Does Physician Compensation Impact Procedure Choice and Patient Health?*

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Abstract

I find that compensation structure impacts a doctor's decision to perform a Cesarean section (C-section). Using Medicaid reimbursement and vital statistics data, I find that fee-for-service doctors respond to an increase in the relative reimbursement for C-sections by increasing their use of the procedure. These incentives are not passed through to salaried doctors – their C-section use remains constant at the same lower rate as fee-for-service doctors who are paid the same for both procedures. For fee-for-service doctors who face pay differentials, however, the increase in C-section use due to increases in the pay difference is associated with fewer infant deaths. This paper demonstrates the difficulty in lowering procedure use while holding patient health constant. Reforms that alter financial incentives indiscriminately may have unintended negative consequences.

JEL Classification: $I11$; $I12$; $I18$

1 Introduction

Health care costs in the United States are very high relative to other developed countries. This is at least partly due to overuse[1] of health care services by doctors in response to the dominant system which pays separately for each service performed [Lipitz-Snyderman and Bach, 2013, Berenson and Docteur, 2013, Combes and Arespacochaga, 2013]. A potential reform often discussed is to break the link between doctors' income and individual services, for example by switching to a flat salaried system. In this paper, I ask two key questions of such a reform: what would be the impact on doctors' procedure choice? And what would be the implications for patients' health outcomes?

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[1]Defined by the Institute of Medicine (IOM) National Roundtable on Health Care Quality as "a health care service [that] is provided under circumstances in which its potential for harm exceeds the possible benefit".

While many authors have found evidence that the supply curve for medical care slopes upward [Clemens and Gottlieb, 2013, Hadley et al., 2009, Gruber et al., 1999], there has been little investigation into how this affects patient health. Built into the definition of physician-induced demand is that it is harmful– from McGuire [2000], "physician-induced demand exists when the physician influences a patient's demand for care against the physician's interpretation of the best interest of the patient". More recently, however, some have found incremental care from increased reimbursement to have health benefits [Jacobson et al., 2013]. Using the case of C-sections as an illustrating example, I lend support to the idea that procedures chosen by doctors because of financial incentives are not necessarily bad for patients. I find that unlike their salaried counterparts, fee-for-service doctors respond to increasing relative reimbursement rates by shifting patients into the more profitable procedures. Yet, these financially motivated procedures have some positive health outcomes. I find that even for an operation such as a C-section that is seen as rife with over-use, lowering procedure use across the board may not be the best strategy.

The choice between a C-section and a vaginal birth is a natural one to shed light on the question of how compensation structure affects physician behavior and patient outcomes. First, it cleanly illustrates the potential trade-off between patient health and physician profit; doctors are usually paid more for C-sections, but surgery always comes with risks. Furthermore, the costs and benefits of C-sections and natural births vary widely across patients. This heterogeneity creates a scenario where individual doctors have a lot of discretion over C-section use; where we would expect financial considerations to be important. Second, C-sections are important because of the procedure itself. In the US, childbirth is the most common reason for hospitalization, and C-sections are the most commonly performed operating room procedures [HCUP, 2012]. Moreover, C-sections are much more expensive than vaginal births – which when combined with high prevalence underlines their importance.

My research design is based on a simple observation: doctors employed by the federal government are salaried, while most others are paid fee-for-service. I use this pay structure distinction to study whether the procedure choices of each group respond differently to changes in relative reimbursement rates, and whether these choices impact health outcomes. The reimbursement rate variation I use comes from changes in the amount Medicaid pays doctors for performing particular procedures in each state over time. Reimbursement rates both increase and decrease over the time period ($1990 - 2008$), likely reflecting each state's response to the conflicting pressures of increasing rates to encourage doctors to see Medicaid patients, and saving money. Thus, I claim this variation is plausibly exogenous to procedure choice. After demonstrating that these changes in relative reimbursement rates – how much more a doctor in each state and year would make for performing a C-section than a vaginal birth on a Medicaid patient – influence fee-for-service doctors' C-section use on the margin, I investigate the impact of these financial incentives on health outcomes.

I find that compensation scheme matters for procedure choice. For fee-for-service doctors, an increase in the relative reimbursement for C-sections increases the probability of C-section. For example, for births that occurred in counties with no federal (salaried) hospital, my results imply that a \$100 increase in the difference between C-section and vaginal birth reimbursement rates increases the probability of a primary (first) C-section by 0.5 percent. In my sample, this is an increase of 3% of the mean (of 17%) for primary C-sections. As expected, effect sizes increase in magnitude and are more precisely estimated in samples with a higher density of Medicaid discharges. In contrast to the findings for fee-for-service doctors, primary C-section use does not respond to changes in the relative reimbursement rate in counties with hospitals where doctors are salaried.

I also find that increased C-section use due to increases in the relative reimbursement rate is associated with fewer infant deaths. Despite the fact that these C-sections were "induced" by changing prices, the end result is better infant health. While Chandra and Staiger [2007] showed the productivity spillovers impact health, previous work on the effects of financial incentives on procedure choice has often focused on other outcomes [Gruber and Owings, 1996, Gruber et al., 1999, Grant, 2009, Hadley et al., 2001]. Information on health outcomes are important, however, to the interpretation of the findings on procedure choice. It is somewhat surprising, in light of the fact that many health care professionals are concerned with the high C-section rates in the US, that a marginal C-section still has health benefits for the infant.

My results, however, should not be taken as evidence that C-section use should increase. Even taking my results on infant health at face value, there are other important considerations – such as the fact that C-sections also put the health of the mother at risk. Decreases in the mother's health due to these marginal C-sections may outweigh any potential gains to the infant. Rather, my results suggest that lowering procedure use indiscriminately has the potential to adversely affect patient health. This highlights the importance of alternative interventions that could lower procedure use in a more sensitive way, such as those that could improve the diagnostic skill of physicians [Currie and MacLeod, 2013].

2 The Model

I use a simple model of the physician intensity decision compare the financial incentives generated from fee-for-service and salaried compensation schemes from the doctor's perspective. This allows for a precise discussion of the trade-off faced by doctors between their medical intuition and income. Ultimately, I use the physician-level implications of the model to guide my county-level empirical analysis.

The model I use is an 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.[2] Physicians get utility from income (Y), but disutility from total inducement (I) – the total number of extra C-sections

[2] 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.

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 $c_C = c_V = 0$.

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

$$U(Y, I) = V(Y) + W(I)$$

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

2.1 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

$$I = Ni$$

where N is the total mass of mothers giving birth[3], and i is inducement of C-sections per patient. 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

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

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

[3]It is assumed that the total number of births are 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.

first order condition fully with respect to m;

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

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. 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], so I expect the substitution effect to dominate: an increase in the pay difference will lead to an increase in the use of C-sections.

2.2 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,

$$Y = Salary$$

and therefore

$$I = 0$$

because the doctor has no financial incentive to induce C-sections, and inducement enters negatively into the utility function. Since Y doesn't 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 $a(0)$. Intuitively, if many doctors are performing C-sections in marginal cases because they are more profitable than the alternative, then being salaried should lead to lower use of the procedure.

2.3 Implications for Empirics

The stylized model predicts that the probability of C-section is increasing in the pay difference (m) in fee-for-service hospitals, while in salaried hospitals it is constant at $a(0)$. If all babies born in counties with a federally controlled hospital were in fact born at that hospital, then I could run the regression

$$Csection = \alpha + \beta_1 Pay\, Difference + \beta_2 Pay\, Diff * Salaried\, HospCnty$$

$$+ \beta_3 Salaried\, Hospital\, County$$

In this thought experiment, 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 – $\beta_3 = 0$.

As I describe in more detail below, I do not have doctor-level data. I know whether a mother gave birth in a county with a federally controlled hospital, but not whether the doctor in attendance was salaried. In the real world, most of the counties with a federally controlled hospital also have at least one other hospital. This weakens the physician level predictions by introducing some noise, but does not eliminate them. I still expect that $\beta_1 > 0$, $\beta_2 < 0$, and $\beta_3 = 0$ – though at the county level β_1 and β_2 may not exactly offset, as some babies born in counties with a federal hospital are born elsewhere. I also still expect the procedure choices of doctors in counties with a salaried hospitals to be same as other doctors when the pay difference is held constant.

3 Data

This section describes my three data sources, and how they fit together. Combining them allows me to examine both how physician compensation influences C-section rates, and also how these choices are reflected in infant health. To answer these questions, I merge together administrative vital statistics data with survey data from hospitals and detailed original data on Medicaid reimbursement rates over time. Since Medicaid is administered by each state, it provides a rich source of variation in reimbursement rates – unfortunately, this rate information is not collected centrally. Thus, one contribution of this paper is in collecting reliable rate information from each state's Medicaid office; previous work has relied on secondary sources that only contain data on a few states and years [Gruber et al., 1999].

3.1 Vital Statistics Data

The primary data I use are the National Vital Statistics System's Linked Birth and Infant Death Data, which encompass the universe of infant births and deaths in the US, from 1990 – 2008. The US National Center for Health Statistics (NCHS) produces these files annually, incorporating information from birth and death certificates provided to the NCHS by states under the Vital

Statistics Cooperative Program (VSCP). These data include the birth procedure used, and the county and month of birth, for everyone born in the US. They also include information on all children who die under a year of age, which I'm able to match to the birth records. Thus, for each birth, I know whether the child survived to one year. In addition, the natality data include demographic and medical risk factors associated with the mother, infant, and birth event. These variables allow me to control for characteristics that might be correlated with county of birth and birth procedure.

For my main estimation, I restrict the sample to birth observations that are within the scope of the financial incentives I study. Since these financial incentives are only applicable to doctors working in hospitals, I remove births that occurred outside a hospital. I further restrict my sample to those born in the 50 states and Washington, D.C.; Territories and protectorates of the US have very different public health insurance programs, and again, the incentives I study do not apply. Finally, I drop multiple births, as they are much more likely to develop complications that require delivery via Cesarean section, and are not comparable to singletons (the C-section rate for twins was 75% in 2008) [Lee et al., 2011].

The inclusion of county of birth is crucial for my ability to link this data to the hospital and physician payment information, as hospital of birth is not available. Next, I describe in detail how I match the two other data sources to the vital statistics files.

3.2 Hospital Data

My second source of data is the American Hospital Association (AHA) annual survey, which gives me variation in physician compensation type at the hospital level. The control type variable is what gives me this information; it is defined as the organization responsible for establishing policy for overall hospital organization. There are five broad categories of controlling organization: federal government, non-federal government, nongovernment not-for-profit, and investor-owned for-profit.[4] I focus on the distinction between hospitals controlled by the federal government and other hospitals, because doctors employed by the federal government are salaried, while most others are paid fee for service.[5]

It is hard to find direct evidence on the prevalence of fee-for-service compensation, but some variables in the Community Tracking Survey from 2008 lend evidence to support this characterization. In the survey, 43% of obstetricians/gynecologists (ObGyns) who admitted a patient to a hospital in the last year report that "the overall personal financial incentives in [their] practice favor expanding services to individual patients" (just 5% report incentives in favor of reducing services and 52% report that incentives favor neither). In addition, among these ObGyns, 73% of

[4]Kaiser Permanente, a large integrated managed care consortium (and non-profit corporation), is also well known for using a salaried incentive scheme rather than fee-for-service. Unfortunately, all Kaiser hospitals are located in densely populated counties where they account for only a very small fraction of births per year, and thus I cannot study them using the framework in this paper.

[5]There is never a statistical difference between for-profit and other non-federally controlled hospitals. This is consistent the literature on for-profit hospitals, which generally provides only weak evidence that that these hospitals behave differently.

doctors are paid based on performance (which is overwhelmingly based on factors reflecting "own productivity"), their share of practice billings, or are solo practitioners. Of the remaining 27% that report basic compensation based primarily on a fixed salary or time-based pay, over half report that "own productivity affects compensation". Finally, 63% are independent contractors or full or part owners of their practice. While the sample size is small (N=284 ObGyns who admitted a patient in the previous year), the survey supports the importance of reimbursements for typical the typical ObGyn.

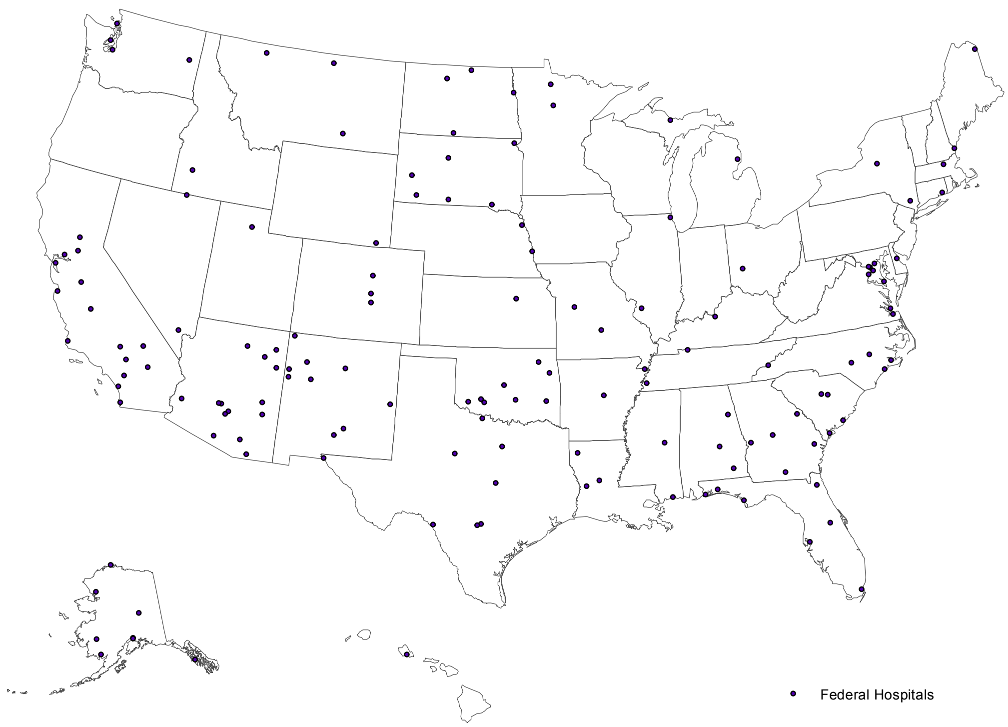
In contrast to the bulk of doctors working under the fee-for-service regime, the salary structure of doctors employed by the federal government is not based on the number of procedures performed. For military doctors, regular compensation consists of officer's pay based on rank and time in service, basic 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 [DoD, 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 [USPHS, 2012]. Thus, the compensation structure of both types of federally employed doctors are characterized by independence of number and type of procedures performed and the inclusion government-paid malpractice insurance (for more information on the pay of federally employed doctors, see Appendix Table A2).

I collapse the American Hospital Association data on compensation type to the county-year level in order to be match them with the vital statistics data. I limit my sample of hospitals to those that are relevant; I eliminate from my analysis hospitals where no births were recorded [6]. With the combined data, I know whether a federal government-controlled (salaried) hospital existed in the county and year of all births in my sample[7]. A drawback of this strategy is that for babies born in counties with more than one hospital, I don't know the exact hospital of birth. My analysis is therefore limited to examining the impact of having a salaried hospital in the county and year of birth, rather than being born in a salaried hospital. For the subsample of babies born in counties with only one hospital, however, the hospital of birth is known. Thus, as a robustness exercise, I repeat my analysis on this subsample.

[6] for the remainder of the paper, when I mention "single hospital counties", what I really mean is "counties where there is only one hospital with non-zero births"

[7] The federally controlled hospitals with non-zero births are made up of Air Force, Army, Navy and Indian Health Service hospitals.

Figure 1: Locations of Federal Government Controlled Hospitals



All federally controlled hospitals from 1990-2008

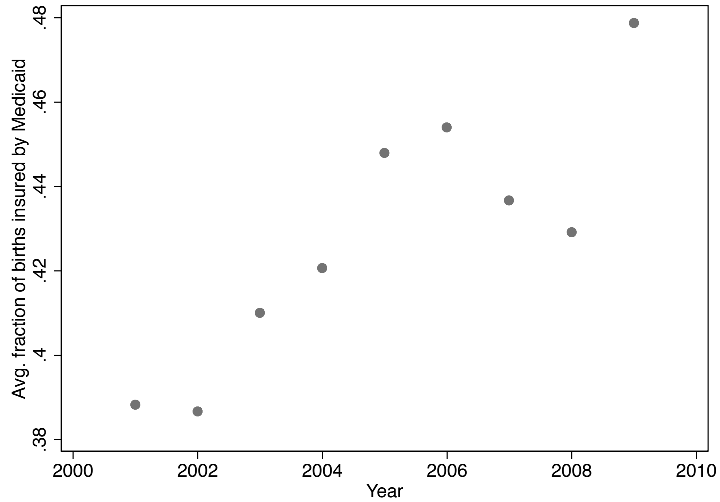
The AHA survey data also has data on the number of Medicaid discharges for each hospital, which I use to focus the analysis on the Medicaid population. I use the Medicaid discharge variable to create a county level index of "Medicaid intensity" – defined as the number of Medicaid discharges divided by the total number of hospital beds. As my financial incentives only bite for Medicaid patients, I expect to find my results in counties that are high on this index.

3.3 Physician Reimbursement Data

My third and final source is data on Medicaid reimbursement rates for obstetric procedures at the state-month level. Medicaid is jointly funded by state and federal governments, but is managed by states. This state level administration is important for my empirical specification, as it creates variation in reimbursement rates both across states and within states over time. Equally important for my research design, almost half of all births in the US are covered by Medicaid (see Figure 2). This high coverage of births makes Medicaid reimbursement rates not only heterogeneous, but also very relevant for physicians choosing between birth procedures.

Medicaid reimbursement rates are not collected centrally, so to access this data I had to contact each state's Medicaid office individually. For every state and Washington DC, I requested their Medicaid reimbursement rates for all obstetric procedures, going back to 1990. Delivery procedures

Figure 2: Medicaid Coverage of Births in the US



Based on discharge data from the Healthcare Cost and Utilization Project

can be billed twelve ways (see Appendix Table 7), and I requested data on each of these rates from 1990 – 2008. While a few states were unable to give me this information due to budgetary limitations, I have data on 38 states and 89 percent of the population. Over this time period, states varied not just on levels of reimbursement rates, but also on how frequently they were changed; some states' payments change at least once a year, and others only change once or twice.

As highlighted in Section 2, the relevant explanatory variables for physician behavior are not the reimbursement rates themselves, but the differences between them. This difference captures how much more doctors receive from Medicaid for performing a C-section, relative to what they would have made for a vaginal birth (for the remainder of the paper, I call this difference the pay difference). For all the states in my analysis, I have information on two such pay differences at the state-month level. For my main results, I limit the sample to woman who have not had a previous C-section. In this case, the relevant pay difference is between C-sections and vaginal birth; these are the two procedures between which doctors are choosing. For robustness, I look at repeat C-sections, where the relevant pay difference is between C-sections and vaginal birth after Cesarean (VBAC). I merge into the vital statistics and hospital data the relevant difference between the Medicaid reimbursement rates in the month and state in which each delivery occurred.

Thus, for each delivery from 1990 – 2008, I know if there was a federally controlled hospital in the birth county, and how much more doctors were reimbursed for C-sections than vaginal deliveries by Medicaid. For deliveries in counties with just one hospital, also know the control type of the exact hospital of birth.

4 Empirical Strategy

This section describes my empirical strategy in detail. I use a simple interaction-based regression model to exploit differences in physician compensation – the fact that doctors employed by the federal government are salaried, while most others are paid fee-for-service. Furthermore, the fact that Medicaid is decentralized means that states vary widely in the pay differences, both across borders and over time. Using these two sources of variation, I first isolate the impact of changing Medicaid payment differential on fee-for-service and salaried doctors, and then look at the effect on patient health.

In my main specification, I only use women whose doctors are choosing between primary C-sections and vaginal births– women whose doctors have lots of medical discretion in procedure choice. There is much less discretion on behalf of the doctor when he or she is choosing between repeat C-section and VBAC. In the US, rates of VBAC are very low, and doctors have long followed the rule of thumb that "once a Cesarean, always a Cesarean". In addition, the medical consequences of the repeat C-section/VBAC choice are much higher than for primary C-sections. Thus, for primary C-sections I expect the pay difference to impact physician behavior, but not for repeat C-sections.

I use a simple linear probability model, where I regress the pay difference, hospital salary type and their interaction on an indicator for primary C-sections. I then repeat the exercise, but with infant death as the dependent variable.

$$Prim.\,Csection_{ict} = \alpha + \beta_1 Pay\,Diff_{ct} + \beta_2 Pay\,Diff_{ct} * FedGovt\,Hosp_{ct}$$

$$+ \beta_3 FedGovt\,Hospital_{ct} + \beta_4 X_{ict} + \lambda_{state} + \gamma_{year} + \epsilon_{ict}$$

Here, i indicates that the variable is defined at the individual level, c that it is defined at the county level, and t that the variable is time varying. The three main explanatory variables are $Pay\,Difference$, the reimbursement differential for Cesarean delivery relative to vaginal delivery, $FedGovt\,Hospital$, a dummy variable for whether the county of birth contained a federally-controlled hospital, and $Pay\,Diff * Govt\,Hosp$ – an interaction between the two. As individual characteristics may vary by hospital type, I also control for the following in X_{ict}: the mother's age, race, marital status and education, health and delivery complications, birth parity, and the weekday of birth. In addition, I include full sets of state and year fixed effects, λ_{state} 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 (but assuming the errors are independent across them), I cluster my standard errors at the county level.[8]

[8] This assumption can be relaxed– results are nearly identical when clustered at the state level, with coefficients remaining statistically significant at the same levels. I report the results clustered at the county level because of the potential for bias resulting from too few clusters.

As the pay difference variable only applies to the births covered by Medicaid, the results should be the strongest in areas with a large Medicaid populations. I attempt to capture this population by stratifying the sample by Medicaid intensity – the total number of inpatient Medicaid discharges in each county-year, divided by the number of hospital beds in the county-year. I then average this over time for each county to create the Medicaid intensity index. I expect the results to increase in magnitude and significance as I look at areas with ever larger proportions Medicaid populations.

The empirical strategy also relies on the exogeneity of the pay difference variable. It would be a problem, for example, if pay differences were increased because of unobserved underlying health factors. I argue that this is unlikely, as changes in reimbursement rates come from state legislators making decisions unrelated to the specific procedure choice of C-sections versus vaginal births. From statements of politicians and government advisory boards, it seems that the goals are not to influence doctors' decisions, but to balance Medicaid costs with physician access. For example, a task force examining Medicaid fees in Colorado recommended that the legislature increase Medicaid fees to encourage provider participation (CO Department of Health Care Policy and Financing, 2007).[9]

A related 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[10] or C-section preferences, this could bias my estimates. Fortunately, my identification strategy hinges on the difference in pay between C-sections and vaginal birth, and not the levels of reimbursement– so this concern is somewhat weakened by the empirical specification. 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.[11] Thus, the relationship between the fee differences and local economic conditions does not appear to be a serious concern.

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

Using CPT codes 59410, 59515, and 59610 (delivery and postpartum care)

Payment schedules vary widely from state to state, with rates both increasing and decreasing

[9] Decker [2007] found that higher Medicaid fees increase the number of private physicians who see Medicaid patients, and Currie et al. [1995] found that higher Medicaid fees relative to private insurance lowers the infant mortality rate.

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

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

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 \$1200 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 gives summary statistics of these payment variables across states and time periods. My maintained assumption is that these numbers neither reflect the opinion of legislators on C-sections, nor economic conditions, but the idiosyncratic politics of each state.

Table 2: NCHS Vital Statistics Means

	Full Sample		**Single Hosp. Counties**	
Variables	**Counties w/o Fed. Hospitals**	**Counties w/ Fed. Hospitals**	**Counties w/o Fed. Hospitals**	**Counties w/ Fed. Hospitals**
Outcome Variables				
Primary C-Section Rate	0.1696	0.1651	0.1797	0.1029
Repeat C-Section Rate	0.8531	0.8346	0.8529	0.7988
Demographic Variables				
% of Mothers ≤ 19	11.92%	12.69%	15.69%	17.19%
% of Mothers $20-29$	53.04%	55.50%	58.69%	62.37%
% of Mothers $30-39$	32.97%	29.90%	24.22%	19.44%
% of Mothers 40+	2.07%	1.90%	1.40%	1.00%
Diabetes	0.0310	0.0294	0.0289	0.0240
Chronic Hypertension	0.0082	0.0075	0.0091	0.0079
Eclampsia	0.0028	0.0048	0.0032	0.0029
Breech	0.0359	0.0321	0.0353	0.0297
% White	78.90%	74.73%	82.48%	33.47%
% Black	15.68%	14.66%	14.52%	10.63%
% Native American	0.830%	3.506%	1.48%	53.85%
% Hispanic	36.30%	46.27%	21.01%	12.77%
% Some college or less	75.38%	77.77%	82.98%	89.99%
% $\geq$ College	22.89%	19.81%	15.85%	8.81%
% Married	65.90%	65.90%	62.60%	56.85%
% Baby Boy	51.22%	51.20%	51.17%	51.05%
Parity	1.966	1.996	1.974	2.207
Weekday of Birth	4.051	4.054	4.044	4.019
N	68,442,892	5,720,734	8,425,384	47,445

It is natural to worry that the people who live in these different types of counties might be fundamentally different; in fact, the populations are fairly similar. From the richness of the vital statistics data, I am able to examine and control for medical and demographic differences between those who give birth in counties with and without federally controlled hospitals. For each population, I report the means of key outcome and control variables for the years 1990-2008 in Table 2. The first column in each panel gives the mean for all counties without a federally controlled hospital, and the second for counties with at least one IHS or military hospital.

While I cannot rule out all omitted variables, the fact the groups of mothers are comparable on many observable characteristics is comforting. There are a few important differences– for example, mothers who give birth in counties with a salaried hospital are less likely to be White or Black, and more likely to be Hispanic or Native American. The higher percentage of Native American mothers is not surprising, since some of the federal hospitals are run by the Indian Health Service. Perhaps counterintuitively, mothers in counties with federal government-controlled hospitals are slightly healthier. This could be due to the age structure of mothers, as on average the mothers in these counties are younger. The few differences in Table 2 highlight the importance of controlling for demographic characteristics and the underlying health of the mother in the regression analysis. The differences between the mothers are generally much greater when I narrow the sample down to single hospital counties, and thus I use this sample only to demonstrate the robustness of my main results.

For robustness, I also repeat the analysis for single hospital counties, where I know the hospital of birth for each child. An indicator for birth in a federal government controlled hospital is included in the regression, as opposed to an indicator for a county with at least one such hospital. This specification has pros and cons. On the one hand, I am now running a regression with less noise in the hospital of birth variable. On the other hand, there are very few single hospital counties where the hospital is federally controlled. In addition, the single hospital counties are very different on observables, both compared to each other and compared to the full sample (as can be seen in Table 2). Thus, I use these results only as supporting evidence for the main specification.

5 Results

I present two main sets of results. First, financial incentives matter: increasing fee differences cause fee-for-service doctors to shift patients into C-sections, while salaried doctors are unresponsive. I perform some additional analyses to explore the robustness of my results. As a placebo test, I look at repeat C-sections, a procedure where doctors have much less medical discretion, and find nothing. I also look at a subsection of single hospital counties, where I know the exact hospital of birth for all patients, and find results that support those of my main specification. Second, these marginal C-sections are associated with positive health outcomes for the patients; these procedures are associated with decreased infant death, and an increased probability that infants are born at normal birth weight.

As mentioned previously, due to data limitations, I do not know the exact insurance coverage or hospital of birth. As such, my county level analysis is fairly coarse. I attempt to convince the reader of the robustness of my results by looking both across counties with different densities of Medicaid patients, by looking at single county hospitals, and by using repeat C-sections as a placebo test. Of course, this does not solve the problem that my results may be attenuated to due to measurement error. Clearly, knowing the magnitude of the supply response is important, and my results are likely a lower bound. I argue that my results are still meaningful for the following two reasons. First, despite the coarseness of my specification, my estimate that a $100 increase in the fee difference is associated with a 3% increase in C-sections is not small. There were approximately 1.4 million C-sections in the U.S. in 2008, so this implies that reducing the fee difference by $100 would result in over 40,000 fewer C-sections per year. And second, the fact that I can differentiate between the supply responses for doctors working under different salary structures, and show that these changes in procedure choice are reflected in infant health outcomes, is important in its own right. Few papers have demonstrated health impacts of salary structure, and any reform aimed at changing procedure use by changing physician incentives must consider the effect of altered behavior on patient health.

5.1 Results on Procedure Choice

In Table 2 I present my main results on procedure choice; that fee-for-service doctors respond to increasing fee differences with increased use of primary C-sections, while salaried doctors do not. Since the outcome is primary C-sections, the sample is restricted to cases where the doctor is choosing between a vaginal birth or a first C-section. Because doctors have a significant amount of discretion over the primary C-section decision, this is where I expect to see physician incentives having an effect. For ease of interpretation, the coefficients presented are for $100 changes in the pay differences.

The pattern of coefficients across the columns of Table 2 is as expected – the coefficients become significant as the Medicaid discharge concentration increases. In the first column, none of the three explanatory variables are significant. This null result in the full sample is not surprising, due to the large amount of noise. The pay difference variable doesn't apply to over half the observations, as Medicaid coverage for births is between $40-50\%$ nationwide (see Figure 3). To remedy the problem of noise in insurance coverage, in columns 2 and 3 I narrow the sample to counties above the median and 75th percentile of the Medicaid intensity variable, respectively. When I focus on a sample with heavier Medicaid coverage, as anticipated, the coefficient on the pay difference increases and the coefficient on the interaction term decreases. The coefficient on the interaction becomes negative when I focus in on the top quartile of the Medicaid intensity variable, and both the interaction term and the pay difference become statistically significant.

The coefficient on the pay difference in column 3 implies the existence of an upward sloping supply curve or what has been called "physician induced demand" for C-sections – an increase of $100 in the C-section reimbursement rate relative to that for vaginal birth is associated with an increase in the probability of a primary C-section of 0.5 percent (for reference, the average primary C-section rate is 17%). An estimate of 0.5 corresponds to an increase of 3% of the primary C-section rate. And furthermore, this estimate is a lower bound; noise is introduced due to the fact that not all births in counties with federal hospitals occur at the salaried hospital, and not all births are covered by Medicaid. Thus, increasing the fee difference by a modest amount could have important

Table 3: Effect of Pay Difference and Hospital Type on Primary C-Sections (1990-2008)

VARIABLES	(1) Full Sample Primary C-section	(2) Above Median Medicaid Inten. Primary C-section	(3) Above 75 Pctle Medicaid Inten. Primary C-section	(4) Single Hosp. Counties Primary C-section
$100 Pay Difference	-0.002	-0.002	0.005**	0.004*
	(0.001)	(0.001)	(0.002)	(0.002)
PayDiff*FedHospCnty	0.004	0.002	-0.004*	-0.028***
	(0.002)	(0.002)	(0.002)	(0.008)
Cnty w/ Fed Hosp	-0.004	-0.006	0.001	-0.005
	(0.006)	(0.007)	(0.006)	(0.010)
Observations	39,494,136	24,352,568	12,693,089	4,952,046
R-squared	0.1718	0.1675	0.1598	0.1754

Robust standard errors clustered at the county level, *** p<0.01, ** p<0.05, * p<0.1. Full sets of birth year, state, and birth parity dummies included, as well as controls for age (<20, 20-24, 25-29, 30-35, 35-39, 40-44, and 45+), education (less than high school, high school, some college, college, and more than college), marital status, gender, weekday of birth, and risk factors (chronic hypertension, eclampsia, meconium, diabetes, and breech presentation).

impacts on primary C-section use. Earlier work on physician induced demand for C-sections used a random sample of discharge data (as opposed to the universe of births) and a much smaller sample of states and years, and the magnitude of the effect was disputed [Gruber et al., 1999, Grant, 2009]. My estimates of the effect of the reimbursement differential on the behavior of fee-for-service doctors support the findings of Gruber et al. [1999].

In addition, the primary C-section use of salaried doctors does not respond to the pay difference. The coefficients on the pay difference and on the interaction term in column 3 are roughly offsetting. Since the effect of the relative reimbursement rate on salaried doctors is the sum of these coefficients, this implies that the primary C-section use of salaried doctors does not respond to the pay difference. This reflects the intuition from the model in Section 2, while refuting the idea that the pay differential will be passed through to salaried doctors by the hospital administration.

And finally, the two types of doctors behave in the same way in the absence of a pay difference. The coefficient on the indicator for a county having a federally controlled hospital in column 3 is not statistically different from zero. This again reflects the intuition of Section 2, and lends support to the comparability of the two types of doctors.

For robustness, in column 4 I restrict the sample to those born in counties where I know the hospital of birth, and find similar results. While noisy, in this subsample of single hospital counties, the coefficients follow a similar pattern to column 3. This pattern reinforces the previous findings, with the main difference in column 4 being that the coefficient on the interaction term is much larger in magnitude than the coefficient on the pay difference. Thus, the two estimates are no longer close to offsetting, as intuition and the model would predict. To shed light this result, I break the data into different regions of the country and run the same single hospital county regression on each in turn. The results of this exercise are reported in Table 3.

Table 4: Effects on Primary C-Sections by Region in Single Hospital Counties

VARIABLES	(1) All Regions Primary C-Section	(2) Northeast Primary C-Section	(3) Midwest Primary C-Section	(4) South Primary C-Section	(5) West Primary C-Section
$100 Pay Difference	0.004*		0.002	0.005	0.001
	(0.002)		(0.004)	(0.004)	(0.001)
PayDiff*FedHospCnty	-0.029***		-0.030	-0.005	-0.046***
	(0.008)		(0.022)	(0.004)	(0.008)
Cnty w/ Fed Hosp	-0.005		-0.002	-0.046***	0.032**
	(0.010)		(0.013)	(0.017)	(0.013)
Observations	4,952,046	167,204	1,069,594	2,962,538	752,710
R-squared	0.175	0.174	0.189	0.167	0.192

Robust standard errors clustered at the county level, *** p<0.01, ** p<0.05, * p<0.1. Full sets of birth year, state, and birth parity dummies included, as well as controls for age (<20, 20-24, 25-29, 30-35, 35-39, 40-44, and 45+), education (less than high school, high school, some college, college, and more than college), marital status, gender, weekday of birth, and risk factors (chronic hypertension, eclampsia, meconium, diabetes, and breech presentation).

While fairly imprecise, the regional analysis shows that for the most part, the single hospital county specification does give estimates which are comparable to the main results in Table 2. I conducted F-tests that the coefficients on the pay difference and the interaction term sum to zero for each region, and test could only be rejected with confidence in the West. Based on the magnitude and precision of the coefficient on the interaction term, the West region seems to be an outlier. In each region, the total number of single hospital counties with federal hospitals is very small, so I do not place much weight on these results. Still, they provide evidence to support the conclusions of the full sample, and show that the results generally hold when the hospital of birth is known.

As a placebo test of my main results, Table 4 shows that the effect of compensation structure on procedure choice disappears when the outcome variable is a repeat C-section. The repeat C-section choice serves as a placebo test because the medical implications of "choosing wrong" are much larger than those for primary C-sections.[12] When I limit sample to cases where the doctor is choosing between a repeat C-section or VBAC, the doctor has less medical discretion, and I don't expect the pay difference to have an impact. As expected, the impact of the pay difference between C-sections and VBAC on procedure choice is nonexistent across the columns; no pattern emerges related to prevalence of Medicaid coverage. This null result provides supporting evidence that the conclusions drawn from Table 2 are not spurious, and reflect a real change in procedure choice due to salary structure and changing pay differences.

Table 5: Effect of Pay Difference and Hospital Type on Repeat C-Sections, 1996-2008

	(1) Full Sample	(2) Above Median Medicaid Inten.	(3) Above 75 Pctle Medicaid Inten.	(4) Single Hosp. Counties
VARIABLES	Repeat C-section	Repeat C-section	Repeat C-section	Repeat C-section
$100 Pay Difference	-0.003	-0.003	-0.000	-0.002
	(0.002)	(0.003)	(0.003)	(0.002)
PayDiff*FedHospCnty	-0.001	-0.003	-0.004	-0.121
	(0.004)	(0.004)	(0.004)	(0.080)
Cnty w/ Fed Hosp	0.000	-0.005	-0.023	0.049
	(0.011)	(0.013)	(0.024)	(0.047)
Observations	4,252,567	2,560,422	1,354,221	520,028
R-squared	0.087	0.083	0.080	0.092

Robust standard errors clustered at the county level, *** p<0.01, ** p<0.05, * p<0.1. Full sets of birth year, state, and birth parity dummies included, as well as controls for age (<20, 20-24, 25-29, 30-35, 35-39, 40-44, and 45+), education (less than high school, high school, some college, college, and more than college), marital status, gender, weekday of birth, and risk factors (chronic hypertension, eclampsia, meconium, diabetes, and breech presentation).

In this section, I showed that in hospitals where doctors are salaried, primary C-section use doesn't respond to changes in the fee difference between C-section and vaginal birth. This is contrasted with the situation in other hospitals, where the pay difference does impact procedure choice. In the next section, I consider the impact of C-sections induced by the changing pay difference on infant health.

[12] McMahon et al. [1996] followed 6138 women in Nova Scotia who had previously given birth by C-section from 1986-1992, roughly half of whom had elected trial of labor in their subsequent delivery, and half of whom had elected to undergo a second Caesarean section. The authors found that while the rate of maternal complications was similar between the two groups, major complications were twice as likely among the group attempting VBAC. This study caused the ACOG to issue new guidelines on VBAC management, including the recommendation that "because uterine rupture may be catastrophic, VBAC should be attempted in institutions equipped to respond to emergencies with physicians immediately available to provide emergency care" [Bulletin, 1999].

5.2 Results on Health Outcomes

In this section, I show that procedures chosen by doctors because of how they are paid are not necessarily bad for patients. The literature on physician induced demand defines it as when the physician influences a patient's demand for care against the doctor's interpretation of the best interest of the patient – such as when a change in the physician's return to inducement stimulates a change in procedure choice [McGuire, 2000]. Much work has been concerned with identifying examples of PID (for an overview, see McGuire [2000]), but has stopped short of investigating what it means for the patient. In the previous section, I identified a case where changes in the relative reimbursement rate increased procedure use, and the supply of C-sections depended on whether the doctors were paid fee-for-service or salary. Now, I turn my attention to the impact of compensation structure and changing pay differences on health outcomes.

My strategy is to use the same variation in compensation structure and Medicaid reimbursement rates that I used to identify impacts on the C-section supply to examine whether these financial incentives also impacted infant health. Ideally, I would look at the impact of these marginal C-sections on both mother and child health, but I am limited by the data to infant health variables. The most prominent infant health outcome available is infant death, which is defined as a child dying before his or her first birthday. I also look at birth weight and gestational age.

Table 6: Effect of Induced Primary C-Sections on Infant Health

	(1) Full Sample	(2) Above Median Medicaid Inten.	(3) Above 75 Pctle Medicaid Inten.	(4) Single Hosp. Counties
VARIABLES	Infant Death	Infant Death	Infant Death	Infant Death
$100 Pay Difference	-0.0000	-0.0000	-0.0003**	-0.0001
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
PayDiff*FedHospCnty	0.0001	0.0000	0.0003**	0.0023***
	(0.0001)	(0.0001)	(0.0001)	(0.0006)
Cnty w/ Fed Hosp	0.0005**	0.0004	0.0002	-0.0022**
	(0.0003)	(0.0003)	(0.0003)	(0.0009)
Observations	39,494,136	24,352,568	12,693,089	4,952,046
R-squared	0.0042	0.0041	0.0034	0.0035

Robust standard errors clustered at the county level, *** p<0.01, ** p<0.05, * p<0.1. Full sets of birth year, state, and birth parity dummies included, as well as controls for age (<20, 20-24, 25-29, 30-35, 35-39, 40-44, and 45+), education (less than high school, high school, some college, college, and more than college), marital status, gender, weekday of birth, and risk factors (chronic hypertension, eclampsia, meconium, diabetes, and breech presentation).

In Table 6, I show that infant death decreases when primary C-sections are induced by changing in pay differences. I run the same specifications as in Table 2, except with infant death as the dependent variable. Previously shown to increase C-section use, increases in the pay difference are also associated with a higher probability of surviving to one year. The pattern across Table 6 is the same as in the analysis on primary C-sections, but opposite in sign; there is no effect in the general population, but once again the results appear in counties with high Medicaid coverage. The coefficients imply that an increase in the pay difference of $100 is associated with a decrease in the probability infant death of 0.0003. This corresponds to roughly 5% of the average infant death rate in 2008 (6.5 deaths per one thousand live births).

Table 7: Effect of Fee Difference and Hospital Type on Other Health Outcomes

	Birth Weight			Weight for Gestational Age		
	Low	Normal	High	Small	Normal	Large
	(1)	(2)	(3)	(4)	(5)	(6)
$100 Pay Difference	-0.001	0.003***	-0.002	0.002*	0.001	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PayDiff*FedHospCnty	0.002	-0.004**	0.002	-0.001	-0.001	0.002
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Cnty w/ Fed Hosp	0.002	-0.002	-0.001	0.001	0.002	-0.002
	(0.003)	(0.004)	(0.006)	(0.003)	(0.002)	(0.006)
Observations	12,693,089	12,693,089	12,693,089	12,693,089	12,693,089	12,693,089
R-squared	0.020	0.010	0.021	0.019	0.003	0.019

Robust standard errors clustered at the county level, *** p<0.01, ** p<0.05, * p<0.1. Full sets of birth year, state, and birth parity dummies included, as well as controls for age (<20, 20-24, 25-29, 30-35, 35-39, 40-44, and 45+), education (less than high school, high school, some college, college, and more than college), marital status, gender, weekday of birth, and risk factors (chronic hypertension, eclampsia, meconium, diabetes, and breech presentation).

In order to investigate potential mechanisms behind the decline in infant death, I look at the impact of compensation structure on birth weight and weight for gestational age. Each measure has pros and cons; birth weight is more precisely measured than gestational age, but weight for gestational age is considered more medically meaningful. Large for gestational age (LGA) infants, for example, are associated with many problems, such as metabolic abnormalities (hypoglycemia, hypocalcemia), traumatic birth injuries, polycythemia, hyperviscosity, hyperbilirubinemia, and the possibility of various congenital anomalies [Nafday, 2008].[13] My strategy is to again use the same

[13] Causes of LGA in infants include obese mothers, long gestational periods, and the overstimulation of growth in utero. Additional risk factors include maternal weight gain during pregnancy, multiparity, a male fetus, and ethnicity. Infants of mothers with pregestational diabetes mellitus or gestational diabetes are exposed to high blood sugar during fetal development, or they may develop high circulating insulin levels and may therefore grow excessively. Women with gestational diabetes with glucose tolerance during late pregnancy may remain undiagnosed and may deliver a

specification, but now to look at the impact of financial incentives on the probability of low, normal, and high birth weight, and small, normal, and large weight for gestational age, respectively.[14] For brevity, I only report the equivalent of column 3 in the previous tables– the sample above the 75th percentile on the Medicaid intensity index, where the results are the strongest.

The main takeaway of Table 7 is that increases in the pay difference previously found to increase C-section use are also associated with decreases in large and LGA babies. As older babies tend to weigh more, this is consistent with doctors increasing C-section rates for babies that are heavy for their age. Since C-sections are scheduled before birth, these babies are born earlier (and thus lighter) than they would be if they were carried to term.[15] This also leads to an increase in normal birth weight babies.

These results shed some light on where the marginal C-sections are being performed, and give further evidence that doctors are changing behavior in response to changing pay differences. The increase in normal birth weight children, coupled with a decrease in LGA infants, implies that many of the induced C-sections are on marginally heavy babies (or those that were expected to become LGA). The increase in SGA is harder to explain, and the weight for gestational age estimates are fairly imprecise. Yet on average, at least, the end result of an increased pay difference appears to be a healthier birth weight and lower probability of infant death.

These findings do not, however, mean that more C-sections should be performed. I have not taken into account the increased health risks of C-sections for the mother, which could out weigh the potential benefits to infant health. What they do suggest is that for some infants whose doctors are on the margin between delivering them vaginally or with a C-section, there appears to be some evidence of C-sections leading to infant health benefits. Again, this result supports 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 the procedure use across the board. Diagnostic improvements could result in better outcomes for both high and low risk pregnancies, while simple salary structure reforms could lead to worse health outcomes for some groups.

6 Conclusion

While there are many aspects of the healthcare system with the potential to drive costly behavior, one is the fact that doctors are typically paid for services provided. This provides a financial incentive for doctors to increase the costs of treatment provided, and because of low cost-sharing, patients don't provide a sufficient check on this behavior. The Obama administration has proposed changing the way doctors and hospitals are paid as one way to bend down the health care cost curve. Changing the dominant payment model would represent a fairly radical reform, and so evidence of

LGA infant with greater perinatal complications [Nafday, 2008].

[14] Normal birth weight is defined as being born between 2500g and 4000g, with low birth weight defined as being below 2500g and high birth weight as being above 4000g. Normal weight for gestational age is defined as being within the 10th and 90th birth weight percentile for each week of gestational age. Small for gestational age is being below the 10th percentile, and large for gestational age is being above the 90th percentile.

[15] In the final month of pregnancy, babies gain around 1/2 pound (227 grams) per week.

its potential impacts is important.

Economists have shown that physicians respond to financial incentives, but there is little work that explicitly compares the procedure choices and health outcomes of physicians working under different compensation systems[16]. By leveraging the fact that doctors in federally controlled hospitals are salaried, I was able to study the different incentives inherent in the two compensation systems. I found that in fee-for-service hospitals, the pay differences has a fairly sizable impact on C-section use. This is in sharp contrast to the situation in salaried hospitals, where the financial incentives to order more intensive procedures are eliminated, despite the potential for the incentives to be passed through to the doctor via the hospital administration. In hospitals where doctors are salaried, primary C-section use doesn't respond to changes in the pay difference between C-section and vaginal birth. This result alone could imply that many C-sections are due to the compensation structure, and a salaried system would be better.

After demonstrating that supply of C-sections varies by compensation structure, however, I examined the effects of these induced procedures on infant health. I found that even procedures performed for purely financial reasons are associated with a decrease in the probability of infant death. The fact that there was a statistically significant decrease in infant deaths due to physician induced C-sections is notable, since infant death rates are already fairly low (around 6.5 deaths per 1000 live births). C-sections are widely regarded as overused in the US – yet even in these marginal cases, there seem to be measurable increases in infant health. Again, this is not a recommendation for more C-sections; it is merely an indication that care must be taken when using financial incentives as a tool to change physician behavior. Reducing procedure use indiscriminately may have unintended consequences for patient health, and these potential side effects of cost control policy should be taken seriously.

Finally, I note that the idea of moving mainstream medicine away from a fee-for-service system is not just an interesting thought experiment; it is becoming a reality. The Affordable Care Act of 2010, for example, created and funded projects designed to shift Medicare away from the fee-for-service model. The law includes pilot programs where Medicare will reimburse health care providers for "episodes" of care, rather than separately for every service provided. In the model presented in Section 2, this is equivalent to a salaried compensation scheme [USDHHS, 2012], as the pay difference between the two procedures would be zero. It will be interesting to see if these types of programs are successful, and whether they are able to lower costs while maintaining high health outcomes.

[16] Another interesting example is [Coey, 2013], which finds that heart attack management becomes more conservative when doctors are paid by bundled payments rather than fee-for-service.

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7 Appendix

Table A1: Procedure and Billing Descriptions

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

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.

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 A1). 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 A2: 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