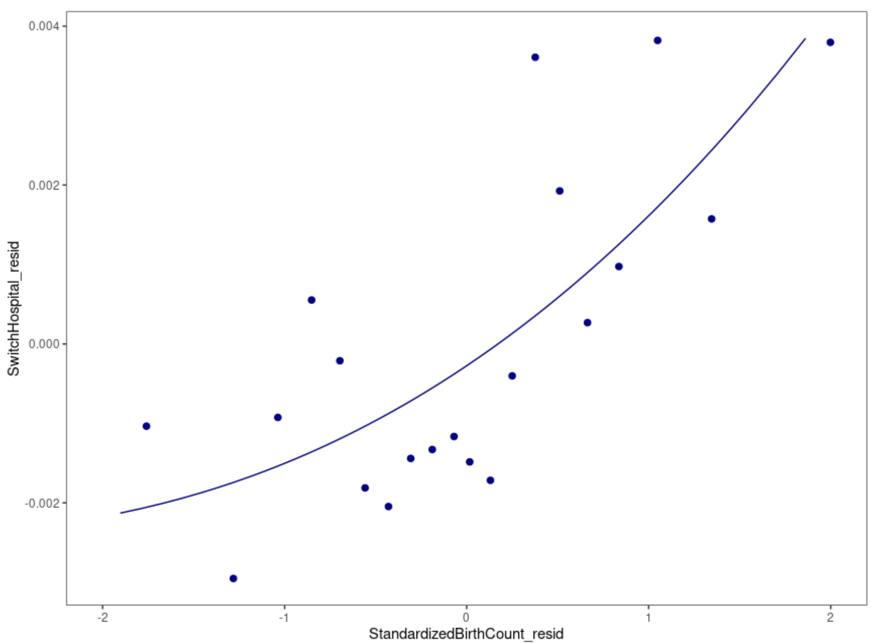
Notes: In this figure, we use California birth records from 2017 and plot the birth or procedure frequency against timing within a calendar day.

Figure A2: Distribution of Births within the year of 2007



Notes: In this figure, a dot represents the weekly average of daily births per hospital within the year of 2007. The blue curve is fitted with a third-order polynomial.

Figure A3: Effect of Standardized Birth Count on Switching Hospital



Notes: We restrict to mothers whose first and second birth are both observed in the birth records. We plot the relationship between the standardized birth count and the outcome of switching hospital, after absorbing the fixed effects and controlling for the variables as specified in Equation 2. We also add a fitted line for their relationship.

Table A1: Summary Statistics: Birth Count at Hospital-Day Level

Variables	Min.	Median	Mean	Max.
Total Mother Count	0	4	5.056	80
Non-Hispanic White Mother Count	0	1	1.800	33
Non-Hispanic Black Mother Count	0	0	0.310	15
Hispanic Mother Count	0	1	2.432	75
Other Mother Count	0	0	0.700	21
Total Birth Count	0	4	5.129	80
Standard Deviation of Birth Count	0.0	2.1	2.135	8.1
Standardized Birth Count (Quarter; main specification)	-3.5	-0.1	0.000	7.9
Standardized Birth Count (Month)	-3.5	-0.1	0.000	4.6
Standardized Birth Count (w/ weekends)	-3.8	-0.1	0.000	9.4
Standardized Mother Count	-3.7	-0.1	0.000	7.9
Standardized Birth Count (2-day Average)	-4.2	-0.1	0.000	9.4
Standardized Birth Count ($\leq$ 15 Miles from Mother's Residence)	-4.0	0.0	0.000	9.4

Notes: The data source is California birth record data from 1989 to 2017. This table shows the summary statistics of variables at the hospital-day level, except for the standard deviation of birth count (at the hospital-year-quarter level), and the standardized birth count based on births within 15 miles of the mother's residence (at the zipcode-day level).

Table A2: Balance Test on First-time Mothers - Non-Singleton Births

		Dependent Variable: Standardized Birth Count	
Variable Name	Mean	Coefficient	S.E.
Mother's Age	30.02	0.0009	(0.0008)
Mother is Hispanic	0.27	0.0095	(0.0126)
Mother is Black	0.06	0.0149	(0.0195)
$\geq$ High School	0.90	0.0205	(0.0017)
$\geq$ College	0.47	-0.0123	(0.0109)
Uses Medi-Cal	0.22	-0.0361	(0.0176)
F-statistic of joint F-test		1.091	
p-value of joint F-test		0.367	

Notes: We restrict the sample to mothers in our dataset who have no reported previous births and are giving birth to non-singletons (twins, triplets, etc.). We regress the birth count measure on all the control variables presented in this table. In the regression, we include hospital-quarter, day-of-week, and hour-of-birth fixed effects.

Table A3: Effect of Standardized Birth Count on Procedure Use and Future Fertility by Quartile

	(1)	(2)	(3)	(4)	(5)
Panel A: Medical Procedure Usage among First-time Mothers					
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural Anesthesia
Std. Birth Count	-0.0026***	-0.0001	-0.0006	-0.0022***	-0.0010
	(0.0006)	(0.0006)	(0.0005)	(0.0005)	(0.0009)
Std. Birth Count × 4th Quartile	0.00001	-0.0021**	-0.0039***	-0.0003	-0.0043***
	(0.0009)	(0.0008)	(0.0007)	(0.0006)	(0.0012)
Std. Birth Count × 3rd Quartile	-0.0008	-0.0044***	-0.0045***	0.0009	-0.0074***
	(0.0017)	(0.0015)	(0.0014)	(0.0013)	(0.0023)
Std. Birth Count × 2nd Quartile	0.0011	-0.0009	-0.0002	-0.0012	-0.0041**
	(0.0015)	(0.0015)	(0.0010)	(0.0011)	(0.0020)
Observations	3,923,045	1,704,185	3,923,045	3,923,045	1,565,839
Dependent Mean	0.2913	0.0753	0.1436	0.1604	0.6173
Adjusted R^2	0.0791	0.1024	0.1400	0.2232	0.4673

	(6)	(7)	(8)	(9)
Panel B: Subsequent Fertility within 2 or 5 Years after First Birth				
	Any, 2 Years	Total, 2 Years	Any, 5 Years	Total, 5 Years
Std. Birth Count	-0.0008	-0.0008	-0.0011	-0.0012
	(0.0005)	(0.0005)	(0.0009)	(0.0012)
Std. Birth Count × 4th Quartile	0.0013*	0.0012*	0.0015	0.0015
	(0.0007)	(0.0007)	(0.0012)	(0.0015)
Std. Birth Count × 3rd Quartile	0.0042***	0.0041***	0.0034	0.0039
	(0.0015)	(0.0015)	(0.0023)	(0.0030)
Std. Birth Count × 2nd Quartile	-0.00003	-0.0001	-0.0016	-0.0022
	(0.0013)	(0.0013)	(0.0018)	(0.0022)
Observations	3,343,453	3,343,453	3,343,453	3,343,453
Dependent Mean	0.1570	0.1577	0.4710	0.5402
Adjusted R^2	0.0111	0.0112	0.0542	0.0479

Notes: In panel A, we restrict the sample to first births from 1989 to 2017. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. In panel B, we restrict the sample to first births from 1989 to 2012. We additionally include interaction terms between standardized birth count and the three quartile indicators for overcrowding level in these regressions. We exclude weekends and holidays. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A4: Effect of Standardized Birth Count on Medical Procedure Usage

Panel A: All Likely Unscheduled Births				
	(1)	(2)	(3)	(4)
	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0012***	-0.0049***	-0.0025***	-0.0060***
	(0.0001)	(0.0003)	(0.0002)	(0.0004)
Observations	3,175,029	7,723,624	7,723,624	2,908,154
Dependent Mean	0.0555	0.1372	0.1488	0.5246
Adjusted R^2	0.0659	0.1573	0.2327	0.3829
Panel B: Likely Unscheduled First-time Births				
	(5)	(7)	(7)	(8)
	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0022***	-0.0036***	-0.0028***	-0.0048***
	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Observations	1,272,336	2,908,072	2,908,072	1,170,898
Dependent Mean	0.1008	0.1491	0.1822	0.6199
Adjusted R^2	0.1166	0.1552	0.2474	0.4326

Notes: In this table, we focus on likely unscheduled births, consisting of vaginal births and C-section births after labor trial. In panel B, we additionally restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A5: Heterogeneous Effect of Standardized Birth Count on Medical Procedure Usage

Panel A: By Race and Ethnicity					
	(1)	(2)	(3)	(4)	(5)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Std. Birth Count	-0.0017***	-0.0021***	-0.0009**	-0.0039***	-0.0020***
	(0.0005)	(0.0004)	(0.0004)	(0.0004)	(0.0006)
Std. Birth Count × Non-Hispanic Black	-0.0012	0.0024**	-0.0025***	0.0021***	-0.0031**
	(0.0010)	(0.0010)	(0.0007)	(0.0007)	(0.0014)
Std. Birth Count × Hispanic	-0.0009	0.0005	-0.0018***	0.0011**	-0.0035***
	(0.0006)	(0.0005)	(0.0005)	(0.0005)	(0.0008)
Std. Birth Count × Others	-0.0026***	0.0008	-0.0092***	0.0054***	-0.0029***
	(0.0009)	(0.0006)	(0.0008)	(0.0006)	(0.0011)
Observations	3,923,045	1,704,185	3,923,045	3,923,045	1,565,839
Dependent Mean	0.2913	0.0753	0.1436	0.1604	0.6173
Adjusted R^2	0.0791	0.1024	0.1401	0.2233	0.4673
Panel B: By Socioeconomic Deprivation of Counties					
	(6)	(7)	(8)	(9)	(10)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Std. Birth Count	-0.0027***	-0.0017***	-0.0032***	-0.0028***	-0.0054***
	(0.0007)	(0.0005)	(0.0006)	(0.0006)	(0.0015)
Std. Birth Count × Less Deprived	-0.0019**	-0.0008	-0.0009	0.0001	0.0019
	(0.0010)	(0.0009)	(0.0009)	(0.0008)	(0.0022)
Observations	955,926	280,055	955,926	955,926	142,385
Dependent Mean	0.2961	0.063	0.1382	0.1435	0.4426
Adjusted R^2	0.0770	0.1023	0.1604	0.2407	0.4933

Notes: In this table, we restrict the sample to mothers in our dataset who have no reported previous births. In Panel A, the baseline is white non-Hispanic mothers. In Panel B, we restrict to mothers with first birth between 2000 and 2009 and a Californian county of residence. The socioeconomic deprivation measure for counties is based on the CDC/ATSDR Social Vulnerability Index (SVI) for year 2000, and a lower index value implies less deprivation. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2 with additional interaction terms as presented. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A6: Heterogeneous Effect of Standardized Birth Count on Medical Procedure Usage

	(11)	(12)	(13)	(14)	(15)
Panel C: By Medi-Cal Usage					
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Std. Birth Count	-0.0029***	-0.0018***	-0.0035***	-0.0025***	-0.0036***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0005)
Std. Birth Count × Medi-Cal	0.0008*	0.0005	0.0007	0.00002	-0.0014*
	(0.0005)	(0.0004)	(0.0004)	(0.0004)	(0.0007)
Observations	3,923,045	1,704,185	3,923,045	3,923,045	1,565,839
Dependent Mean	0.2913	0.0753	0.1436	0.1604	0.6173
Adjusted R^2	0.0791	0.1024	0.1400	0.2232	0.4673

	(16)	(17)	(18)	(19)	(20)
Panel D: By College Education Status					
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Std. Birth Count	-0.0023***	-0.0015***	-0.0033***	-0.0027***	-0.0047***
	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0005)
Std. Birth Count × College	-0.0010*	-0.0003	0.0003	0.0007	0.0015**
	(0.0006)	(0.0004)	(0.0004)	(0.0004)	(0.0006)
Observations	3,923,045	1,704,185	3,923,045	3,923,045	1,565,839
Dependent Mean	0.2913	0.0753	0.1436	0.1604	0.6173
Adjusted R^2	0.0791	0.1024	0.1400	0.2232	0.4673

Notes: In this table, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2 with additional interaction terms as presented. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A7: Heterogeneous Effect of Standardized Birth Count on Total Fertility with 5 Years

Panel A: By Race and Ethnicity of Mother				
	(1)	(2)	(3)	(4)
	Non-Hispanic White	Non-Hispanic Black	Hispanic	Others
Standardized Birth Count	-0.00001	-0.0007	-0.0008	0.0003
	(0.0005)	(0.0018)	(0.0005)	(0.0008)
Observations	1,299,181	193,078	1,359,546	492,013
Dependent Mean	0.5614	0.4331	0.5430	0.5185
Adjusted R^2	0.0789	0.0432	0.0274	0.0521

Panel B: By Socioeconomic Deprivation of Counties			
	(5)	(6)	(7)
	All Counties	Below Median Counties	Above Median Counties
Standardized Birth Count	-0.0003	-0.0006	-0.0001
	(0.0007)	(0.0009)	(0.0010)
Observations	878,593	427,095	451,498
Dependent Mean	0.5576	0.5637	0.5511
Adjusted R^2	0.0532	0.0616	0.0463

Notes: In this table, we restrict the sample to first births from 1989 to 2012. In Panel B, we additionally restrict to mothers with first birth between 2000 and 2009 and a Californian county of residence. The socioeconomic deprivation measure for counties is based on the CDC/ATSDR Social Vulnerability Index (SVI) for year 2000, and a lower index value implies less deprivation. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the heterogeneity results from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A8: Heterogeneous Effect of Standardized Birth Count on Total Fertility with 5 Years

Panel C: By Medi-Cal Usage		
	(8)	(9)
	Medi-Cal Mothers	Non Medi-Cal Mothers
Standardized Birth Count	-0.0008	-0.0001
	(0.0006)	(0.0004)
Observations	1,256,336	2,087,117
Dependent Mean	0.5173	0.5540
Adjusted R^2	0.0296	0.0638
Panel D: By College Education Status		
	(10)	(11)
	Mothers w/ a College Degree	Mothers w/o a College Degree
Standardized Birth Count	0.0012**	-0.0008**
	(0.0006)	(0.0004)
Observations	939,787	2,403,666
Dependent Mean	0.5908	0.5204
Adjusted R^2	0.0965	0.0328

Notes: In this table, we restrict the sample to first births from 1989 to 2012. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A9: Heterogeneous Effect of Standardized Birth Count on Switching Place of Birth

	Panel A: By Race of Mother			
	(1)	(2)	(3)	(4)
	Non-Hispanic White	Non-Hispanic Black	Hispanic	Others
Standardized Birth Count	0.0024***	0.0008	0.0018***	0.0021**
	(0.0005)	(0.0019)	(0.0006)	(0.0009)
Observations	808,468	105,706	882,129	301,173
Dependent Mean	0.3598	0.5136	0.4639	0.3780
Adjusted R^2	0.1199	0.0993	0.1141	0.1031

	Panel B: By Socioeconomic Deprivation of Counties		
	(5)	(6)	(7)
	All Counties	Below Median Counties	Above Median Counties
Standardized Birth Count	0.0017**	0.0022**	0.0009
	(0.0007)	(0.0010)	(0.0010)
Observations	527,026	252,300	274,726
Dependent Mean	0.3911	0.4129	0.3674
Adjusted R^2	0.1020	0.0956	0.1092

Notes: We restrict the sample to mothers whose first and second births are both observed in our dataset. In Panel B, we additionally restrict to mothers with first birth between 2000 and 2009 and a Californian county of residence. The socioeconomic deprivation measure for counties is based on the CDC/ATSDR Social Vulnerability Index (SVI) for year 2000, and a lower index value implies less deprivation. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the heterogeneity results from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A10: Heterogeneous Effect of Standardized Birth Count on Switching Place of Birth

Panel C: By Medi-Cal Usage		
	(8)	(9)
	Medi-Cal Mothers	non Medi-Cal Mothers
Standardized Birth Count	0.0020***	0.0021***
	(0.0006)	(0.0004)
Observations	780,766	1,316,710
Dependent Mean	0.4880	0.3701
Adjusted R^2	0.1180	0.1071

Panel D: By College Education Status		
	(10)	(11)
	Mothers w/ a College Degree	Mothers w/o a College Degree
Standardized Birth Count	0.0025***	0.0018***
	(0.0006)	(0.0004)
Observations	613,914	1,483,562
Dependent Mean	0.3156	0.4547
Adjusted R^2	0.0989	0.1067

Notes: We restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the heterogeneity results from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A11: Effect of Standardized Birth Count on Future Fertility and Hospital Choice, Second-birth Sample

	(1)	(2)	(3)	(4)	(5)	(5)
	Fertility after 2 Years		Fertility after 5 Years		Second Birth	
	Any	Total	Any	Total	Switched the Place of Birth	Switched to non-Hospital
Standardized Birth Count	0.0001 (0.0002)	0.0001 (0.0002)	-0.00002 (0.0003)	-0.00004 (0.0003)	0.0007 (0.0004)	-0.00002 (0.0001)
Observations	2,931,841	2,931,841	2,931,841	2,931,841	1,165,878	1,165,878
Dependent Mean	0.0945	0.0951	0.2748	0.3138	0.4458	0.0040
Adjusted R^2	0.0193	0.0194	0.0569	0.0610	0.0942	0.0025

Notes: This table restricts the sample to second births from 1989 to 2012. The independent variable is the standardized birth count within the same hospital in the same year-quarter. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. We exclude weekends and holidays. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A12: Racial Interaction Effects on Switching Hospital

	Dep Var: Switched Hospital			
	(1)	(2)	(3)	(4)
	Non-Hispanic White	Non-Hispanic Black	Hispanic	Others
Standardized Birth Count	0.0034**	−0.0018	0.0003	0.0003
	(0.0015)	(0.0025)	(0.0016)	(0.0017)
Own Racial Percent	−0.0052	0.0152	0.0020	0.0042
	(0.0032)	(0.0156)	(0.0038)	(0.0063)
Std. Birth Count × Own Racial Percent	−0.0034	0.0093	0.0022	0.0055
	(0.0023)	(0.0067)	(0.0022)	(0.0042)
Observations	711,921	93,334	774,017	258,099
Dependent Mean	0.3556	0.5089	0.4627	0.3719
Adjusted R^2	0.1231	0.1001	0.1159	0.1054

Notes: In this table, we restrict the sample to mothers in our dataset who have no reported previous births. The independent variable is the standardized birth count within the same hospital in the same year-quarter. Own Racial Percent measures the share of the corresponding race within the same hospital on the same day. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A13: Robustness Check on Medical Procedure Usage - No Demographic Covariates

	Panel A: All Births				
	(1)	(2)	(3)	(4)	(5)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0016***	-0.0009***	-0.0040***	-0.0021***	-0.0049***
	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0003)
Observations	10,906,333	4,774,169	10,906,333	10,906,333	4,383,169
Dependent Mean	0.2911	0.0385	0.1172	0.1222	0.5493
Adjusted R^2	0.0836	0.0521	0.1247	0.1940	0.4183
	Panel B: First-time Births				
	(6)	(7)	(8)	(9)	(10)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0026***	-0.0016***	-0.0032***	-0.0026***	-0.0041***
	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0004)
Observations	4,026,797	1,779,285	4,026,797	4,026,797	1,636,651
Dependent Mean	0.2918	0.0751	0.1439	0.1601	0.6194
Adjusted R^2	0.0490	0.0982	0.1392	0.2224	0.4672

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2, but only include a binary indicator for plurality births and the set of fixed effects as covariates. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A14: Robustness Check on Future Fertility and Hospital Choice - No Demographic Covariates

	(1)	(2)	(3)	(4)	(5)	(6)
	Fertility after 2 Years		Fertility after 5 Years		Second Birth	
	Any	Total	Any	Total	Switched the Place of Birth	Switched to non-Hospital
Standardized Birth Count	0.00004	0.0001	-0.0003	-0.0004	0.0022***	0.0002***
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.00005)
Observations	3,364,928	3,364,928	3,364,928	3,364,928	2,138,956	2,138,956
Dependent Mean	0.1588	0.1595	0.4754	0.5451	0.4123	0.0047
Adjusted R^2	0.0064	0.0064	0.0252	0.0220	0.1018	0.0074

Notes: Columns (1)-(4) restrict the sample to first births from 1989 to 2012. Column (5) and (6) restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized birth count within the same hospital in the same year-quarter. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. We exclude weekends and holidays. We only include a binary indicator for plurality births and the set of fixed effects as covariates. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A15: Robustness Check on Medical Procedure Usage - Standardization by Month

	(1) All C-sections	(2) C-section after Labor Trial	(3) Labor Induction	(4) Labor Augmentation	(5) Epidural
Panel A: All Births					
Standardized Birth Count	-0.0016***	-0.0008***	-0.0038***	-0.0020***	-0.0050***
	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0003)
Observations	10,638,777	4,584,561	10,638,777	10,638,777	4,204,034
Dependent Mean	0.2904	0.0384	0.117	0.1225	0.5461
Adjusted R^2	0.0993	0.0550	0.1294	0.1996	0.4262
Panel B: First-time Births					
	(6) All C-sections	(7) C-section after Labor Trial	(8) Labor Induction	(9) Labor Augmentation	(10) Epidural
Standardized Birth Count	-0.0025***	-0.0015***	-0.0029***	-0.0024***	-0.0041***
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)
Observations	3,923,044	1,704,185	3,923,044	3,923,044	1,565,839
Dependent Mean	0.2913	0.0753	0.1436	0.1604	0.6173
Adjusted R^2	0.0794	0.1067	0.1441	0.2274	0.4730

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-month. We exclude weekends and holidays. We exclude weekends and holidays. We use hospital-year-month FE in this specification. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A16: Robustness Check on Future Fertility and Hospital Choice - Standardization by Month

	(1)	(2)	(3)	(4)	(5)	(6)
	Fertility after 2 Years		Fertility after 5 Years		Second Birth	
	Any	Total	Any	Total	Switched the Place of Birth	Switched to non-Hospital
Standardized Birth Count	0.00003	0.00004	-0.0002	-0.0003	0.0018***	0.0002**
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.0001)
Observations	3,294,993	3,294,993	3,294,993	3,294,993	2,097,474	2,097,474
Dependent Mean	0.1588	0.1595	0.4754	0.5451	0.4149	0.0047
Adjusted R^2	0.0087	0.0087	0.0433	0.0390	0.1147	0.0137

Notes: Columns (1)-(4) restrict the sample to first births from 1989 to 2012. Column (5) and (6) restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized birth count within the same hospital in the same year-month. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. We exclude weekends and holidays. We use hospital-year-month FE in this specification. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A17: Robustness Check on Medical Procedure Usage - Standardized Mother Count

	Panel A: All Births				
	(1)	(2)	(3)	(4)	(5)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Mother Count	-0.0015***	-0.0008***	-0.0040***	-0.0021***	-0.0049***
	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0003)
Observations	10,638,784	4,584,564	10,638,784	10,638,784	4,204,037
Dependent Mean	0.2904	0.0384	0.117	0.1225	0.5461
Adjusted R^2	0.0990	0.0529	0.1262	0.1961	0.4219
	Panel B: First-time Births				
	(6)	(7)	(8)	(9)	(10)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Mother Count	-0.0026***	-0.0016***	-0.0032***	-0.0025***	-0.0041***
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)
Observations	3,923,045	1,704,185	3,923,045	3,923,045	1,565,839
Dependent Mean	0.2913	0.0753	0.1436	0.1604	0.6173
Adjusted R^2	0.0791	0.1024	0.1400	0.2232	0.4673

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized mother count within the same hospital in the same year-quarter. We exclude weekends and holidays. We exclude weekends and holidays. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A18: Robustness Check on Future Fertility and Hospital Choice - Standardized Mother Count

	(1)	(2)	(3)	(4)	(5)	(6)
	Fertility after 2 Years		Fertility after 5 Years		Second Birth	
	Any	Total	Any	Total	Switched the Place of Birth	Switched to non-Hospital
Standardized Mother Count	0.00003	0.00005	-0.0002	-0.0003	0.0020***	0.0002***
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.00005)
Observations	3,294,994	3,294,994	3,294,994	3,294,994	2,097,475	2,097,475
Dependent Mean	0.1588	0.1595	0.4754	0.5451	0.4149	0.0103
Adjusted R^2	0.0087	0.0087	0.0433	0.0389	0.1148	0.0080

Notes: Columns (1)-(4) restrict the sample to first births from 1989 to 2012. Column (5) and (6) restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized mother count within the same hospital in the same year-month. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. We exclude weekends and holidays. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A19: Effect of Standardized Birth Count on Medical Procedure Usage - Including Weekends

	(1)	(2)	(3)	(4)	(5)
Panel A: All Births					
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0005**	-0.0008***	-0.0028***	-0.0028***	-0.0049***
	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0004)
Observations	13,947,221	5,977,019	13,947,221	13,947,221	5,483,873
Dependent Mean	0.2701	0.0394	0.1121	0.1267	0.5445
Adjusted R^2	0.0901	0.0526	0.1202	0.1980	0.4129
Panel B: First-time Births					
	(6)	(7)	(8)	(9)	(10)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0016***	-0.0015***	-0.0020***	-0.0033***	-0.0039***
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)
Observations	5,273,850	2,291,641	5,273,850	5,273,850	2,106,762
Dependent Mean	0.2797	0.0753	0.1378	0.1643	0.6183
Adjusted R^2	0.0749	0.1003	0.1345	0.2253	0.4617

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-quarter. We exclude holiday births but include weekend births. We present the results on medical procedures used from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A20: Robustness Check on Future Fertility and Hospital Choice - Including Weekends

	(1)	(2)	(3)	(4)	(5)	(6)
	Fertility after 2 Years		Fertility after 5 Years		Second Birth	
	Any	Total	Any	Total	Switched the Place of Birth	Switched to non-Hospital
Standardized Birth Count	0.0001	0.0001	-0.0001	-0.0002	0.0018***	0.0002***
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)
Observations	4,421,468	4,421,468	4,421,468	4,421,468	2,820,462	2,820,462
Dependent Mean	0.1585	0.1592	0.4739	0.5433	0.4111	0.0103
Adjusted R^2	0.0086	0.0086	0.0423	0.0378	0.1146	0.0076

Notes: Columns (1)-(4) restrict the sample to first births from 1989 to 2012. Column (5) and (6) restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized birth count within the same hospital in the same year-quarter. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. We exclude first births on holidays but include those on weekends. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A21: Effect of Standardized Birth Count on Medical Procedure Usage - 2-day Average Birth Count

Panel A: All Births

	(1) All C-sections	(2) C-section after Labor Trial	(3) Labor Induction	(4) Labor Augmentation	(5) Epidural
Standardized Birth Count	-0.00001	-0.0011***	-0.0045***	-0.0021***	-0.0046***
	(0.0002)	(0.0001)	(0.0003)	(0.0002)	(0.0004)
Observations	8,440,234	3,639,732	8,440,234	8,440,234	3,334,162
Dependent Mean	0.2887	0.0391	0.1224	0.1223	0.5456
Adjusted R^2	0.0962	0.0537	0.1279	0.1965	0.4215

Panel B: First-time Births

	(6) All C-sections	(7) C-section after Labor Trial	(8) Labor Induction	(9) Labor Augmentation	(10) Epidural
Standardized Birth Count	-0.0009***	-0.0018***	-0.0047***	-0.0020***	-0.0040***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Observations	3,138,813	1,368,220	3,138,813	3,138,813	1,256,178
Dependent Mean	0.2933	0.0761	0.1509	0.1589	0.6169
Adjusted R^2	0.0781	0.1039	0.1426	0.2224	0.4689

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count within the same hospital in the same year-quarter based on the average number of births on the mother's day of delivery and the day before. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A22: Robustness Check on Future Fertility and Hospital Choice - 2-day Average Birth Count

	(1)	(2)	(3)	(4)	(5)	(6)
	Fertility after 2 Years		Fertility after 5 Years		Second Birth	
	Any	Total	Any	Total	Switched the Place of Birth	Switched to non-Hospital
Standardized Birth Count	0.0004	0.0001	-0.0003	-0.0003	0.0020***	0.0002***
	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0004)	(0.0001)
Observations	2,635,648	2,635,648	2,635,648	2,635,648	1,677,611	1,677,611
Dependent Mean	0.1588	0.1595	0.4754	0.5451	0.4149	0.0047
Adjusted R^2	0.0087	0.0087	0.0434	0.0389	0.1145	0.0083

Notes: Columns (1)-(4) restrict the sample to first births from 1989 to 2012. Column (5) and (6) restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized birth count within the same hospital in the same year-quarter based on the average number of births on the mother's day of delivery and the day before. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. We exclude weekends and holidays. We use hospital-year-month FE in this specification. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A23: Effect of Standardized Birth Count on Medical Procedure Usage - Regional Level Measure

	(1)	(2)	(3)	(4)	(5)
Panel A: All Births					
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0001	-0.0002**	-0.0011***	-0.0011***	-0.0016***
	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0003)
Observations	10,063,386	4,354,477	10,063,386	10,063,386	3,991,415
Dependent Mean	0.2907	0.0384	0.1178	0.1234	0.5511
Adjusted R^2	0.0989	0.0530	0.1266	0.1969	0.4213
Panel B: First-time Births					
	(6)	(7)	(8)	(9)	(10)
	All C-sections	C-section after Labor Trial	Labor Induction	Labor Augmentation	Epidural
Standardized Birth Count	-0.0001	-0.0002	-0.0005**	-0.0012***	-0.0010***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0004)
Observations	3,726,029	1,627,833	3,726,029	3,726,029	1,495,221
Dependent Mean	0.2921	0.0751	0.1445	0.1616	0.6218
Adjusted R^2	0.0795	0.1022	0.1405	0.2235	0.4677

Notes: In panel B, we restrict the sample to mothers in our dataset who have no reported previous births. Information on C-section after labor trial has been available since 2005, and information on epidural has been available since 2006. The independent variable is the standardized birth count based on total daily births at all hospitals within 15 miles of the mother's residence in the same year-quarter. We exclude weekends and holidays. We present the results on medical procedures used from Equation 2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A24: Robustness Check on Future Fertility and Hospital Choice - Regional Level Measure

	(1)	(2)	(3)	(4)	(5)	(6)
	Fertility after 2 Years		Fertility after 5 Years		Second Birth	
	Any	Total	Any	Total	Switched the Place of Birth	Switched to non-Hospital
Standardized Birth Count	0.0002	0.0002	-0.0001	-0.0001	0.0015***	0.0002***
	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0004)	(0.0001)
Observations	2,493,772	2,493,772	2,493,772	2,493,772	1,511,196	1,511,196
Dependent Mean	0.1588	0.1595	0.4754	0.5451	0.4123	0.0047
Adjusted R^2	0.0085	0.0085	0.0412	0.0370	0.1199	0.0065

Notes: Columns (1)-(4) restrict the sample to first births from 1989 to 2012. Column (5) and (6) restrict the sample to mothers whose first and second births are both observed in our dataset. The independent variable is the standardized birth count based on total daily births at all hospitals within 15 miles of the mother's residence in the same year-quarter. Switching a place of birth includes switching to another hospital or to a non-hospital setting. Switching to non-hospital means either the mother gave birth at home or at a birth center. We exclude weekends and holidays. We only include a binary indicator for plurality births and the set of fixed effects as covariates. * significant at 10%, ** significant at 5%, *** significant at 1%.