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Does Physician Pay Affect Procedure Choice and Patient Health? Evidence from Medicaid C-section Use

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Abstract

I investigate the relationship between physician pay, C-section use, and infant health, using vital statistics data and newly collected data on Medicaid payments to physicians. First, I confirm past results—when Medicaid pays doctors relatively more for C-sections, they perform them more often. I bolster the causal interpretation of this result by showing that salaried doctors do not respond to this pay differential, and by using a much larger sample of states and years. Second, unlike past work, I look at how changing physician pay affects infant health outcomes. I find that increased C-section use is associated with fewer infant deaths for births likely covered by Medicaid, suggesting that C-section rates may be too low for some groups. Taken together, these findings suggest that policies aimed at decreasing costs by lowering procedure use may have adverse health consequences, especially for low-income patients.
(JEL I11, I13, I18)

Attempts to lower the cost of health care often focus on unnecessary procedures as an important source of waste. C-sections are usually at the top of any such list, for two main reasons. First, C-sections are intrinsically important when thinking about costs. They are not only more expensive on average than vaginal births, but also are the most commonly performed operating room procedures in the US (Healthcare Cost and Utilization Project, 2012). Second, the costs and benefits of C-sections vary widely across patients, giving doctors a lot of discretion over C-section use and making it difficult to know whether a C-section was necessary. In addition, doctors are generally paid more for performing C-sections than vaginal births. Thus, it is theorized that the combination of financial incentives and difficulty in monitoring leads to higher than necessary C-section rates. Policy discussions about C-sections therefore typically revolve around how to incentivize doctors to perform fewer C-sections—the assumption being that changing the incentives would both lower costs and increase population health by removing unnecessary procedures. The Center for Healthcare Quality and Payment Reform (a national health care policy organization) sums up the sentiment: "nobody wants to cut spending [...] if it's going to harm mothers or babies, but there is at least one aspect of maternity care that's not only expensive but bad for both mothers and babies, and that's the high rate of Cesarean sections" [CHQPR, 2013]. There does not exist evidence, however, to back up this sanguine view.

While there is a growing literature that explores how doctors respond to financial incentives over procedure choice (Hadley et al., 2001; Yip, 1998; Coey, 2013), with many papers looking specifically at C-sections (Gruber and Owings, 1996; Gruber et al., 1999; Grant, 2009; Keeler and Folk, 1996), few link the changes in physician pay to health outcomes. In one of the most credibly identified recent papers looking at the impact of payment on medical treatment, Clemens and Gottlieb (2014) estimate small health impacts of changing financial incentives for physicians, "albeit with limited precision". The lack of evidence on the effect of payment policy on health outcomes is a large gap in this literature. Decreasing costs is an important policy goal, but policymakers presumably wish to consider patient health as well.

In this paper, I look at the effect of Medicaid payment incentives for C-sections on procedure choice and infant health. My main data are U.S. vital statistics records on all births in the US, from 1990-2008. A well known limitation of this data is the lack of information on insurer at birth. I address this by using the 2012 vital statistics data, which does report insurance coverage at birth, to predict which mothers are covered by Medicaid at birth during my sample period.

I first show that as in Gruber et al. (1999), physicians' procedure choices respond to how much more they are paid to perform a C-section than a vaginal birth (the "pay differential"). One concern about work using variation in pay to identify changes in physician behavior is that payment changes may reflect changes in population health or needs; if true, the association between pay and procedure use would not be causal. To support the argument that changes in the pay difference are indeed driving procedures, I show that the Medicaid pay difference does not affect the behavior of salaried doctors, who by definition are not paid per procedure.

Next, I demonstrate that increases in the Medicaid pay difference are also associated with *decreases* in infant death rates for fee-for-service doctors (but, again, not for salaried doctors). Contrary to conventional wisdom, the infant health results suggest that C-section rates among Medicaid women may actually be too low. This interpretation is consistent with the fact that the primary C-section rate for women predicted to be on Medicaid is approximately 30 percent lower than that of women predicted to be on private insurance, despite Medicaid women being in worse average health (for the remainder of the paper, I call women predicted to be on Medicaid (privately insured) "Medicaid (privately insured) women" for brevity).[1] Thus, policies targeting "unnecessary C-sections" in the Medicaid population may not only be misplaced, but harmful.

The main variation in physician pay comes from changes in how much more each state's Medicaid program paid for a C-section than a vaginal birth in a given year, from 1990-

[1]The primary C-section rate refers to C-sections performed on women who have not had a previous C-section.

2008.[2] Previous work using Medicaid reimbursement rates has relied upon secondary sources for just a small sample of states and years, as Medicaid rates are not compiled centrally. However, a long panel is necessary to detect effects on a low frequency outcome such as infant death. Therefore, one contribution of this paper is the collection of reliable historical rate information from each state's Medicaid office.[3] Both raw reimbursement rates and the pay differential increase and decrease over the time period (1990−2008). There is no evidence that these changes in pay differentials are correlated with average population health or local economic conditions. Thus, the variation the pay difference is plausibly exogenous to the question of C-section use and infant health.

The pay differential is positively associated with the decision to perform a C-section, confirming Gruber et al. (1999) on a larger sample of states and years. In counties with large Medicaid populations, a $100 increase in the pay difference is associated with a four percent increase increase in the probability of a C-section for women on Medicaid. The association between the pay difference and the probability of C-section disappears for mothers on Medicaid who reside in a county with a salaried hospital, as expected if pay differences themselves (and not unobservable difference in patient health that may be correlated with pay difference) drive procedure choice. Similarly, the Medicaid pay difference does not affect C-section use among privately insured mothers. Finally, I show that the pay differential has no effect on procedure use in cases where medical guidelines limit discretion: women who have had a previous C-section. Thus, the association between the pay difference and C-section use is unique to women on Medicaid with no previous C-section, whose doctors actually face the measured pay differential when making decisions.

Infant death rates, on the other hand, go down among births covered by Medicaid when the pay difference between procedures goes up. Again, there is no association between infant death rates and the pay difference for Medicaid births in counties with a salaried hospital,

[2] A complete list of which states and years are used is reported in Table A.1. Not all states were able to give out historical reimbursement rate data, and some states did not have records going all the way back to the start of the sample period.

[3] These data are posted on my website: http://scholar.princeton.edu/dalexand

nor for the privately insured. The increase in C-section use is associated with an increase in infant health for births covered by Medicaid—calling into question the idea that C-section rates in the US are too high, at least for this important subgroup. Instead, the positive association between C-section use and infant health in the Medicaid population suggests that C-section rates may be too low for these women, and that not disincentivizing the procedure for these mothers could actually improve infant health.

The positive association between the pay differential and infant health is much larger for Medicaid women with ex ante high-risk pregnancies (pregnancies with risk factors listed on the birth certificate; a list of the conditions used is included in the data appendix). These pregnancies include the majority of pregnancies where C-sections are medically indicated. Thus, it appears that there are many Medicaid women not receiving a C-section for whom the benefits of the procedure outweigh the costs. When doctors are paid relatively more for C-sections, these mothers do receive C-sections, which results in improvements in infant health. Unfortunately, I have no information on the health of the mother, so I do not see the complete picture of how changes in incentives to perform C-sections affect health.[4] Still, the results imply that lowering procedure use for all mothers has the potential to adversely affect health outcomes, especially for low-income populations. That C-sections are seen as overused in the general population does not necessarily imply that they are overused for all groups. Trying to save money for Medicaid by discouraging these types of procedures could backfire, if Medicaid enrollees on the margin have a higher benefit for the procedure than the population average.

Despite the fact that the primary C-section rate for Medicaid women is already lower than that of the privately insured, the current political rhetoric is that Medicaid programs can save money by further reducing C-section use. The Southern Legislative Council, for example, argues that Medicaid programs can save a substantial amount of money through policies that

[4]While maternal mortality rates can be constructed using vital statistics mortality files, maternal death in childbirth in the US is extremely rare. The more salient health concern for mothers considering a C-section is postnatal morbidity. As I do not know a good way to measure childbirth related morbidity, I leave this question to future research.

discourage unnecessary C-sections. The Council specifically mentions equalizing Medicaid payments for C-sections and vaginal birth as a popular and lucrative solution.[5] While there is evidence that some C-sections performed in the US are unnecessary (Johnson and Rehavi, 2013; Currie and MacLeod, 2013, 2008), and it is true that Medicaid pays for almost half of all US births (see Figure 1), it does not follow that dis-incentivizing the use of C-sections for women on Medicaid will either save money or improve health outcomes. In fact, I show that equalizing Medicaid payments across birth procedures does decrease the use of C-sections, but at a very high cost: increasing the probability of infant death.

The rest of the paper is organized as follows. Sections 1 and 2 lay out the conceptual framework and the data, respectively. Section 3 describes the empirical strategy, which makes use of state-time variation in the Medicaid pay differential. Section 4 discusses the relationship between physician pay, C-section use and infant health. For Medicaid mothers seen by fee-for-service doctors, the pay difference is positively correlated with the probability of receiving a C-section, and is negatively correlated with infant death. In order to see which mothers benefit from high pay differentials, I differentiate between women with low risk and high risk pregnancies. Using this distinction, I examine the associations between the pay differential and infant outcomes: infant death, birth weight, gestational age, and the number of prenatal visits. Section 5 concludes.

I. CONCEPTUAL FRAMEWORK

The intuition of this paper is straightforward—when doctors choose whether or not to perform a C-section, the relevant price is how much more they are paid for a C-section compared to a vaginal birth. To further establish the relationship between the pay difference and C-section use for fee-for-service doctors, I compare them to doctors paid a flat salary, who would not be expected to respond to the pay difference.

A formal model is included in the Appendix, which is a simple extension of that in Gruber

[5] https://www.slcatlanta.org/QoM/qom.php?post_id=130

et al. (1999). In the model, the pay difference is the relevant variable influencing procedure choice, and under a salaried regime, this pay difference is zero. If many doctors are performing C-sections in marginal cases because they are more profitable than the alternative, then either a decrease in the pay difference or being salaried should lead to lower use of the procedure.[6] The model predicts that the probability of C-section is increasing in the pay difference in fee-for-service hospitals, while in salaried hospitals it is constant over the pay differential.

If all infants born in counties with a salaried hospital were in fact born at that hospital, then I could run the regression

$$\begin{aligned} Csection_{ict} = {} & \beta_0 + \beta_1 Pay\,Difference_{st} + \beta_2 Pay\,Difference_{st} * Salaried\,Hosp_{ct} \\ & + \beta_3 Salaried\,Hospital_{ct} + \epsilon_{ict}, \end{aligned} \tag{1}$$

where i indicates that the variable is defined at the individual level, c at the county level, s at the state level, and t that the variable is time varying. I would expect β_1 to be positive—doctors at fee-for-service hospitals increase procedure use in response to increases in the relative reimbursement rate. Likewise, I would predict that the fee difference would have no effect on doctors in salaried counties: $\beta_1 + \beta_2 = 0$. Finally, the model implies that all else being equal, the procedure choices of salaried doctors and fee-for-service doctors will be the same: $\beta_3 = 0$.

In the real world, however, many counties with a salaried hospital also have at least one other hospital. According to survey data from the American Hospital Association, in the

[6] The statement that being salaried should lead to lower procedure use assumes that the substitution effect dominates the income effect. Conversely, if the income effect dominates, the fact that doctors are more wealthy due to the increased pay difference will lead to a decrease in C-sections; inducement will go down. Previous empirical studies have found that increasing relative reimbursement for intensive procedures increases their use (Gruber et al., 1999; Hadley et al., 2001; Grant, 2009). I follow these studies and assume that the substitution effect does in fact dominate: an increase in the pay difference will lead to an increase in the use of C-sections.

year 2000, on average 43 percent of births in counties with a salaried hospital occur in that hospital. The fact that I do not know the exact hospital of birth introduces noise, which weakens the physician level predictions. I still expect that $\beta_1 > 0$, $\beta_2 < 0$, and $\beta_3 = 0$. In the data, however, β_1 and β_2 may not exactly offset, as some infants born in counties with a salaried hospital are born elsewhere.

II. DATA

Studying the link between physician pay, procedure choice, and patient health is difficult primarily because of the scarcity of data. To remedy this problem, I combine data from several sources: vital statistics data on births and infant deaths, survey data about hospitals, and newly collected data on Medicaid pay rates. As Medicaid is administered at the state level, it provides a rich source of variation in physician pay. Unfortunately, data on Medicaid pay rates are not collected centrally. One contribution of this paper, therefore, is the compilation of reliable rate information. Unlike the Medicaid payment data used in other papers, which are built up from a combination of secondary sources, the payment data used in this paper is constructed from primary sources obtained by reaching out to each state's Medicaid office.[7] I use these new data to build upon previous work, which was not able to look at health effects.

II.A. *Vital Statistics Data*

The primary data sources are the National Vital Statistics System's linked birth and infant death records, which record all infant births and deaths in the US, from $1990-1991$ and and $1995 - 2008$ (the linked files were not created in $1992 - 1994$). All outcome variables used

[7] Gruber et al. (1999) used HCUP data from nine states (CA, CO, FL, IL, IA, MA, NJ, WA) from 1988–1992. Their data on payment came from secondary sources stitched together: for 1988 and 1992, they used data from by the American College of Obstetricians and Gynecologists (ACOG); for 1989 and to supplement missing values in 1988, the Physician Payment Review Commission; for 1990, Holahan (1993) supplemented with information from ACOG; for 1991, from Singh et al. (1993).

in this analysis originate in the vital statistics data: C-section use, infant and pregnancy characteristics, and infant death. In addition, the natality data include county and month of birth, as well as detailed demographic and medical risk factors associated with the mother, infant, and birth event. These variables allow me to control for individual characteristics which may be correlated with place of birth and birth procedure.

The main analysis sample includes only women who have not had a previous C-section—whose doctors are choosing between a first C-section or a vaginal birth (these women could have had other births, as long as they never had a C-section). This sample restriction is important, as doctors have much more discretion over procedure choice when contemplating a first C-section. Rates of vaginal birth after Cesarean (VBAC) are very low in the US (MacDorman et al. (2011) reports that in 2007, the US VBAC rate was just 8.3 percent), and doctors have long followed the rule of thumb that "once a Cesarean, always a Cesarean". This recommendation has been heavily criticized in recent years, but was closely followed over much of the sample period. In addition, because of the high risk of serious complications for women who have undergone a previous C-section, it is unlikely that the Medicaid pay differential would influence a doctor's decision in the case of repeat C-sections. For all of these reasons, I expect the pay difference to impact physician behavior for primary C-sections only, and will use mothers who had previous C-sections only in placebo tests.

As the identification strategy uses Medicaid pay differentials, it is important to determine which mothers are covered by Medicaid at the time of birth. Unfortunately, the vital statistics data do not include insurer over the study period. However, insurance coverage information was added in the most recent natality files for some states. I use these new data to predict Medicaid coverage for my sample of mothers. This prediction is quite good; the pseudo R^2 is 0.300 (details on this exercise can be found in the data appendix). I call mothers whose predicted probability of Medicaid coverage are in the top third "high predicted Medicaid mothers", and use this group as my preferred sample. "Low predicted Medicaid mothers" are those whose predicted probability of Medicaid coverage are in the bottom third, and are used throughout the analysis as a placebo group.

The main health measure used to study how C-section use affects infant health is infant survival, as death is an unambiguously bad outcome. My preferred measure is whether the infant survived to the first birthday, though I also look at the probability of death over different time horizons. Birth weight is also often used as a measure of infant health; low birth weight (less than 2500 grams) is associated with a range of poor outcomes, both health related and economic, such as schooling and earnings (Black et al., 2007). As the pay differential impacts only the type of birth and not the overall health of the infant pre-birth, however, there should be no effect on birth weight—except for a mechanical decrease due to C-sections being scheduled slightly before vaginal birth would occur, or an increase due to fluid in the lungs, which is expelled during a vaginal delivery but not a C-section.[8]

Finally, the sample is restricted to singleton births that occurred inside a hospital, in the 50 states and Washington, DC. Territories and protectorates of the US have very different public health insurance programs, and the incentives studied do not apply. Multiple births are also dropped from the analysis, as they are much more likely to develop complications that require delivery via Cesarean section (the C-section rate for twins was 75% in 2008) (Lee et al., 2011).

II.B. *Physician Reimbursement Data*

The second data source contains Medicaid reimbursement rates for obstetric procedures at the state-month level, from 1990 – 2008 (the exact date range depends on the state). As Medicaid reimbursement rates are not collected centrally, the rate data was obtained directly from each state's Medicaid office. While some states were unable to provide this information, I was able to collect data on 36 states plus Washington, D.C., which cover approximately 85 percent of the population (details on which states and years are used are provided in Table

[8]Approximately 35 mL of fluid is expelled from an infant's lungs during a vaginal delivery. In the first few hours of life, infants born by C-section at term have overall lung volumes similar to those born by vaginal delivery, but the liquid volume is increased and the gaseous component decreased (Milner et al., 1978).

A.1).[9] Over the study period, states varied both in reimbursement levels, as well as in how frequently the rates were changed; some states' payments change at least once a year, and others only change once or twice over the sample period (see Table 1 for means).

As discussed in Section 2, the relevant choice variable for physicians deciding to perform a C-section is the pay differential—how much more they are paid for a C-section than a vaginal birth. This variable is constructed as the difference between amounts paid to doctors by Medicaid for these two procedures (details of the construction of the pay differential can be found in the data appendix).[10] Figure 2 plots the Medicaid pay differential for each state, over time. Payment schedules vary widely from state to state, with the rates and the pay difference both increasing and decreasing over the eighteen year period. On January 1st, 2000, reimbursement rates for a C-section with postpartum care ranged from less than \$600 or less in California, New Jersey, and Michigan to \$1,200 or more in Georgia, Arizona, Nevada, and Alaska. On the same date, the payment difference ranged from \$0 in Michigan and Montana to \$370.80 in Minnesota and \$410.72 in Nebraska. Table 1 reports summary statistics of these payment variables across states and time periods. My maintained assumption is that the timing of changes in these pay rates—and especially the differences between them—reflect the idiosyncratic politics of each state, rather than the preferences of legislators over C-section use.

Finally, an important institutional detail of the Medicaid program is the role of Medicaid Managed Care. States have flexibility not just with respect to Medicaid generosity, but also in how to administer the benefit. Over the past few decades, an increasing number of states have opted to contract with health maintenance organizations (HMOs) and other managed care organizations (MCOs) to provide care for part or all of their Medicaid recipients (Duggan and Hayford, 2013). In states and time periods where a large fraction of Medicaid recipients are covered by managed care organizations, the details of the Medicaid fee schedule—which

[9] The raw data on reimbursement rates is available for download on my website: http://scholar.princeton.edu/dalexand

[10] As a placebo test, I also look at women with previous C-sections; in these regressions, the pay difference is between C-sections and vaginal birth after Cesarean (VBAC).

mainly applies to traditional fee-for-service Medicaid—should have less of an impact.[11] To verify that the effect of pay difference on procedure choice is stronger when MCOs are less active, I will examine how the impact of the pay differential on C-section use varies with respect to state-level use of managed care.

II.C. *Hospital Data*

The final data source is the American Hospital Association (AHA) annual survey, which contains information on whether counties contain government-run hospitals. The key distinction is between hospitals controlled by the federal government and other hospitals, because doctors employed by the government are salaried, while most others are paid fee-for-service.[12,13] In contrast to the doctors working under a fee-for-service regime, the salary structure of doctors employed by the government is based on promotions and years of service, rather than the number of procedures performed (for more information on the pay of federally employed doctors, see Table A.3). The AHA data let me use salaried doctors as a comparison group when looking at the effect of the pay differential on C-section use. The federally controlled hospitals with non-zero births are Air Force, Army, Navy and Indian Health Service hospitals—hospitals with no births recorded are not counted (Figure 3 shows the locations of these hospitals).

The Medicaid pay differential described in the previous section only applies to mothers

[11] One large category of managed care also uses the Medicaid fee schedule to reimburse doctors: Primary Care Case Management (PCCM). In PCCM, a primary care provider is paid a small monthly case management fee in return for monitoring the care of Medicaid beneficiaries. This fee is in addition to fee-for-service reimbursement for treatment (Sekunda et al., 2001).

[12] It is difficult to find direct evidence on the prevalence of fee-for-service compensation, but the Community Tracking Survey (2008) supports this characterization. Among obstetricians/gynecologists who admitted a patient to a hospital in the last year, 73% report either being paid for performance (mostly based on factors reflecting "own productivity"), for their share of practice billings, or are solo practitioners. Additionally, 63% are independent contractors or full or part owners of their practice. While the sample size is small (N=284), the survey supports the importance of fee-for-service reimbursements for the typical obstetrician/gynecologist.

[13] Kaiser Permanente, a large integrated managed care consortium, also uses a salaried incentive scheme rather than fee-for-service. However, all Kaiser hospitals are located in densely populated counties where they account for only a very small fraction of births per year, and thus cannot be studied using the framework of this paper.

covered by Medicaid. Doctors treating mothers covered by private insurance face a different pay difference, which I cannot observe. Therefore, I need to be able to target my analysis towards women covered by Medicaid at the time of birth. In order to focus on the Medicaid population, I use two complementary approaches. As described previously, I use recent data on Medicaid coverage at birth to predict the likelihood of Medicaid coverage for the full sample. In addition, I construct an index of Medicaid intensity at the county level using American Hospital Association data on the number of Medicaid discharges per hospital.

The county-level "Medicaid intensity" index is constructed by dividing the number of Medicaid discharges by the total number of hospital beds, and averaging the ratio over the sample period. I expect that doctors with many Medicaid patients should be more sensitive to the pay difference than doctors who primarily deliver privately insured mothers. Alternatively, this index may identify counties where there is less error in the Medicaid prediction equation. Either way, the index captures the geographic concentration of Medicaid recipients, and is used to identify counties where the Medicaid pay differential is predicted to have an especially large impact.

The hospital level is collapsed to the county-year level, and merged into the vital statistics files. In the combined data, whether a federally controlled (salaried) hospital existed in the county and year of birth is known for all births in the sample. A drawback to this strategy is that the exact hospital of birth for infants born in counties with more than one hospital is not known. I am limited by the data to studying the impact of having a salaried hospital in the county and year of birth, rather than being born in a salaried hospital. This data limitation, however, should bias me against finding a difference between counties which do and do not contain a salaried hospital.

III. WHEN SHOULD A C-SECTION BE PERFORMED?

C-sections are generally used when pregnancy complications make traditional vaginal birth difficult, or when vaginal birth puts the mother or child in danger. While not necessary in the majority of deliveries, C-sections are lifesaving for both mother and infant in many situations. The most common reasons given for primary C-section in the US are arrest of labor, abnormal or indeterminate fetal heart rate tracing, fetal malpresentation, multiple gestation, and suspected fetal macrosomia; over half of all C-sections are indicated by the top two categories: arrest of labor, and abnormal fetal heart rate tracing (Barber et al., 2011).

The primary C-section rate of women predicted to be on Medicaid is much lower than for women predicted to be privately insured. Should we expect fewer C-sections to be performed on women on Medicaid, due to differences in medical conditions or demographics? Birth certificates do not record the most common indications for C-section in the US: arrest of labor and abnormal fetal heart rate. However, many health and behavioral characteristics recorded on the birth certificate are related to C-section use (Table 2, Panel A).

Women predicted to be covered by Medicaid in my sample tend to have riskier and less healthy pregnancies along many dimensions, as is shown in Table 2. Pregnancies of women predicted to be on Medicaid display higher rates of fetal distress (meconium staining) than those predicted to be covered by private insurance. In addition, these women are over four times as likely to smoke during pregnancy than those predicted to be privately insured. Smoking is associated with problems involving the placenta, such as an increased risk of placenta previa, a condition requiring C-section. Not surprisingly, women predicted to be on Medicaid are also more likely to have acute or chronic lung disease; pulmonary conditions, if poorly controlled, can also adversely affect pregnancy. On the other hand, women predicted to be on Medicaid are younger than their privately insured counterparts. Hence, they have lower incidence of medical risk factors associated with age, such as chronic hypertension, diabetes, and breech birth.

Using 2012 natality data which reports the insurer, I find that the primary C-section rate of women on Medicaid is three to four percentage points (approximately fifteen percent) lower than that of privately insured women, depending on the specification. Table 3 reports regressions comparing C-section use between those recorded to be on Medicaid and private insurance, and then between Medicaid plus the self-insured and private insurance. Self-insured births are combined with Medicaid births in the second set of regressions, as many of these births are likely ultimately covered by Medicaid; the socioeconomic status of self-insured women is similar to that of those covered by Medicaid, and hospitals often sign up Medicaid eligible women at the time of birth (Heberlein et al., 2011).[14] As shown in Table 3, the gap in primary C-section use between those on Medicaid versus private insurance use remains nearly unchanged when controls are added for demographic characteristics, medical risk factors, and state, month, and day of the week fixed effects. Thus, there does not appear to be a medical reason for the lower C-section rates rates among women covered by Medicaid than those that are privately insured.

While significant in both my main data (1990-2008) and the 2012 natality data, the gap in C-section use between women on Medicaid and the privately insured is larger in the earlier data. It could be true that the gap in C-section use between mothers on Medicaid and the privately insured has gotten smaller over time—perhaps as C-sections have become more common, doctors have become more likely to perform them on Medicaid patients. However, these two datasets are difficult to directly compare. For example, their sample composition is different; the states with data on the pay differential are a different group than those using the revised birth certificate in 2012, which are included in Table 3. In addition, the cut off in predicted probability of Medicaid coverage used to divide the main sample is fairly arbitrary. No matter how the data is cut, however, there is strong support for the fact that women on Medicaid are less likely to receive a C-section than those that are privately insured—and

[14]In 1986, presumptive eligibility in Medicaid was established as a state option to improve access to timely care for uninsured pregnant women (Section 1920 of the Social Security Act, 42 U.S.C. 1396r-1). Hospitals, doctors, and pharmacies are paid for the services they provide during this temporary coverage period, even if an individual does not complete the full application (Families USA,2011)

that this is not explained by differences in underlying health or demographic factors.

IV. EMPIRICAL STRATEGY

A linear probability model is used to measure the impact of the Medicaid pay differential on C-section use and infant health. In the main specification, I compare the effect of changing pay differentials on outcomes in counties with and without salaried hospitals, for mothers predicted to be on Medicaid. For robustness, and to show that the results are not spurious, I repeat the analysis on mothers predicted to be privately insured. The main explanatory variables are the pay differential between C-section and vaginal birth, $Pay\,Difference_{st}$, an indicator for whether the county contained a salaried hospital at the time of birth, $Salaried\,Hospital_{ct}$, and their interaction $Pay\,Difference_{st} * Salaried\,Hosp_{ct}$. The outcome is first whether a C-section was performed, and later infant survival—during the neonatal period, which is most closely related to birth outcomes, or to the standard one-year threshold.

$$\begin{aligned} Outcome_{ict} = {} & \beta_0 + \beta_1 Pay\,Difference_{st} + \beta_2 Pay\,Difference_{st} * Salaried\,Hosp_{ct} \\ & + \beta_3 Salaried\,Hospital_{ct} + \beta_4 X_{ict} + \lambda_s + \gamma_{year} + \epsilon_{ict} \end{aligned} \tag{2}$$

Here, i, c, and s indicate that the variables are defined at the individual, county, and state level, respectively, and t that the variable is time varying. Many individual characteristics are also controlled for in X_{ist}: the mother's age, race, marital status and education, health and delivery complications, birth parity, and the weekday of birth. In addition, full sets of state and year fixed effects are included, λ_s and γ_{year}, as unobserved factors impacting delivery and prenatal health may differ between states or over time. Finally, to allow for arbitrary correlation of errors within counties, the standard errors are clustered at the county level.[15]

After establishing the link between the pay differential, procedure choice, and infant health, I examine which births benefit from high pay differentials. I focus on births which occurred in fee-for-service hospitals, and differentiate between ex ante low and high risk pregnancies. As high risk pregnancies are where C-sections are usually indicated, finding a larger effect on these pregnancies would be consistent with a story where doctors respond to increased financial incentives for C-sections by performing them on women who were previously just below the C-section threshold. In this analysis, various infant health outcomes are regressed on the pay difference, a dummy for a high risk pregnancy, and their interaction, along with patient level covariates and state and year fixed effects. I run the following regression,

$$\begin{aligned} Health\,Outcome_{ict} = {} & \beta_0 + \beta_1 Pay\,Difference_{st} + \beta_2 Pay\,Difference_{st} * high\,risk_{ict} \\ & + \beta_3 high\,risk + \beta_4 X_{ict} + \lambda_s + \gamma_{year} + \epsilon_{ict}. \end{aligned} \tag{3}$$

where the notation and covariates in X_{ict} are the same as above. The health outcomes are indicators for infant death and neonatal death. In order to investigate any potential effect of the fee differential on access to care, I also look at the number of prenatal visits. I follow previous literature and define a pregnancy as high risk if at least one of risk factor is noted on the birth certificate. Due to changes in recording over time, the group of complications used differs slightly across the sample (details can be found in the data appendix). The results, however, are robust to only using the set of complications that I can observe in all years.

The richness of the vital statistics data lets me control for the fact that women giving

[15] The results are nearly identical if I instead cluster the standard errors at the state level. I choose to cluster at the county level because the number of states in my sample is 36 plus Washington D.C., which falls below the rule of thumb of 50 clusters being the approximate lower bound to avoid the problems associated with too few clusters (Cameron and Miller, 2015).

birth in areas with particular Medicaid pay differences or types of hospitals may differ from the norm along other observable dimensions. As shown in 2, Panel B, women who give birth in counties with and without salaried hospitals are fairly similar along observable dimensions, with a few caveats. For example, mothers who give birth in counties with a salaried hospital are more likely to be Hispanic or Native American. The higher percentage of Native American mothers is to be expected, as some of the federal hospitals are run by the Indian Health Service. Mothers in counties with federal government-controlled hospitals are also slightly healthier, which may be explained by them being a bit younger on average. In the regression analysis, I control for all demographic and health characteristics reported in Table 2.

The above empirical strategy has two main limitations: neither the exact insurance coverage nor the hospital type at birth is known for the majority of the sample. I address the first issue by predicting Medicaid coverage using the most recent natality file, which includes the insurance status of the birth. The second weakness—that the exact hospital of birth in counties with more than one hospital is not known—is more difficult to address. However, the lack of individual level data on hospital type will bias my results towards finding no difference between counties with and without salaried hospitals. Since I do find a difference between these groups, I believe this particular data limitation is less of a concern. However, I cannot disprove a story where counties with a salaried hospital are different along some unobservable dimension, which also causes doctors not to respond to the pay differential.

In both specifications, I differentiate between women who are predicted to be on Medicaid and those who are not, as well as two subsamples: counties with few Obstetrician-Gynecologists (Ob-Gyns) per capita, and counties with a high density of Medicaid coverage. I focus on Medicaid mothers as their pregnancies are "treated" with the pay difference; mothers predicted to have private coverage are always shown for comparison. Counties which are underserved by Ob-Gyns are used to examine the role of capacity constraints in the decision to perform a C-section. If capacity constraints play an important role, increases in C-section rates for Medicaid mothers would be accompanied by decreases in C-section rates for other mothers—and this offset effect would be the largest in areas where providers are scarce. If capacity constraints are not important, however, C-section rates for Medicaid mothers could increase without a corresponding decrease in C-section rates for other mothers. Finally, I look at counties with a high density Medicaid coverage. If having more Medicaid patients makes the pay difference more salient for doctors, the effect of the pay difference on procedure use should be largest in these counties. Alternatively, my ability to predict which mothers are on Medicaid may be better in counties with high Medicaid density; if true, this would also predict finding larger effects in these counties.

Following Gruber et al. (1999), I assume that changes in pay difference over time are exogenous. The exogeneity assumption seems reasonable, as changes in reimbursement rates likely come from state legislators making decisions unrelated to the specific procedure choice of C-sections versus vaginal births. And furthermore, the timing of adoption is idiosyncratic; for example, the timing of legislation is often constrained by features of the legislature. One potential concern is that states reduce Medicaid payment rates in order to balance budgets during recessions. If reimbursements were high during good times, and economic conditions are correlated with health or C-section preferences, the estimates could be biased.[16] As the identification strategy hinges on the difference in pay between C-sections and vaginal birth, rather than the levels of reimbursement, this concern is less of an issue. Still, a relationship between payment reductions and economic conditions could be a problem if states cut Medicaid payment rates differentially for C-sections in response to the business cycle. My results, however, are robust to controlling for state-level unemployment, both contemporaneous and lagged.[17] Therefore, the relationship between the fee differences and local economic conditions does not appear to be a serious concern. Another issue raised

[16]Whether health is pro- or countercyclical is a debate that is outside the scope of this paper; for a discussion see Ruhm (2000) and Dehejia and Lleras-Muney (2004), among others.

[17]Not only are the main coefficients unchanged, but the coefficients on the unemployment variables are not statistically significant.

in Gruber et al. (1999) is that a deterioration in fetal or maternal health that gave rise to more C-sections could also cause state policymakers to increase the pay differential. They address this possibility by including variables which control for the riskiness of the birth in their regressions, and find that it does not affect their estimates. Following these authors, an indicator for high-risk pregnancies is included in all regressions.

V. RESULTS

V.A. *Impact of Pay Difference on Procedure Choice*

Consistent with Gruber et al. (1999), I find a positive correlation between the Medicaid fee difference and C-section use. Figure 4 shows this relationship graphically for the state of Arkansas. Arkansas is an ideal state to demonstrate the relationship between the fee difference and the C-section rate, for two reasons. First, the fee difference changed only once over the time period, making the pre- and post- comparisons straightforward. Second, the Medicaid pay difference is very relevant in Arkansas, as all doctors treating Medicaid patients are reimbursed on a fee-for-service basis.[18] Figure 4 plots the residuals from the following regression of C-section use on year fixed effects for Arkansas,

$$C\text{-}section_{ict} = \beta_0 + \gamma_{year} + \epsilon_{ict} \tag{4}$$

as well as the fee differential. The regression residuals are shown, rather than the average C-section rate, because the secular trends in C-section use over the last two decades swamp the changes in procedure use associated with the pay differential. After the pay differential drops in April of 2004, there is a corresponding drop in the regression residuals – the model goes from over-predicting the probability of C-section to under-predicting it. Furthermore,

[18] The only type of Medicaid Managed Care used for medical coverage in Arkansas is Primary Care Case Management (in place since 1994), which uses a fee-for-service payment structure. Risk-based capitation reimbursement is only used for non-emergency transportation.

this drop only appears for women predicted to be on Medicaid (on the left), and not for women predicted to be privately insured (on the right).

More specifically, fee-for-service doctors respond to high pay differences by increasing the use of C-sections. For all women who are predicted to be covered by Medicaid at birth, I find that the payment variables are the expected sign, but are not statistically significant (Table 4, Column 1). When I narrow the sample to counties with high density of Medicaid coverage, however, I find much larger and significant effects. I expect doctors to be particularly affected by the pay differential when a large fraction of their patients are insured by Medicaid, and this is born out by the data. As shown in Column 2, women on Medicaid in high Medicaid counties are 0.6 percentage points more likely to have a C-section when the pay differential increases by $100. This translates to a four percent increase in the probability of C-section for these women. In addition, as can be seen in Column 4, there are no analogous results for women predicted not to be on Medicaid.

In counties with low Ob-Gyn to population ratios (Columns 3 and 6), the results are less precisely estimated, but similar to those found in high Medicaid counties—suggesting that there are no offsetting effects on privately insured mothers. There is no evidence that providers decrease the use of C-sections for privately insured mothers in order to increase them for Medicaid mothers. This suggests that capacity constraints are not binding in the choice to perform a C-section, and cannot explain the lower baseline C-section rates for Medicaid women. The similarities in effect size between the low provider and high Medicaid counties is a pattern that will be repeated through out all the results. While there is some overlap between these two groups, they are not the same. Over half the mothers in low provider counties do not reside in a "high Medicaid density" county. The Ob-Gyn to population ratio is negatively correlated with Medicaid density, however, which likely explains why the effect sizes are larger than average in underserved areas.

As predicted, the C-section rate of Medicaid women at salaried hospitals is not responsive to the pay differential. The lack of response in salaried hospitals shows up in Table 4 as a negative and roughly offsetting coefficient on the interaction term between the pay difference and being in a salaried hospital in Columns 1-3; the effect of the pay difference rate on salaried doctors is the sum of the coefficients on pay difference and the interaction of the pay difference with hospital type. Again, as can be seen in Columns 4-6, there are no analogous results for women predicted not to be on Medicaid. The lack of response of salaried doctors suggests that the results for fee-for-service doctors reflect a true effect of the pay differential on procedure choice.

When the pay difference between procedures is zero, patients of salaried and fee-for-service doctors are equally likely to receive a C-section. The coefficient on the indicator for a county having a federally controlled hospital in Columns 1-3 of Table 4 is not statistically different from zero. The lack of a main effect of having a salaried hospital on the probability C-section indicates that the regression model is successful in controlling for population differences between mothers living in counties with and with out a salaried hospital.

As a placebo check, the above analysis is repeated on women who have had a previous C-section; doctors have less discretion over procedure choice in these pregnancies.[19] As expected, there is no effect of the pay differential on procedure choice for these women. These results are reported in Table A.4. Not only does the effect of compensation structure on procedure choice disappear when the outcome variable is a repeat C-section, but no pattern emerges related to prevalence of Medicaid coverage. This null result again supports the interpretation that Columns 1-3 of Table 4 reflect a causal effect of the pay differential on C-section use.

Appendix Table A.6 shows that the effect of the pay difference on C-section use is higher in states with lower use of Medicaid Managed Care. In Appendix Table A.6, I stratify the sample by the fraction of Medicaid users enrolled in Medicaid Managed Care plans which reimburse doctors using capitation, as opposed to fee-for-service. In a capitated system, providers are paid a set amount for each enrollee assigned to them, per period of time,

[19] In these regressions, I use the pay differential between a C-section and vaginal birth after Cesarean (VBAC).

whether or not that person seeks care. The sample is divided into two groups: low and high use of capitation—based on the average fraction of Medicaid enrollees in Managed Care plans using capitation from 2003 (the earliest year of data available). While it is impossible to know how doctors in these managed care plans are actually paid, to the extent that it is not based on the Medicaid fee schedule, I expect to find weaker associations between the pay differential and C-section use in the states with high use of capitation. As can be seen in Table A.6, that is what I find, albeit with low precision. In addition, the appendix reports results of a permutation test where pay differential time series are randomly assigned to states (Figure A.2), and adding state-level linear time trends (Tables A.7 and A.8). The main results pass both of these additional robustness tests.

The results in Table 4 demonstrate that decreasing the fee difference by a modest amount could have an important impact on C-section use. As the exact insurance coverage and hospital of birth are unknown, these results are likely attenuated to due to measurement error. Despite the coarseness of the specification, the estimate that a \$100 increase in the fee difference is associated with a 4% increase in C-sections is non-negligible, and can be interpreted as a lower bound on the true effect.

V.B. *Impact of Pay Difference on Infant Health*

The above results suggest that policy makers can exert considerable influence over procedure choice by changing how doctors are paid. However, more information is needed to recommend such a policy. In the case of C-sections, as in the case of many procedures, the effect of reducing procedure use on health is theoretically ambiguous. Reducing C-section rates could improve health by eliminating medically unnecessary procedures; on the other hand, it could worsen health by reducing the rates below the optimum level.

In Table 5, I show that the increased C-section rates for Medicaid mothers associated with high pay differentials are actually beneficial to the health of their children. The regression specification is the same as in the previous section, except with infant death as the dependent variable. The pattern across Table 5 is the same as Table 4, but opposite in sign. There is no effect in the general population, but once again the results appear in counties with high Medicaid coverage and low provider ratios. Infant death *decreases* when the pay difference goes up; a \$100 increase in the pay differential is associated with a 0.0006 percentage point decrease in infant death—6% of the mean for women on Medicaid. For salaried doctors, an increase in the pay differential does not affect infant death, again shown by the offsetting positive coefficient on the interaction term. In Tables 5 and 6, I repeat the analysis looking separately at death in and after the neonatal period—which is seen as more closely tied to events surrounding birth than deaths occurring later in the first year. The results for neonatal death closely mirror those of infant death; the association between the pay differential and death after the neonatal period is both smaller and less precisely estimated.

The positive association between C-sections and infant health is somewhat surprising from the perspective of the medical and health economics literature (Baicker et al., 2006), which suggests that more C-sections are being performed in the US than are medically necessary. However, pregnant women on Medicaid are very different than those covered by private insurance. By definition these mothers are worse off financially, and as can be seen in Table 4, they have a much lower baseline probability of C-section. The primary C-section rate for mothers predicted to be on Medicaid is just two thirds of the rate of mothers predicted to be privately insured. While the rate for "all mothers" may be too high, the rate for Medicaid mothers may be too low, especially given that they also tend to be in worse health. Taking both these factors into account, it is not surprising that more C-sections are associated with better outcomes for this particular population.

That higher pay differentials are associated with both more C-sections and better infant health for Medicaid patients should give pause to policymakers intent on using payment incentives to lower costs. Any reform using incentives to change physician behavior must consider possible downstream effects on patient health. At least in the case of C-section use in the Medicaid population, reducing C-section rates seems to come with significant health costs for infants.

V.C. *Pathways between pay differential and infant health*

Finally, I investigate whether high pay differentials help all Medicaid mothers, or whether the benefits accrue to a particular group. I separate pregnancies into those considered ex ante high risk, and those that are not. As women with high-risk pregnancies would be the most likely to benefit from physicians performing C-sections at higher rates, I expect to find larger positive effects of high pay differentials on infant health among these women. I now estimate Equation 3, where an indicator for a high risk pregnancy is interacted with the pay differential. For both clarity and brevity, counties with salaried hospitals are dropped from this part of the analysis.

The benefits associated with high pay differentials do appear to be concentrated among women with high risk pregnancies. For women with at least one risk factor, a \$100 increase in the pay differential is associated with a -.0007 to $-.001$ percentage point decrease in the probability of infant death (see Table 8, Columns 1-3). As hypothesized, the effect of the pay differential is significantly larger for women with at least one recorded risk factor than for women with none. As death during the neonatal period (first 28 days) is considered to directly reflect prenatal, intrapartum, and neonatal care, in Table 9 I replicate the analysis for neonatal death, and find similar results. For comparison, Table 10 shows that the pay differential has much smaller estimated effects on infant deaths after the first 28 days.

Higher pay differentials are for the most part not associated with changes in birthweight or gestational age, as seen in Tables 11 and 12. The pay difference seems to be negatively correlated with birth weight for low-risk pregnancies, and positively correlated with birth weight for high-risk pregnancies, though the effects are generally not statistically significant. As previously discussed, C-section use could be mechanically related to birth weight; either positively due to retained liquid in the lungs, or negatively, due to shorter gestational age.[20]

[20] Approximately 35 mL of amniotic fluid is pushed from infants' lungs during vaginal birth. While this

Neither of these mechanical effects, however, seem to be very large.

There are at least two potential mechanisms linking increases in the pay difference to health outcomes: direct benefits of higher C-section rates, and indirect benefits derived from changes to the delivery of and access to healthcare. I find the first explanation to be more compelling, especially as primary C-section rates for Medicaid women are far below that of the privately insured. Still, it could also be the case that higher pay differences affect infant health indirectly—for example, by making Ob-Gyns more likely to take on Medicaid patients, which could affect the quality and quantity of care provided).[21] If true, increases in infant health would be correlated with—but not directly caused by—the increases in C-section rates. If increasing the Medicaid pay difference causes providers to increase the supply of services to the poor, we might expect the infant health gains to be particularly large in underserved areas. However, this is not the case; the pay difference always has a larger effect on outcomes in high Medicaid counties compared to low provider counties. On the other hand, higher pay differentials are associated with a small increase in the number of prenatal visits (see Table 13). While potentially supporting an access story, the effect on prenatal visits is both small in magnitude, and is larger for low-risk women than high-risk women—so it cannot explain the decrease in infant death.

Regardless of the particular mechanism driving the positive association between pay differentials and infant health, the above results do not necessarily imply that more C-sections should be performed, even for Medicaid women with high risk pregnancies. In this study, I was unable to take into account the increased health risks C-sections may bring to the mother, which could outweigh the benefits to infant health. The results do imply, however, that policies which try to control costs by lowering the use of procedures may be too heavy handed. Even for C-sections, a procedure widely considered overused, lowering the use of procedures by reducing financial incentives can come with important health costs. These

fluid is eventually cleared over the first six to twelve hours of life, its presence would lead to higher measured birth weight, on average.

[21] Currie et al. (1995), for example, found that increasing Medicaid physician fees relative to private fees makes Medicaid patients more attractive, and was associated with declines in the infant mortality rate.

results support the findings of Currie and MacLeod (2013)—that improvements in doctors' ability to diagnose when C-sections are indicated is likely better for health outcomes than reducing procedure use across the board. Diagnostic improvements could result in better outcomes for both high- and low-risk pregnancies, while simple payment reforms could lead to worse health outcomes for some groups, as shown here.

VI. CONCLUSION

In hospitals where doctors are paid under a fee-for-service system, the more doctors are paid for a C-section relative a vaginal birth, the more likely they are to perform C-sections. In salaried hospitals, where the pay incentives to order more intensive procedures are eliminated, I find no effect of the pay difference on procedure use and lower C-section rates. This result alone could imply that many C-sections are due to the compensation structure, and a salaried system would eliminate perverse incentives and unnecessary surgeries. After demonstrating that the supply of C-sections is influenced by financial incentives, however, I find that higher pay differentials are associated not just with a higher probability of C-section, but with *better* health outcomes for high-risk Medicaid pregnancies. C-sections are widely considered to be overused—yet for marginal patients on Medicaid, there are measurable benefits for infant health from increasing their use.

In order to make a policy recommendation, however, it is necessary to have evidence on the effect of increasing C-section use on both maternal and infant health. Unfortunately, due to data limitations, I cannot look at how changing C-section use affects the health of Medicaid mothers. Furthermore, the main maternal health effects of C-sections lie in morbidity rather than mortality (maternal mortality rates in the US are very low), which is difficult to see in the data. Learning more about how C-section use affects maternal morbidity for women on Medicaid is a useful avenue for future research, and would allow for a cost-benefit analysis of changing C-section use for women on Medicaid.

Disincentivizing C-section use is associated with worse health for infants whose births are covered by Medicaid. This finding is an important indication that care must be taken when using financial incentives as a tool to change physician behavior. Reducing procedure use may have unintended consequences for patient health, which are likely to fall disproportionately on already vulnerable segments of the population. These potential side effects of cost control policy should be taken into account when considering any changes to physician compensation.

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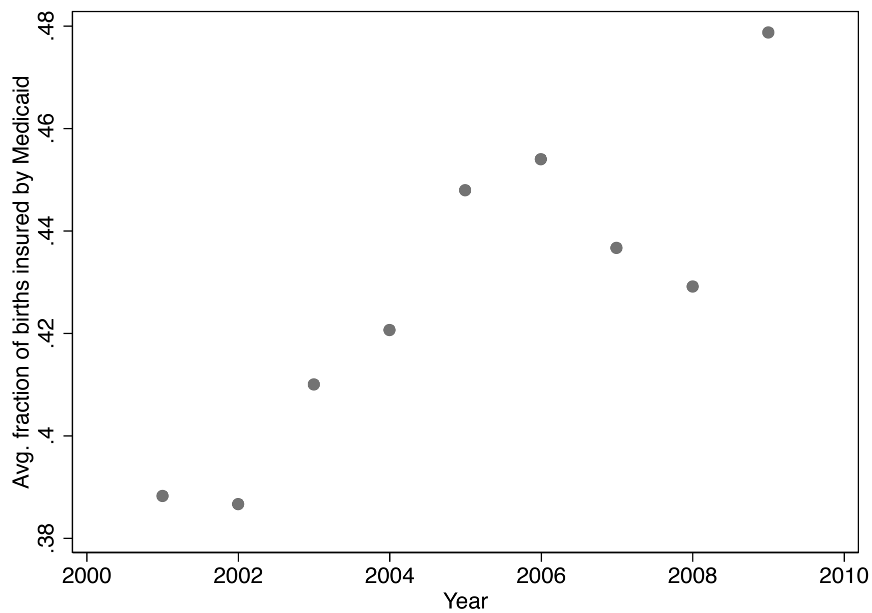
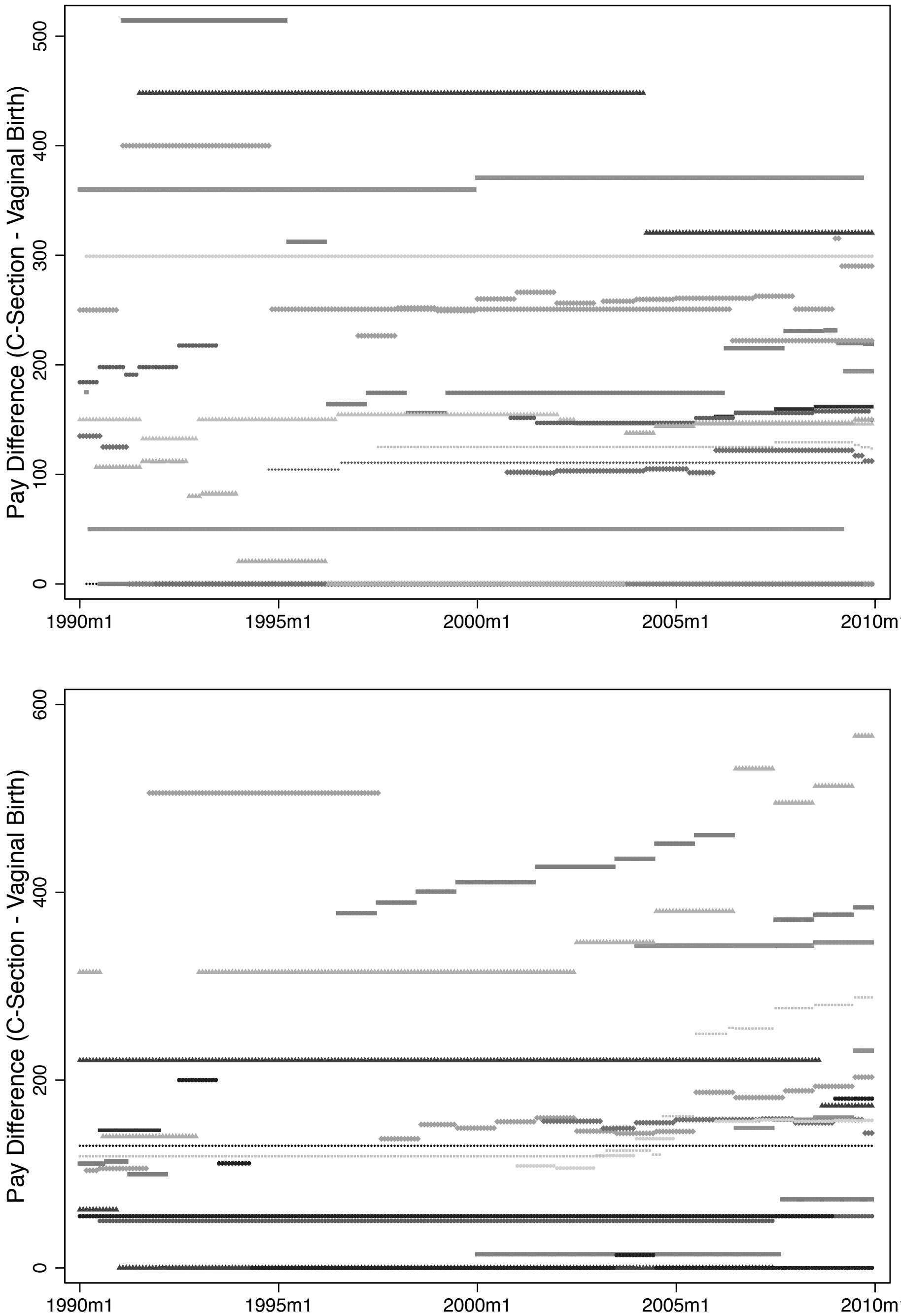
VII. FIGURES

Figure 1: Medicaid Coverage of Births in the US



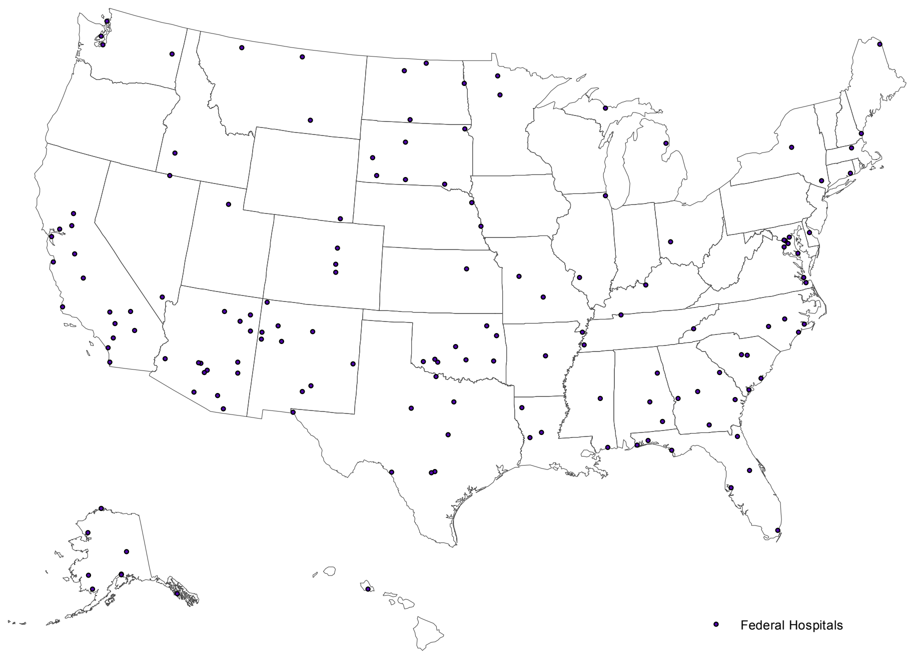
Notes: Data from the Healthcare Cost and Utilization Project.

Figure 2: Variation in Pay Difference over Time



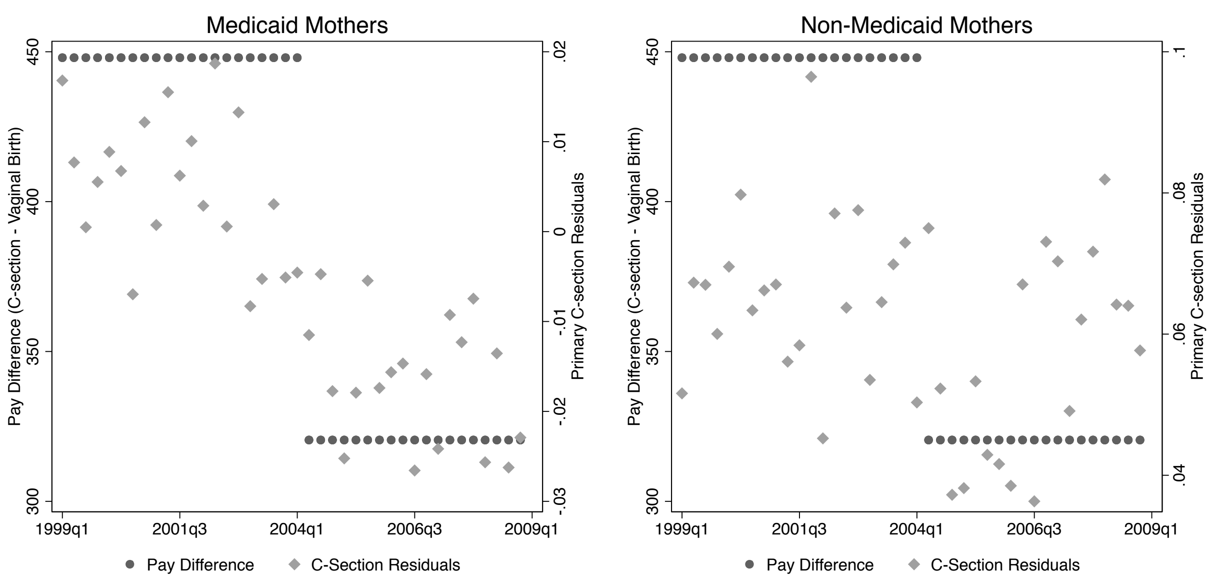
Notes: The top graph displays states Alabama to Mississippi, the bottom graph shows Missouri to Wyoming. Top and bottom one percent trimmed, in order to better display the fee difference variation over time.

Figure 3: Locations of Federal Government Controlled Hospitals



Notes: All federally controlled hospitals from 1990-2008.

Figure 4: Case Study: Arkansas



Notes: The residuals in Figure 4 are from a regression of C-section on year fixed effects for the whole sample, plotted over time for Medicaid and non-Medicaid mothers in Arkansas.

VIII. TABLES

Table 1: Payment Variable Means

Variables	**Mean**	**SD**
Payment for Vaginal Birth	\$788	\$262
Payment for C-Sections	\$922	\$315
Fee Difference (C-Section-Vaginal)	\$135	\$154

Notes: Using CPT codes bundling delivery and postpartum care

Table 2: Summary Statistics

Panel A: Individual Medical Risk Factors

Variables	**All Mothers Mothers**	**Predicted Medicaid**	**Predicted Private**
% Fetal distress	5.5	6.1	5.2
% Smoke during pregnancy	12.5	19.2	4.7
% Lung disease	1.0	1.1	0.9
% Diabetes	3.0	2.4	3.1
% Chronic Hypertension	0.8	0.6	0.8
% Breech	4.1	3.3	5.0
% Low birth weight (< 2501 g)	7.8	9.6	6.5
% Preterm birth ($<$ 37 weeks)	11.8	14.2	9.8
% of Mothers ≤ 16	2.2	5.9	0.0
% of Mothers 40+	2.0	0.6	3.8
Primary C-section rate	17.8	14.9	21.4

Panel B: County Characteristics

Variables	**All Counties**	**High Medicaid Counties**	**Low Provider Counties**	**Counties w/o Fed. Hospitals**	**Counties w/ Fed. Hospitals**
% of Mothers ≤ 16	2.3	2.9	2.3	2.4	2.4
% of Mothers 40+	2.0	2.0	2.0	2.0	2.0
% White	79.6	77.8	79.7	80.0	74.9
% Black	14.7	16.1	14.7	14.8	16.0
% Native American	1.1	1.5	1.0	1.0	2.2
% Hispanic	20.1	29.0	20.2	19.9	30.2
% $\geq$ College	22.4	15.3	22.6	22.6	20.8
% Married	63.8	57.8	64.0	63.8	63.9
Median County Income	$45,060	$40,893	$45,139	$44,857	$45,456
County Population	105,619	73,220	111,253	102,218	323,372
Avg. unemployment rate	5.2	5.5	5.2	5.3	5.3

Notes: All means in Panel B are population weighted, except for county population.

Table 3: Probability of Primary C-section by Insurer in 2012 (x100)

	(1)	(2)	(3)	(4)
Medicaid	-3.0***	-2.4***	-2.3***	-2.8***
	(0.1)	(0.1)	(0.1)	(0.1)
Observations	2,573,985	2,573,985	2,573,985	2,573,985
Avg. C-section Rate	21.9	21.9	21.9	21.9
	(1)	(2)	(3)	(4)
Medicaid + Self Pay	-3.4***	-3.1***	-3.0***	-3.5***
	(0.1)	(0.1)	(0.1)	(0.1)
Observations	2,698,904	2,698,904	2,698,904	2,698,904
Avg. C-section Rate	21.6	21.6	21.6	21.6
Demographics	X	✓	✓	✓
Medical Risk Factors	X	X	✓	✓
State & Time Fixed Effects	X	X	X	✓

Notes: Omitted category is private insurance. Demographic variables: dummies for Black, American Indian/Alaskan Native, Hispanic, married, education categories, and age in five year bins. Medical risk factors: diabetes, chronic hypertension, eclampsia, breech birth, fetal distress, and an indicator for whether mother smoked during pregnancy (dummies for these variables being missing included when needed, to keep sample constant across specifications). State and time fixed effects: fixed effects for day of week, month of year, year, and state.

Table 4: Effect of Salary Structure and Pay Differentials on C-Section Use (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	0.13	0.58***	0.33*	0.08	0.50	-0.01
	(0.18)	(0.21)	(0.17)	(0.25)	(0.45)	(0.24)
Pay diff. * Salaried	0.02	-0.46**	-0.25	0.67	-0.38	0.34
	(0.24)	(0.23)	(0.21)	(0.42)	(0.39)	(0.31)
Salaried hospital	-0.28	0.77	0.38	-0.19	-0.04	-0.58
	(0.70)	(0.69)	(0.57)	(0.64)	(1.08)	(0.67)
Observations	14,531,737	6,085,151	7,381,948	13,178,385	2,830,188	5,473,547
Mean dept. var	15.0	14.8	14.8	22.0	23.0	21.3

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 5: Effect of Salary Structure and Pay Differentials on Infant Death (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.06***	-0.06***	-0.06***	0.02	0.00	0.01
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
Pay diff. * Salaried	0.03*	0.04**	0.05***	-0.01	0.02	0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
Salaried hospital	0.04	0.03	0.01	0.02	-0.03	-0.01
	(0.03)	(0.04)	(0.03)	(0.02)	(0.03)	(0.02)
Observations	14,531,766	6,085,154	7,381,950	13,178,918	2,830,196	5,473,626
Mean dept. var	0.93	0.77	0.90	0.44	0.42	0.47

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 6: Effect of Salary Structure and Pay Differentials on Neonatal Death (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.05***	-0.04***	-0.05***	0.01	-0.01	0.01
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Pay diff. * Salaried	0.03*	0.03**	0.04***	-0.00	0.02*	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Salaried hospital	0.04	0.05	0.01	0.01	-0.03	-0.01
	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
Observations	14,531,766	6,085,154	7,381,950	13,178,918	2,830,196	5,473,626
Mean dept. var	0.58	0.48	0.55	0.33	0.31	0.35

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 7: Effect of Salary Structure and Pay Differentials on Death After Neonatal Period (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.02*	-0.02	-0.02**	0.01	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
Pay diff. * Salaried	0.01	0.01	0.01*	-0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
Salaried hospital	0.00	-0.02	-0.00	0.01	-0.00	0.00
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	14,531,766	6,085,154	7,381,950	13,178,918	2,830,196	5,473,626
Mean dept. var	0.35	0.29	0.35	0.11	0.11	0.12

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 8: Effect of Pay Difference on Infant Death (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.06**	-0.05**	-0.06**	0.01	0.00	0.00
	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
Pay diff. * High risk	-0.01	-0.05**	-0.03*	-0.00	0.02	-0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)
High risk	0.14***	0.09**	0.10**	0.08***	0.01	0.09**
	(0.03)	(0.04)	(0.04)	(0.03)	(0.07)	(0.04)
Observations	13,172,588	5,368,132	6,345,019	12,083,982	2,360,809	4,769,676
Mean dept. var	0.92	0.76	0.90	0.44	0.41	0.47

Notes: Births in counties with salaried hospitals dropped. All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 9: Effect of Pay Difference on Neonatal Death (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.05**	-0.03**	-0.04**	0.00	-0.01	0.00
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Pay diff. * High risk	-0.01	-0.04**	-0.03**	0.00	0.02	-0.00
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
High risk	0.13***	0.09**	0.08***	0.07***	0.02	0.08**
	(0.03)	(0.04)	(0.03)	(0.02)	(0.06)	(0.03)
Observations	13,172,588	5,368,132	6,345,019	12,083,982	2,360,809	4,769,676
Mean dept. var	0.58	0.47	0.55	0.33	0.31	0.35

Notes: Births in counties with salaried hospitals dropped. All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 10: Effect of Pay Difference on Death After Neonatal Period (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.02*	-0.02	-0.02**	0.00	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Pay diff. * High risk	0.00	-0.01	0.00	-0.00	-0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
High risk	0.02	-0.00	0.01	0.01	-0.01	0.01
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
Observations	13,172,588	5,368,132	6,345,019	12,083,982	2,360,809	4,769,676
Mean dept. var	0.35	0.29	0.35	0.11	0.11	0.12

Notes: Births in counties with salaried hospitals dropped. All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 11: Effect of Pay Difference on Birth Weight

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-1.95	-8.86***	-3.38	3.06	-5.33	1.90
	(2.80)	(3.03)	(2.40)	(1.93)	(3.69)	(1.83)
Pay diff. * High risk	5.77	7.04	6.62	-3.02	-6.05	-3.47
	(3.90)	(4.69)	(3.83)	(3.49)	(8.76)	(4.04)
High risk	-53.23***	-30.26***	-45.59***	-27.90***	-0.87	-20.00***
	(6.05)	(9.06)	(7.77)	(5.36)	(10.63)	(7.22)
Observations	13,168,875	5,367,052	6,343,434	12,081,362	2,360,577	4,768,957
Mean dept. var	3,214	3,247	3,223	3,364	3,351	3,371

Notes: Births in counties with salaried hospitals dropped. All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 12: Effect of Pay Difference on Gestational Age at Birth

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	0.00	-0.01	-0.01	0.01	-0.01	-0.00
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
Pay diff. * High risk	0.01	0.00	0.02	-0.01	-0.03	-0.01
	(0.02)	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)
High risk	-0.21***	-0.11***	-0.18***	-0.12***	-0.02	-0.09***
	(2.78)	(3.56)	(3.19)	(2.11)	(3.63)	(2.65)
Observations	12,972,666	5,222,930	6,231,716	12,010,232	2,329,801	4,737,948
Mean dept. var	38.7	38.8	38.7	38.8	38.9	38.8

Notes: Births in counties with salaried hospitals dropped. All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table 13: Effect of Pay Difference on Number of Prenatal Visits

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	0.02	0.18**	0.13***	-0.04	-0.04	-0.05
	(0.06)	(0.08)	(0.04)	(0.04)	(0.09)	(0.04)
Pay diff. * High risk	-0.08**	-0.18*	-0.04	0.04	-0.09	0.06*
	(0.04)	(0.11)	(0.04)	(0.03)	(0.09)	(0.03)
High risk	-0.21***	-0.14**	-0.26***	-0.03	0.02	-0.07
	(0.04)	(0.07)	(0.04)	(0.05)	(0.11)	(0.05)
Observations	12,662,987	5,155,846	6,120,307	11,774,693	2,309,217	4,659,290
Mean dept. var	10.4	10.5	10.4	12.3	12.4	12.2

Notes: Births in counties with salaried hospitals dropped. All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

IX. APPENDIX

IX.A. *Data Construction*

Table A.1: Medicaid Fee Schedule Data Used

States	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
Alabama		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Alaska								x	x	x	x	x	x	x	x	x	x	x	x
Arizona	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Arkansas		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
California	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Colorado								x	x	x	x	x	x	x	x	x	x	x	x
Delaware	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Florida		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Georgia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Idaho																	x	x	x
Illinois	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Indiana					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Iowa	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Kansas	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Kentucky	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Michigan		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Minnesota	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mississippi	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Missouri	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Montana	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Nebraska							x	x	x	x	x	x	x	x	x	x	x	x	x
Nevada	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
New Hampshire	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
New Jersey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
New York	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
North Carolina												x	x	x	x	x	x	x	x
North Dakota																	x	x	x
Oklahoma												x	x	x	x	x	x	x	x
South Carolina	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Texas	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Utah	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Virginia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Washington			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Wisconsin															x	x	x	x	x
Wyoming	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Washington, D.C.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

IX.B. *Predicting which mothers are covered by Medicaid at birth*

I run the following probit regression to predict which mothers are covered by Medicaid in the full sample; the explanatory variables are: married, diabetes, chronic hypertension, black, native american, other race, sex of child, eclampsia, breech, and dummies for state, education categories (four categories and missing), age categories (20-24, 25-29, 30-34, 35-39, 40-44, 45+), hispanic origin (Mexican, Puerto Rican, Cuban, Central American, other and unknown Hispanic, and origin unknown or not stated), birth month, birth order, and week day of birth. In addition, county-year population and population squared, as well as the county-year number of people eligible for Medicaid and the number eligible for Medicaid squared are included, and interacted with race, ethnicity, education, and marital status. The pseudo R^2 is 0.300; prediction based upon 3,388,469 observations from 40 states in the 2012 vital statistics natality file.

IX.C. *Creating an indicator for high risk pregnancies*

The complications I use for high risk pregnancy varies by time period and state, because of the new birth certificates being phased in, resulting in risk factors being changed, added or dropped. I use all the information I have available for each state and year for the main specification. If I limit the risk factors to only those available throughout the entire time period, my results are largely unchanged.

The total set of complications used to define a high risk pregnancy are: anemia, cardiac disease, acute or chronic lung disease, diabetes, eclampsia, genital herpes, hydramnios/oligohydramnios, hemoglobinopathy, chronic and pregnancy associated hypertension, incompetent cervix, previous infant weighing over 4000 grams, previous preterm or small-for-gestational-age infant, renal disease, Rh sensitization, uterine bleeding, previous poor pregnancy outcome, other medical risk factors.

IX.D. *Construction of Pay Differential*

For each pay difference I use in my analysis (C-section minus vaginal birth and C-section minus VBAC), I actually have three different potential measures (see Table A.2). Each reflects one of the three ways a delivery procedure can be billed; the bill could be just for the delivery, for the delivery and postpartum care, or for antepartum care, the delivery and postpartum care. I primarily use the pay difference from the codes that include postpartum care, because this variable has the fewest missing state-month observations. In the regressions analysis, I use a composite variable that is constructed as the difference between the "delivery and postpartum care" codes (59515 − 59410 and 59515 − 59614), with missing state-month observations filled in using the other two pay difference measures.

Table A.2: Procedure and Billing Descriptions

Birth Procedures	**CPT Code**	**Included in Billing**
Vaginal delivery	59400	Delivery, ante and postpartum care
(w/ or w/o episiotomy	59409	Delivery only
and/or forceps)	59410	Delivery and postpartum care
Cesarean Delivery	59510	Delivery, ante and postpartum care
	59514	Delivery only
	59515	Delivery and postpartum care
VBAC	59610	Delivery, ante and postpartum care
(w/ or w/o episiotomy	59612	Delivery only
and/or forceps)	59614	Delivery and postpartum care
Cesarean delivery, following	59618	Delivery, ante and postpartum care
attempted VBAC	59620	Delivery only
	59622	Delivery and postpartum care

Notes: An episiotomy is a cut made at the opening of the vagina during childbirth, to aid delivery and prevent tissue rupture; forceps are a surgical instrument used to assist the delivery.

IX.E. *Salary Components for Federally Employed Doctors*

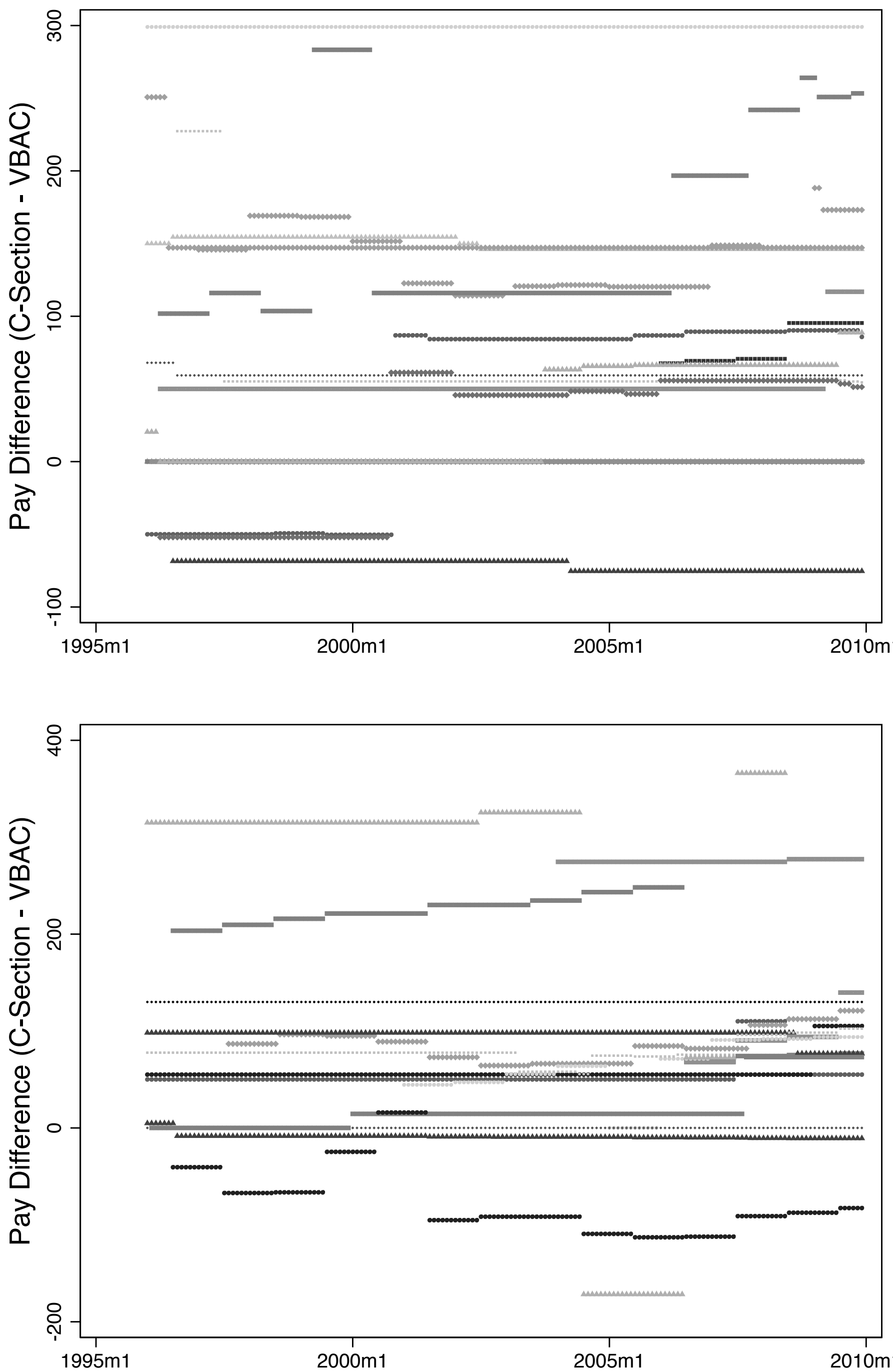
For military doctors, regular compensation consists of officer's pay based on rank and time in service, basic housing and subsistence allowances, and for those who are eligible, a cost of living allowance. Military physicians do not have to pay for malpractice insurance, and are eligible for special medical bonuses (Department of Defense, 2012). Doctors in the Indian Health Service are medical officers in the U.S. Public Health Service Commissioned Corps, and face a similar compensation structure. They are also paid a salary, which again increases with promotions and years of service. And like military doctors, IHS doctors also get free clinical practice liability coverage (U.S. Public Health Service, 2012). The compensation structure of both types of federally employed doctors is characterized by independence of number and type of procedures performed and the inclusion government-paid malpractice insurance.

Table A.3: Components of Salary for Military and IHS Doctors

	Military Doctors
Variable Special Pay	Monthly bonus received by all physicians including interns and residents
Additional Special Pay	Annual bonus for physicians who graduated a residency or interns serving a GMO tour
Incentive Special Pay	Annual bonus only for physicians who have graduated a residency
Board Certification Pay	Monthly bonus reserved for physicians who are board certified in their medical specialty
Multi-year Special Pay	Annual bonus for doctors who sign a contract for additional years of obligated service
	Indian Health Service Doctors
Retention Special Pay	Annual payment for medical officers who contract to stay on active duty for term of 1+ yrs
Variable Special Pay	annual special pay based on years of creditable service
Board Certified Pay	based on years of creditable service and board certification in an accredited specialty
Incentive Special Pay	a special bonus for certain medical officers that is paid annually based on medical specialty
Multi-year Retention Bonus	payable depending on the specialty training and the duration of the contract

IX.F. *Analysis for women who have had a previous C-section*

Figure A.1: Variation in Pay Difference over Time



Notes: The top graph displays states Alabama to Mississippi, the bottom graph shows Missouri to Wyoming. Top and bottom one percent trimmed, in order to better display the fee difference variation over time.

Table A.4: Women with a Previous C-section: Effect of Salary Structure and Pay Differentials on C-Section Use (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.14	-0.04	-0.15	-0.15	0.23	0.08
	(0.27)	(0.31)	(0.31)	(0.19)	(0.28)	(0.18)
Pay diff. * Salaried hosp.	-0.43	-0.60	-0.53	0.27	-0.47	-0.11
	(0.48)	(0.49)	(0.54)	(0.28)	(0.31)	(0.22)
Salaried hospital	0.28	-0.86	0.97	0.67	1.71	0.19
	(1.36)	(2.80)	(1.42)	(0.72)	(1.13)	(0.61)
Observations	1656280	707961	819043	1492034	303556	614811
Mean dept. var	85.6	87.5	86.7	85.6	87.8	86.2

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level. Only births from 1996-2008 used, as VBAC payment code did not exist before this period.

Table A.5: Women with a Previous C-section: Effect of Pay Differentials on Infant Death (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.00	0.00	-0.00	0.01	0.01	0.03
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Pay diff. * High risk	-0.03	-0.04	-0.02	-0.00	-0.01	-0.02
	(0.02)	(0.02)	(0.03)	(0.01)	(0.03)	(0.02)
High risk	0.00	0.00	0.02	-0.02	-0.18**	-0.00
	(0.04)	(0.05)	(0.05)	(0.03)	(0.08)	(0.05)
Observations	1522813	639691	713193	1376856	255938	541781
Mean dept. var	0.75	0.64	0.76	0.32	0.31	0.36

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level. Only births from 1996-2008 used, as VBAC payment code did not exist before this period.

IX.G. *Stratifying sample by use of capitation-based Medicaid Managed Care*

Table A.6: Stratifying by Medicaid Managed Care: Effect of Salary Structure and Pay Differentials on C-Section Use (x100)

Low Managed Care States						
	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	0.32	0.76*	0.29	0.18	1.25*	0.09
	(0.24)	(0.46)	(0.28)	(0.22)	(0.69)	(0.29)
Pay diff. * Salaried hosp.	-0.50	-0.87	-0.07	0.61	0.60	0.78*
	(0.45)	(1.26)	(0.41)	(0.44)	(0.58)	(0.47)
Salaried hospital	0.41	1.26	-0.63	-1.25	-0.96	-1.71**
	(1.12)	(2.52)	(0.99)	(0.85)	(0.98)	(0.87)
Observations	3796256	1005058	1664929	3261733	528904	1464714
Mean dept. var	0.1536	0.1608	0.1596	0.2097	0.2185	0.2029

High Managed Care States						
	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	0.07	0.36	0.20	-0.01	-0.63	-0.42
	(0.21)	(0.25)	(0.21)	(0.33)	(0.49)	(0.30)
Pay diff. * Salaried hosp.	0.06	-0.18	-0.10	0.17	0.59	0.50**
	(0.22)	(0.24)	(0.22)	(0.27)	(0.41)	(0.23)
Salaried hospital	-0.16	-0.33	-0.16	-0.76	-2.22*	-1.92***
	(0.54)	(0.59)	(0.56)	(0.56)	(1.16)	(0.51)
Observations	5280621	3337657	3071404	4999452	1461146	2069471
Mean dept. var	0.1380	0.1384	0.1317	0.2107	0.2218	0.2023

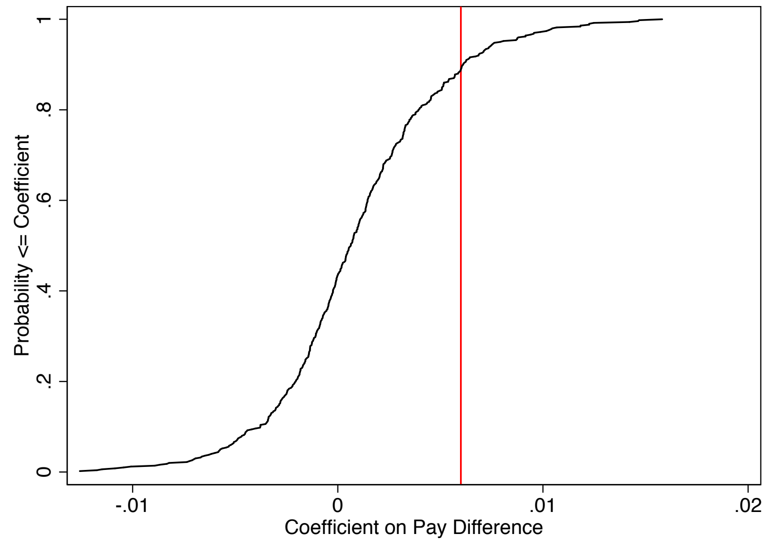
Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

IX.H. *Permutation Analysis*

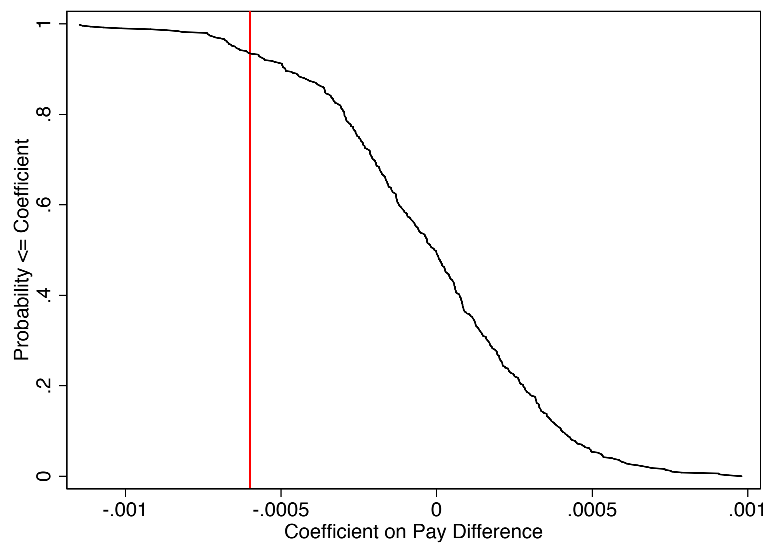
States were randomly matched to fee schedule series, and then the main specification was run: Equation 2 on the subsample of high Medicaid counties. This was performed 500 times, and the coefficients on the pay difference were recorded. Figure A.2 plots the histogram and CDF of the estimates from the permutation analysis; the red line shows the estimate reported in the main text.

Figure A.2: Estimates from Randomly Assigning States to Pay Schedules

Estimate for Probability of C-section



Estimate for Probability of Infant Death



Notes: Each figure is based on 500 repetitions.

IX.I. *Including Linear State Time Trends*

Table A.7: Effect of Salary Structure and Pay Differentials on C-Section Use: Linear State Trends (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	0.16	0.40*	0.37	-0.11	0.15	0.01
	(0.24)	(0.23)	(0.31)	(0.31)	(0.56)	(0.28)
Pay diff. * Salaried	-0.10	-0.46*	-0.24	0.80*	0.03	0.48
	(0.27)	(0.24)	(0.26)	(0.43)	(0.51)	(0.31)
Salaried hospital	-0.10	0.77	0.30	-0.30	-0.52	-0.76
	(0.65)	(0.80)	(0.54)	(0.48)	(1.61)	(0.55)
Observations	14,531,737	6,085,151	7,381,948	13,178,385	2,830,188	5,473,547
Mean dept. var	15.0	14.8	14.8	22.0	23.0	21.3

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

Table A.8: Effect of Salary Structure and Pay Differentials on Infant Death: Linear State Trends (x100)

	High Predicted Medicaid Mothers			Low Predicted Medicaid Mothers		
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	High Medicaid Counties	Low Provider Counties	All Counties	High Medicaid Counties	Low Provider Counties
Pay difference	-0.03	-0.06***	-0.05***	0.02***	-0.01	0.02
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
Pay diff. * Salaried	0.01	0.03	0.04**	-0.02	0.01	-0.01
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
Salaried hospital	0.05	0.06	0.02	0.03*	-0.01	0.00
	(0.03)	(0.05)	(0.03)	(0.02)	(0.03)	(0.02)
Observations	14,531,766	6,085,154	7,381,950	13,178,918	2,830,196	5,473,626
Mean dept. var	0.93	0.77	0.90	0.44	0.42	0.47

Notes: All regressions include maternal controls: indicators for race and ethnicity (black, Hispanic, and American Indian/ Alaskan Native), four education categories, age in five year bins, maternal diabetes, eclampsia, breech presentation, and chronic hypertension. In addition, deciles of county-level median income, month and day of week of birth, sex of infant, birth order, and state and year fixed effects are also included. Standard errors clustered at the county level.

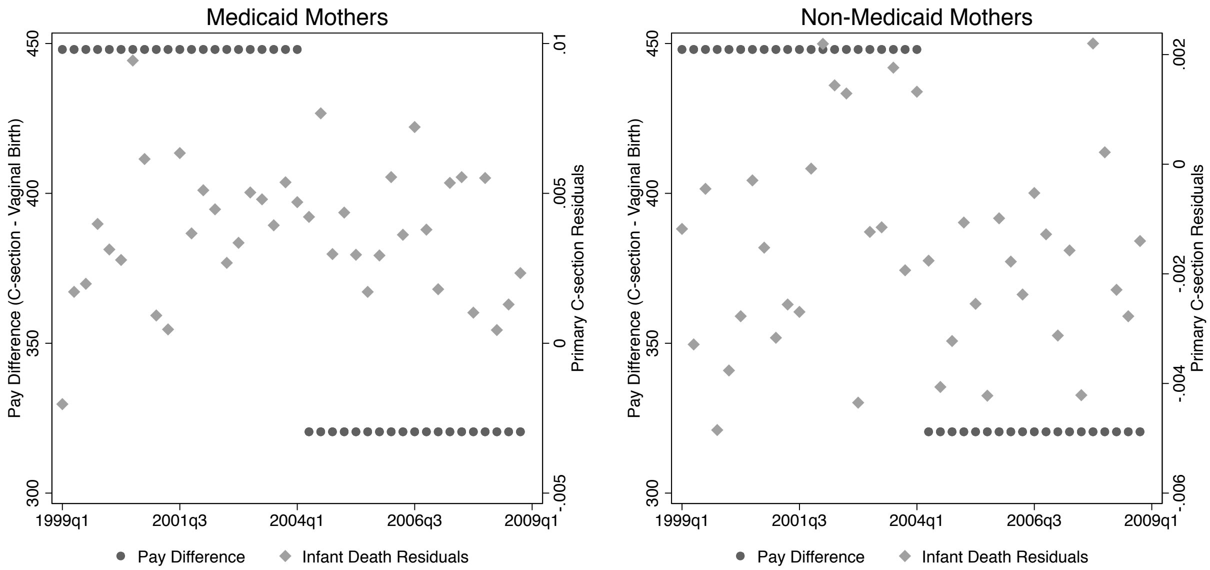
IX.J. *Miscellaneous*

Table A.9: Relationship between Pay Differentials and Unemployment

	(1) Pay Difference b/se
State unemployment	6.87
	(6.17)
L1 State unemployment	0.72
	(9.98)
L2 State unemployment	-9.25
	(10.08)
L3 State unemployment	1.35
	(10.24)
L4 State unemployment	5.20
	(6.95)
L12 State unemployment	-0.95
	(1.53)
Observations	5709
Mean dept. var	140
Mean unemployment	5.8
State & Year Fixed Effects	✓

Notes: Regression run at the state-month level. L1 denotes state unemployment lagged one month (L2, L3, L4, and L12 defined analogously).

Figure A.3: Case Study: Arkansas (Infant Death)



Notes: The residuals in Figure A.3 are from a regression of infant death on year fixed effects for the whole sample, plotted over time for Medicaid and non-Medicaid mothers in Arkansas.

IX.K. *Model*

This model is a simple extension of the framework from Gruber et al. (1999), where doctors choose between two procedures: C-section and vaginal birth. In this model, the choice variable for doctors is C-section inducement per birth, i. Since inducement has no natural units, I follow Gruber et al. (1999) and define the proportion of total deliveries that are Cesarean, $a(i)$, as linear in i. In this model, $a(0)$ is the C-section rate if there was no inducement.[22] Physicians get utility from income (Y), but disutility from total inducement (I) — the total number of extra C-sections performed. Doctors incur a psychic cost from advising unnecessary surgery, but are reimbursed more for C-sections than for vaginal births, $p_C > p_V$. I assume throughout that $p_C - c_C > p_V - c_V$. This is in line with the fact that at most hospitals, doctors with admitting privileges are not charged by the hospital for resources used, in which case $c_C = c_V = 0$.

[22]The C-section rate in the absence of inducement, $a(0)$, is the C-section rate when reimbursements are equalized between procedures. This is not necessarily the optimal rate, as it includes the impact of costs and benefits to doctors that are not reflected in pay— for example, scheduling convenience.

To keep things simple, I followMcGuire and Pauly (1991) and Gruber and Owings (1996) and assume that the utility function of physicians is additively separable, with the form

$$U(Y, I) = V(Y) + W(I) \tag{5}$$

where Y is income and I is total inducement. The standard assumptions on the utility function hold: $U_Y > 0$, $U_I < 0$, and $U_{YY}, U_{II} < 0$.

Fee-for-Service Compensation Regime The income of a fee-for-service doctor is equal to

$$\begin{aligned} Y &= N\left(a\left(i\right)\left(p_C - c_C\right) + \left(1 - a\left(i\right)\right)\left(p_V - c_V\right)\right) \\ &= Na\left(i\right)m + NY_V \end{aligned}$$

and I, total inducement, is

$$I = Ni \tag{6}$$

where N is the total mass of mothers giving birth, and i is inducement of C-sections per patient.[23] The difference in revenue from performing a C-section versus a vaginal birth is $m = Y_C - Y_V = (p_C - c_C) - (p_V - c_V)$, and $a(i)$ is the share of deliveries that are Cesarean as a function of i. As in Gruber et al. (1999), $a'(i) > 0$, and $a'' = 0$.

For a physician choosing i to maximize utility, the first order condition gives

[23] It is assumed that the total number of births is fixed. This could be problematic in the context of Medicaid beneficiaries, who doctors may choose not to see. Since I am looking at births, however, I think this assumption is reasonable— if a woman shows up to a hospital in labor, by law she cannot be turned away. Under the Emergency Medical Treatment and Active Labor Act of 1986, hospitals are required to deliver the baby of a woman in active labor, unless the institution is not equipped, as in the case of lacking a neonatal ICU for a high-risk pregnancy.

$$
\begin{aligned}
U_Y a'(i^*)\, m + U_I &= 0 \\
a'(i^*)m &= -\frac{U_I}{U_Y}
\end{aligned}
$$

where i^* is the optimally chosen level of inducement per birth. The physician picks i^* so that the marginal return (in \$) of inducing C-sections equals the psychic marginal utility cost of higher inducement. In order to see how procedure choice responds to the pay difference, I differentiate the first order condition fully with respect to m;

$$
\begin{aligned}
\frac{\mathrm{d}i}{\mathrm{d}m} &= \frac{-U_{YY} a(i^*)\, a'(i^*)\, m - \frac{U_Y a'(i^*)}{N}}{U_{YY}\left(a'(i^*)\, m\right)^2 + U_{II}} \\
&= \underbrace{\frac{-U_{YY} a(i^*)\, a'(i^*)\, m}{U_{YY}\left(a'(i^*)\, m\right)^2 + U_{II}}}_{\substack{<0 \\ \text{income effect}}} + \underbrace{\frac{-\frac{U_Y a'(i^*)}{N}}{U_{YY}\left(a'(i^*)\, m\right)^2 + U_{II}}}_{\substack{>0 \\ \text{substitution effect}}}
\end{aligned}
$$

While the overall sign of $\frac{\mathrm{d}i}{\mathrm{d}m}$ is ambiguous, it separates into the income and substitution effects of a change in the pay difference (m). If $m = Y_C - Y_V$ increases and the substitution effect dominates, then an increase in the pay difference will increase inducement, as the doctor substitutes patients into delivery via C-section. Conversely, if the income effect dominates, the fact that doctors are more wealthy due to the increased pay difference will lead to a decrease in C-sections; inducement will go down.

Salaried Compensation Regime Now consider the case of a salaried doctor. In this case, a physician's income is not impacted by the mix of procedures that is chosen. Thus,

$$Y = Salary \tag{7}$$

and therefore

$$I = 0 \tag{8}$$

because the doctor has no financial incentive to induce C-sections, and inducement enters negatively into the utility function. Since Y does not depend on $a(i)$, the doctor's choice of procedure is not influenced by income considerations, and the share of mothers who receive C-sections is $a(0)$.

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