Do Payment Contracts in Healthcare Influence Medical Treatment Decisions?*

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May 21, 2025

Abstract

We estimate the plausibly causal effect of fee-for-service (FFS) contracts relative to less retrospective contracts between health insurers and healthcare practices on treatment decisions for deliveries. We find that covering c-sections under FFS increases the c-section rate by 16% while covering vaginal deliveries under FFS has no impact on procedure choice. Effects are explained mainly by payment retrospectiveness rather than payment amount. Impacts of FFS on treatment decisions do not vary by pregnancy risk, but also have no impact on maternal or infant health outcomes. Results constitute evidence of substantial moral hazard at the healthcare practice level generated by retrospective contracts.

Keywords: Moral hazard, Cesarean section, Fee-for-service, Capitation.

JEL codes: I11, I13, I18.

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1 Introduction

A fundamental question in health economics is whether contracts between insurers and healthcare practices affect medical treatment decisions. The most common contracts across different health systems are fee-for-service (FFS) and capitation, which lie on opposite ends of the spectrum of payment retrospectiveness.[1] Other contracts such as bundled payments have also emerged recently, which are less than perfectly prospective or retrospective (Einav et al., 2022; Agarwal et al., 2020; Press et al., 2016). Most literature to date documents a correlation between FFS contracts and health care costs (e.g., Baker, 1999, 1997) and establishes incentives that insurers and healthcare practices face under each contract (e.g., Acquatella, 2021; Ho and Pakes, 2014a; Ellis and McGuire, 1986). However, evidence on the causal impacts of FFS contracts on treatment decisions is scarce because of a lack of comprehensive data on insurer-practice contracts and limited sources of exogenous variation in these bilateral contracting decisions.

In this paper, we estimate the plausibly causal effect of health care contracts in Colombia's health system, where multiple insurers negotiate with multiple practices over contracts for every health service. Healthcare practices in our setting encompass hospitals, clinics, and physician groups. We focus on the impact of FFS relative to less retrospective contracts like capitation and bundled payments (CAP) on the decision to provide a cesarean section (c-section). In our setting, insurers and practices may cover c-sections under a different contract than vaginal deliveries, resulting in contract variation within insurer-practice pair. Contracts for each service also vary across types of women—defined by age group and pregnancy risk—as well as over time. Using data on deliveries performed between 2013 and 2015, we show that the temporal variation in contracting decisions is unrelated to a wide range of insurer, practice, and woman characteristics.

We regress the c-section rate and other outcomes on an indicator for whether c-sections

[1] FFS contracts are fully retrospective, while capitation contracts are fully prospective.

or whether vaginal deliveries are covered under FFS.[2] Our findings show that the c-section rate increases 16% when c-sections switch from CAP to FFS and vaginal deliveries are fixed at CAP. Similarly, c-section rates increase 11% when vaginal deliveries switch from FFS to CAP and c-sections are fixed at FFS. These results are consistent with the predictions of a model in which insurer-practice pairs cover different procedures under different contracts and where physicians in those practices choose procedures to maximize profits. In this model, the impact of FFS is asymmetric across c-sections and vaginal deliveries due to differences in their prices and marginal costs.

We find that the impact of FFS does not vary according to pregnancy risk, which is particularly worrisome for high-risk pregnancies for whom one procedure is likely to be medically recommended. Conversely, we estimate that responsiveness to contract types is more pronounced among smaller healthcare practices, where incentives between physicians and managers may be better aligned.

Our findings also show that healthcare practices are responsive to contract type even when controlling for the payment amount from insurers. This demonstrates that, conditional on payment amount, healthcare practices respond to the incentives generated by whether payments are made prospectively or retrospectively. Furthermore, there is no evidence that CAP contracts generate risk selection incentives on the intensive margin; that is, in the style of Brown et al. (2014), there is zero correlation between ex-ante health care spending and contracting decisions. Hence, the main mechanism at play is moral hazard.

We additionally estimate whether rates of severe maternal morbidity after birth and infants' birth weights and 1-minute APGAR scores differ depending on the delivery procedure contract.[3] We find no evidence that the use of FFS affects these measures of maternal and infant health.

Our paper contributes to a long line of literature dating back to the 1980s studying

[2]We define the c-section rate as the fraction of deliveries performed by c-section within an insurer, practice, type of woman, and half-year.

[3]The APGAR score is a measure of infant health during the birthing process. This score is on a scale from 1 to 10, with a higher score reflecting better infant health.

provider moral hazard under different payment schemes (e.g., Ellis and McGuire, 1996, 1986). Early and recent papers have analyzed provider incentives by payment amount and degree of retrospectiveness through a theoretical lens (e.g., Acquatella, 2021; Ma and Mak, 2019, 2015), but so far empirical evidence estimating causal impacts of the use of retrospective or prospective payments has been scant. Some exceptions have modeled optimal contracts in the context of dialysis medications (Gaynor et al., 2023), utilized system-wide changes in payments such as transitions from FFS to managed care systems (Kuziemko et al., 2018; Aizer et al., 2007), leveraged changes in payments within FFS systems (Clemens and Gottlieb, 2014) or within capitation systems (Ho and Pakes, 2014b,a), and exploited changes in how the government reimburses hospitals under bundled payments (Einav et al., 2022). We complement this work by estimating the plausibly causal effect of the use of FFS exploiting variation in contracting decisions within insurer-practice pairs in a managed care system.

We also contribute to the literature on determinants of c-section rates. With c-sections becoming more prevalent in the last two decades across the globe (Betrán et al., 2016), contributing to rising health care costs (Sakala et al., 2013), and being the top reason for hospitalization among women (AHRQ, 2018), understanding how delivery decisions are made has become central to the health policy debate. Some work has studied place-based drivers of c-section rates (Robinson et al., 2024; Card et al., 2023) and the role of physician moral hazard (Foo et al., 2017; Godager and Wiesen, 2013; Johnson and Rehavi, 2016). We contribute to this work by showing that contracts between insurers and healthcare practices have significant effects on c-section rates. Moreover, we show that incentives depend on the contract under which each delivery procedure is covered, and that regulation of payments for a single delivery service may generate very different effects depending on how the alternative service is reimbursed.

The remainder of this paper is structured as follows: Section 2 describes our institutional setting and presents the theoretical framework, Section 3 describes our data, Section 4 presents our empirical design, Section 5 shows our main results, and Section 6 concludes.

2 Setting and Theoretical Framework

We study the contracts established between insurers and healthcare practices participating in Colombia's contributory health care system, which covers the half of the population in the country who pay payroll taxes (around 25 million people). In this system, private insurers provide one national health insurance plan to their beneficiaries through a network of providers. Other elements of the insurance plan such as premiums, cost-sharing, and benefits are strictly regulated. Healthcare practices in our empirical setting include hospitals, clinics, and physician groups, but not stand-alone doctors. These practices operate in a single market or municipality (similar to a county in the U.S.).

Insurers negotiate with practices over contracts for each health service covered by the national insurance plan. This means that different services such as c-sections and vaginal deliveries may be covered under different contracts even for the same insurer-practice pair. Insurers and healthcare practices can choose from a set of three contract types: FFS, bundled payments, and capitation. If a service is covered under FFS, then the insurer negotiates a price to be paid every time the service is provided to one of its beneficiaries only after it has been provided. Thus, FFS is fully retrospective. If a service is covered under capitation, then the insurer negotiates a price per person, a service frequency per person, and a target population, and pays the healthcare practice the product of these three elements before services are provided to their beneficiaries (typically at the beginning of the calendar year). Thus, capitation is fully prospective. Low-complexity services such as primary care consultations and blood tests tend to be capitated.[4]

Under bundled payments, the insurer negotiates a price for a bundle of services used during an episode of care. This price is paid every time an episode of care occurs. Episodes of care typically covered under bundled payments tend to be highly standardized such as hysterectomies or appendectomies. Bundled payments are less than fully retrospective because

[4]The distinction between FFS and capitation with respect to the complexity of the service implies that delivery procedures are more likely to be covered under FFS and bundled payments than under capitation.

the insurer does not pay for additional services provided during the episode of care that are not included in the bundle. For example, if the physician at the healthcare practice uses a vacuum cup during a vaginal birth but the contract only covers forceps, then the vacuum cups will not be reimbursed by the insurer. Given that capitation and bundled payments function similarly with respect to retrospectiveness in this setting, for the remainder of this study we will distinguish only between FFS and non-FFS, where non-FFS refers to both capitation and bundled payments and will be referred to as CAP.

In the case of childbirth, physicians at healthcare practices that have fully retrospective contracts like FFS, have an incentive to provide the service with the highest profit margin. Under prospective contracts like capitation and bundled payments, physicians at these practices instead have an incentive to provide the lowest cost treatment since payments do not vary with the services actually rendered.[5] These incentives have been well documented in other settings where contracts may vary over time, but do not vary across services (e.g., Kuziemko et al., 2018; Adida et al., 2017; Ho and Pakes, 2014a). However, in our setting where contracts may differ across delivery procedures, incentives will depend on the combination of contracts.

To see these incentives more clearly, we propose a simple theoretical model in which the practice chooses a procedure for each woman type to maximize profits. This decision is independent across woman types and we assume that all physicians within the practice adopt these practice-level procedure choices. For simplicity, we present the model conditional on one type of woman but a more general description would have procedure prices and marginal costs indexed to the woman type.[6] Let the price of a c-section be p_C and its marginal cost be

[5] In our setting, physicians' incentives are aligned with practice incentives because of how physicians are paid. Hospitalists and OBGYNs at private healthcare practices or hospitals are typically paid per procedure or have base salaries plus commissions per procedure. In the case of public hospitals, physicians and OBGYNs tend to have fixed salaries.

[6] In this model, we also take insurer-practice contracting decisions as fixed and focus on practices' downstream procedure choices. In the upstream contracting problem, a risk-neutral insurer contracts with a practice whose treatment intensity is unobservable to the insurer, generating a problem of asymmetric information. The treatment intensity determines the probability of c-sections and vaginal deliveries. The insurer offers a contract to the practice, which it can accept or reject. Our analysis centers on determining the practice's optimal choice of treatment intensity, given that they have accepted the contract.

m_C and let the corresponding values for vaginal deliveries be p_V and m_V. We assume that $m_C > m_V$. The unit of payment depends on which contract type the procedure is covered under. When a procedure is covered under CAP, we summarize the product of frequency of use and target population as the "expected rate of use," normalized to one. Thus, the expected rate of use is π_C for c-sections and $1 - \pi_C$ for vaginal deliveries when they are covered under CAP.

We assume practices are risk neutral. The profit from choosing procedure $s \in \{C, V\}$ conditional on the contracts and the type of woman is

$$E[\Pi_s|\mathbf{FFS}, \mathbf{x}] = (E[R_s|\mathbf{FFS}] - m_s)D(\mathbf{x})$$

where

$$\begin{aligned} E[R_s|\mathbf{FFS}] =& (\text{FFS}_C\mathbf{1}[s = C] + (1 - \text{FFS}_C)\pi_C)p_C \\ &+ (\text{FFS}_V(1 - \mathbf{1}[s = C]) + (1 - \text{FFS}_V)(1 - \pi_C))p_V \end{aligned}$$

R_s is the practice's revenue per woman, FFS_s is an indicator for whether service s is covered under FFS, $\mathbf{1}[s = C]$ is an indicator for choosing c-sections, and $\mathbf{x}$ is a vector of observed insurer, practice, and woman characteristics. We assume practice demand $D(\mathbf{x})$ is independent of FFS_s because contracts are not directly observable to women conditional on $\mathbf{x}$.[7] Demand is also independent of procedure prices for simplicity. The practice's problem is

$$\max_{s \in \{C,V\}} \{E[\Pi_C|\mathbf{FFS}], E[\Pi_V|\mathbf{FFS}]\}$$

In this model, payment retrospectiveness affects only expected revenues but not costs, since costs are incurred only when a procedure is actually rendered. Payment retrospective-

[7] Patients in Colombia do not observe the contracts between insurers and practices, but may select into practices based on characteristics that correlate with the use of FFS such as practice size or quality, which we capture in the model with $\mathbf{x}$. Thus, our assumption is that conditional on $\mathbf{x}$, practice demand does not vary with contract types.

ness impacts expected revenues in two ways. First, the expected rate of use summarizes the ex-ante number of procedures that insurers and practices expect to render to their beneficiaries and thus applies only when procedures are covered under CAP. For example, if both procedures are covered under CAP, then the expected revenue per woman is $\pi_C p_C + (1-\pi_C)p_V$, but when both procedures are covered under FFS the expected revenue per woman is independent of π_C. Second, even if a procedure is covered under CAP but is not chosen, practices still get paid for it ex-ante. For example, if conditional on c-sections being covered under FFS and vaginal deliveries being covered under CAP, the practice chooses c-sections, then its expected revenue per woman equals $p_C + (1-\pi_C)p_V$.

TABLE 1: Example of Contracting Scenarios and Incentives

Scenario (1)	Contract (2)	Service (3)	Expected rate of use (4)	Expected practice profit (5)	Choice (6)
1	CAP	C-section	π_C	$\pi_C p_C + (1-\pi_C)p_V - m_C$	0
	CAP	Vaginal delivery	$1-\pi_C$	$\pi_C p_C + (1-\pi_C)p_V - m_V$	1
2	FFS	C-section	—	$p_C - m_C$	?
	FFS	Vaginal delivery	—	$p_V - m_V$	
3	FFS	C-section	—	$p_C + (1-\pi_C)p_V - m_C$	1
	CAP	Vaginal delivery	$1-\pi_C$	$(1-\pi_C)p_V - m_V$	0
4	CAP	C-section	π_C	$\pi_C p_C - m_C$	0
	FFS	Vaginal delivery	—	$\pi_C p_C + p_V - m_V$	1

Note: Table shows examples of the profit maximizing choice of procedure for the practice under four possible contracting scenarios in which c-sections and vaginal deliveries are either covered under the same contract or under different contracts. The price and marginal cost of a c-section are p_C and m_C, respectively, and the corresponding values for vaginal delivery are p_V and m_V. The expected rate of use π_C summarizes the product of frequency of use and target population in a CAP contract, normalized to 1. The procedure choice is the one that maximizes profits for the practice conditional on each contracting scenario.

Table 1 summarizes practices' expected profits per woman under the four possible contract type combinations. This table highlights that the choice of procedure will depend on prices, marginal costs, and payment retrospectiveness. For instance, in the case where both procedures are capitated in scenario 1, practices will choose to render vaginal deliveries because of their lower marginal cost. Covering vaginal delivery under FFS as in scenario 4 only heightens incentives to provide vaginal deliveries as now revenues increase in the number of vaginal deliveries provided. In scenario 2, we see that covering both c-section

and vaginal delivery under FFS generates ambiguous predictions on the choice of procedure, as the decision depends on whether the profit margin for c-section exceeds that for vaginal delivery. In scenario 3, where c-sections are covered under FFS and vaginal deliveries under capitation, the practice would choose to perform c-sections because of the degree of payment retrospectiveness. Note that in this scenario even if c-sections and vaginal deliveries had the same price and marginal cost, the profit maximizing choice of procedure would still be c-sections. Therefore, this choice of procedure can only be explained by the degree of payment retrospectiveness. In Appendix D we extend this stylized model to allow for practice-level risk aversion, finding that our predictions of the choice of procedure hold under certain assumptions of the risk aversion coefficient.

Table 1 also provides insight into the overall effect of using retrospective contracts like FFS and how those effects can be expected to differ for c-section and vaginal delivery. To estimate the effect of covering c-section under FFS we can:

- Compare scenario 3 to scenario 1, where the contract for vaginal deliveries is fixed to CAP. In the latter scenario, incentives are strongly in favor of providing vaginal delivery; therefore, the effect of covering c-section under FFS is very likely to increase the c-section rate.

- Compare scenario 2 to scenario 4, where the contract for vaginal deliveries is fixed to FFS. As before, incentives in scenario 4 favor vaginal delivery; hence, covering c-section under FFS likely increases the use of c-section in this exercise.

Similarly, to estimate the effect of covering vaginal delivery under FFS we can:

- Compare scenario 4 to scenario 1, where the contract for c-sections is fixed to CAP. Because in both scenarios incentives are aligned with the provision of vaginal delivery, we should expect to find no impact of FFS on the c-section rate.

- Compare scenario 2 to scenario 3, where the contract for c-section is fixed to FFS.

Given that incentives under scenario 3 are aligned with the provision of c-sections, the effect of covering vaginal deliveries under FFS on the c-section rate is ambiguous.

In our empirical application, we take advantage of variation in contracts over time and across procedures to estimate whether insurers and practices are responsive to these asymmetric incentives. Failure to account for differential responses to FFS depending on the procedure can lead to underestimation of the desired treatment effect. Consider for example a comparison of scenarios 2 and 3 to scenarios 1 and 4. In the former group, c-sections are covered under FFS while in the latter they are covered under CAP. In scenarios 1 and 4 the practice would always choose vaginal delivery, thus covering c-section under FFS in scenarios 2 and 3 would likely lead to higher c-section rates. While the direction of the effect is consistent with our intuition, this naïve estimation confounds the impact of changes in the contract for vaginal deliveries with changes in the contract for c-sections. If vaginal deliveries are more likely to be provided in scenario 4, then the effect of the c-section contract on c-section rates will likely be attenuated.

We note that our model is a simplified representation of the world and may not capture several other ways in which profits may vary and in which agents may respond to contracts. On the one hand, physicians at these healthcare practices may be altruistic, considering both profits and patient utility when making procedure choices. However, to the extent that the degree of altruism does not vary across contracting scenarios, this distinction will not affect the predictions of our model. On the other hand, practices under CAP may have incentives to select low-risk patients who are less likely to need health care, while insurers may have incentives to steer high-risk patients towards practices covered under CAP. These risk selection incentives can make healthcare practice demand depend on the contracts, which would lead us to underestimate the impact of FFS on the use of c-sections. For example, if insurers send all the high-risk women who potentially need c-sections to practices where c-sections are covered under CAP, then the impact of FFS on the c-section rate will be biased toward zero.

There may be other unobserved determinants of delivery procedure choice such as convenience or practice-level capacity constraints, which we do not consider. However, if moral hazard at the practice level is the predominant way in which contracts affect delivery procedure choice and outcomes, we can expect to estimate results in line with the incentives presented in Table 1.

3 Data and Descriptives

We use health claims data for all pregnant women in the contributory system who had a childbirth between 2013 and 2015. These data report the type of service, service date, healthcare practice, insurer, negotiated service price, and contract type for each claim. There are 521,408 deliveries in the raw data. We categorize women as having a high-risk pregnancy if they received a diagnosis indicating that their pregnancy was high risk any time in the 9 months of pregnancy.[8] We also categorize women as having severe maternal morbidity (SMM) based on the services and diagnosis codes rendered between 1 week and 1 month after childbirth following the Centers for Disease Control and Prevention's definition.[9]

We focus on women in reproductive age (15-50), exclude women with multiple or breech pregnancies for whom c-sections are medically recommended, and keep deliveries associated with a woman's first childbirth. Our final analysis sample contains 324,876 deliveries. Whenever a delivery is performed at a hospital, clinic, or physician practice, we observe the facility's ID number, but we do not have information on the individual physician who performed the delivery procedure at this facility. Furthermore, we do not observe whether a c-section is scheduled or emergent.

[8] These ICD-10 codes include: supervision of high-risk pregnancies (O09), infections of genitourinary tract in pregnancy (O23), pregnancy-induced hypertension or pre-eclampsia (O10-O16), hemorrhage due to threatened abortion (O20), excessive vomiting during pregnancy (O21), venous complications and hemorrhoids in pregnancy (O22), diabetes mellitus in pregnancy, childbirth, and the puerperium (O24), malnutrition in pregnancy, childbirth and the puerperium (O25), abnormal findings on antenatal screening of mother (O28), and complications of anesthesia during pregnancy (O29)

[9] See Centers for Disease Control and Prevention (2024).

TABLE 2: Summary Statistics of Analysis Sample

	C-sections	Vaginal deliveries
Delivery characteristics, mean (sd)		
Fee-for-service (FFS)	0.743	0.662
	(0.437)	(0.473)
Bundled payment	0.233	0.324
	(0.423)	(0.468)
Pure capitation	0.0245	0.0142
	(0.154)	(0.118)
Age≤27	0.674	0.787
	(0.469)	(0.409)
Age>27	0.326	0.213
	(0.469)	(0.409)
High pregnancy risk	0.513	0.452
	(0.500)	(0.498)
Severe maternal morbidity (SMM)	0.0480	0.0320
	(0.214)	(0.176)
Gestational age (weeks)	38.21	38.62
	(2.024)	(1.521)
Birth weight (grams)	3099.5	3070.8
	(569.4)	(413.0)
1-min APGAR	8.236	8.277
	(0.888)	(0.853)
Spending on delivery day†	545.7	441.2
	(539.9)	(333.5)
Spending up to delivery day†	621.1	534.0
	(647.4)	(479.4)
Number of observations		
Deliveries	155793	169083
Insurer-practice pairs	1057	1043
Practices	426	425
Insurers	12	12

Note: Table shows the mean and standard deviation (in parenthesis) of the main variables in our analysis sample separately by delivery procedure. An observation is a delivery. The 1-minute APGAR score reflects how well the infant tolerated the birthing process and is measured on a scale from 1 to 10, with a higher score reflecting better infant health.
†Measures of spending are reported in 2014 USD.

Table 2 presents summary statistics of our analysis sample. An observation is a delivery claim. The c-section rate equals 48%. Most deliveries are reimbursed under a FFS contract, although the use of FFS is more prevalent for c-sections than for vaginal deliveries. Among less retrospective contracts, we see that most insurer-practice pairs tend to use bundled payments over capitation, and that the use of these contracts is more common for vaginal

deliveries than for c-sections. More than half of deliveries performed correspond to women of age 27 or younger. Around half of pregnancies are classified as high risk, but the rate of high risk pregnancies is greater among c-sections. Likewise, spending up to and on the day of the delivery is higher for c-sections, as are rates of SMM. Infant health outcomes including the 1-minute APGAR score and birth weight are marginally better for vaginal deliveries relative to c-sections.

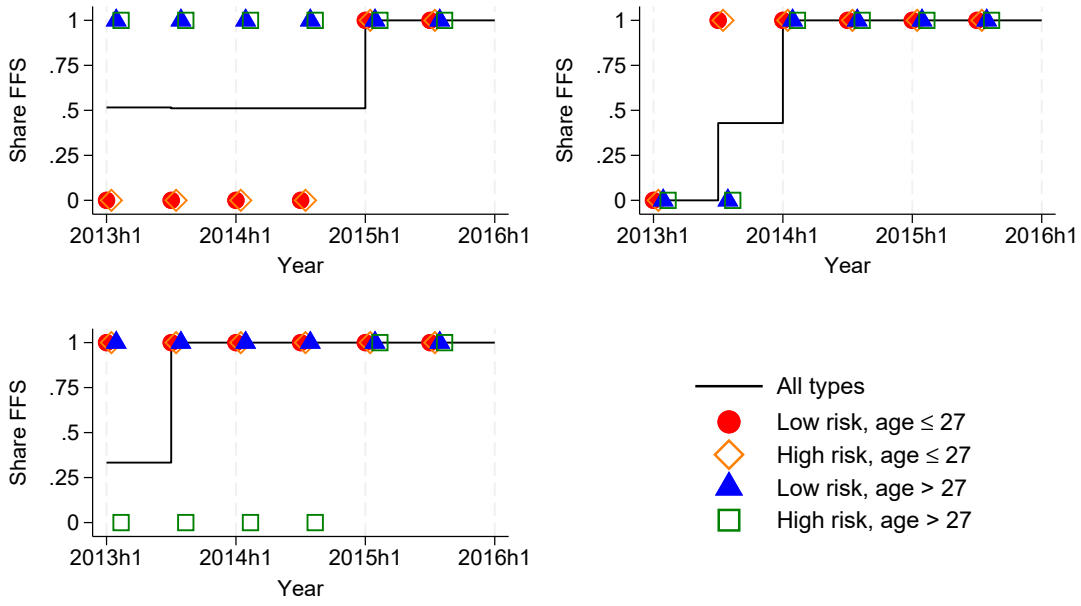
3.1 Trends in Contracting Decisions

Insurers and healthcare practices typically negotiate contracts at the beginning of every calendar year, but the end of these negotiations and the timing of when contracts are enacted can vary. Insurer-practice pairs negotiate contracts for each delivery procedure and may choose to index contract types to patient characteristics such as the woman's age and pregnancy risk. In the analysis to follow, we define a woman type or contracting unit for an insurer-practice pair in a given half-year as a combination of age-group ($\leq$27, >27) and pregnancy risk (high vs. low). We choose the age of 27 as the age group cutoff because this corresponds to the average age in the analysis sample. We assign to each insurer-practice-woman type-half year its modal contract type; this modal contract equals the observed contract for 96% of deliveries in our data.[10]

The primary source of variation that we use in our empirical analyses is in the contract type used by an insurer-practice pair for a given woman type over time. Figure 1 illustrates this variation in the c-section contract for three of the 3,404 insurer-practice pairs in our analysis sample. For each insurer-practice pair there is variation in contracts within a woman type. For example, Panel A shows an insurer-practice pair where no c-sections were reimbursed under a FFS contract for low-risk women under the age of 27 before 2014-2, but by 2015-2 all c-sections were covered under FFS. Panel B shows an insurer-practice pair

[10]For the 4% of observations for which the modal contract does not equal the observed contract, we impose the modal contract. Our results are robust to excluding these observations as seen in section 5.4.

FIGURE 1: Examples of Contract Variation within Insurer-Practice Pairs

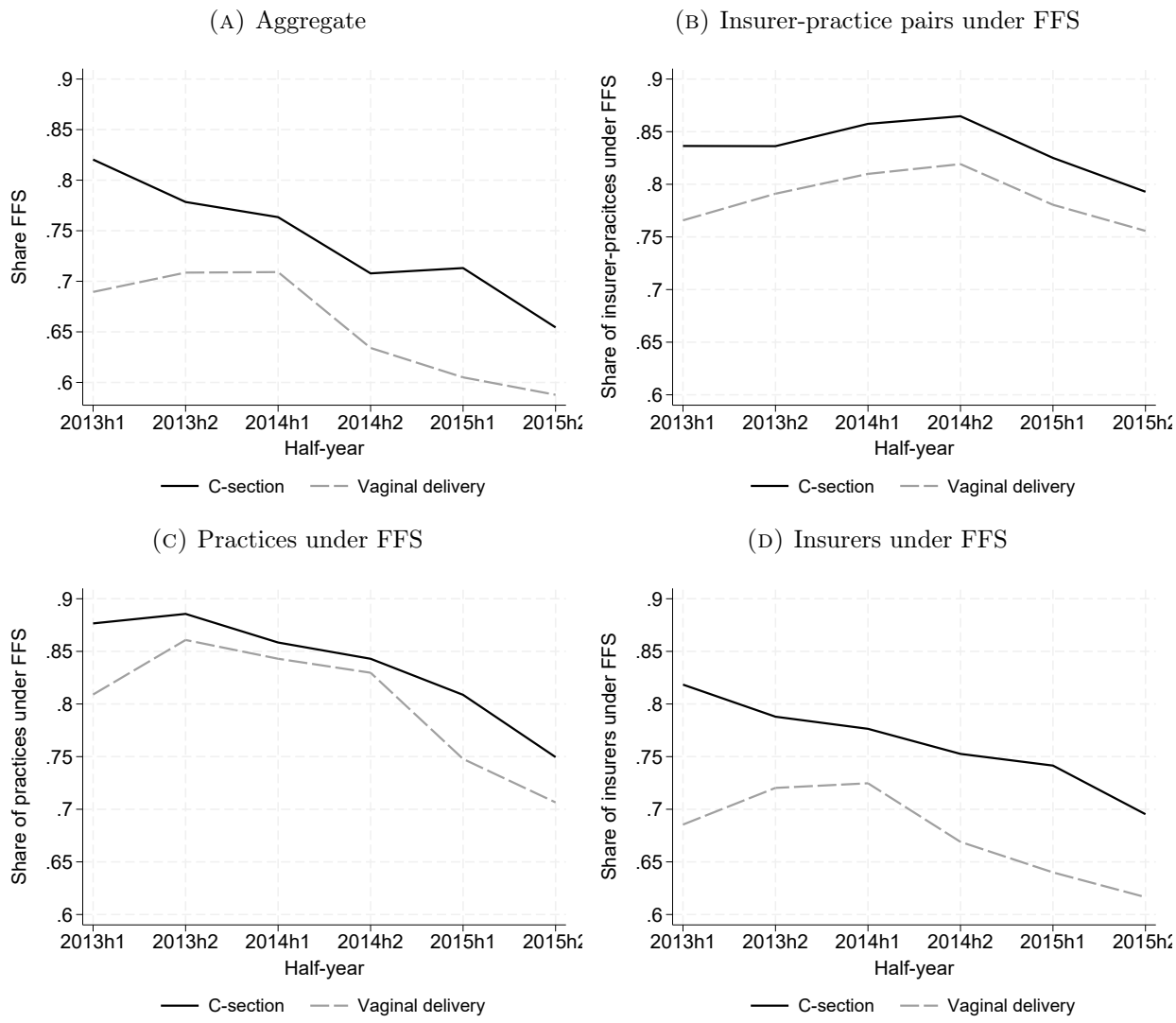


Note: Figure shows the contract for each type of woman within an insurer-practice pair. Each panel corresponds to a different pair. The solid black line shows the share of c-sections in each half year that are reimbursed under FFS. The markers show the contract type for each woman type in each half year, which will be either FFS or CAP.

where, in 2013-1, no c-sections were reimbursed under FFS. In 2013-2, only c-sections for women age 27 or younger were reimbursed under FFS, and by 2015-2, all c-sections were reimbursed under FFS. In the data we see that there is a trend toward either a fully CAP system or a fully FFS system within insurer-practice pair, but the direction of the trend varies across pairs.

Figure 2, Panel A shows that, in aggregate, the use of FFS fell over the sample period by approximately 10 p.p. from a baseline of 82% for c-sections and 70% for vaginal deliveries. This pattern is explained by insurers switching most of the healthcare practices in their network to CAP as seen in Panel C, and by practices increasing the number of insurers that they contract with under CAP as seen in Panel D. The decreasing trend in the use of FFS is much stronger among practices within an insurer than among insurers within a practice. Finally, in Panel B we also see a decline in the fraction of insurer-practice pairs covered under FFS, particularly towards the second half of our sample period.

FIGURE 2: Trends in the Use of FFS



Note: Figure shows trends in the use of FFS for c-sections in the solid black line and for vaginal delivery in dashed gray line. Panel A reports the fraction of procedures that are covered under FFS over time. Panel B reports the average fraction of insurer-practice pairs in a municipality that cover the procedure under FFS weighted by the number of deliveries. Panel C reports the average fraction of practices within an insurer's network that are covered under FFS weighted by the number of deliveries. Panel D reports the average fraction of insurers that use a FFS contract with a given practice weighted by the number of deliveries.

4 Empirical Design

To study the effect of contracts on medical treatment decisions, we take advantage of the variation in contracts within a procedure, insurer, practice, and type of woman over time described in the previous section. Note that because contracts are established at the procedure level, it may the case that c-sections are more likely to be covered under FFS than vaginal deliveries across all insurer-practice pairs. It may also be the case that women for whom c-sections are medically recommended tend to be covered under FFS. This suggests that a comparison of c-section rates across insurer-practice pairs and services would yield a mechanically higher c-section rate under FFS than CAP because of selection into contracts. Thus, the appropriate research design should instead exploit the variation in contracts within procedure, insurer, practice, and type of woman, which the Colombian setting uniquely provides.

We estimate models as follows:

$$y_{jhmt} = \alpha \text{FFS}^s_{jhmt} + \gamma_{jhm} + \delta_{jt} + \varepsilon_{jhmt} \tag{1}$$

where y_{jhmt} is an outcome for insurer j, practice h, and type of woman m in half-year t, FFS^s_{jhmt} is an indicator for whether procedure $s \in \{\text{c-section, vaginal delivery}\}$ is covered under FFS, γ_{jhm} is an insurer-practice-woman type fixed effect and δ_{jt} is an insurer-by-half year fixed effect.[11] The coefficient of interest is α, which captures the plausibly causal effect of FFS contracts relative to CAP. To estimate these models we collapse the claim-level data to the $jhmt$-level, calculating average per capita outcome measures. Appendix A details our data cleaning process. We cluster our standard errors at the level of insurer-practice-woman type, which defines a contract, and at the level of an insurer-practice pair, to allow for correlation between women who visit the same practice or are enrolled with the same

[11] We do not include practice-by-half year fixed effects because around 50% of healthcare practices contract with only one insurer and thus these coefficients cannot be identified.

insurer.

We include fixed effects at the level of insurer-practice-woman type to control for time-invariant factors that may be correlated with the use of FFS. For example, if insurer or practice quality are correlated with contract type, then the estimated effect of FFS would be biased. These fixed effects also capture market-level variation in outcomes, since practices operate in a single market. δ_{jt} accounts for changes in insurers' relative bargaining power, quality, or enrollee composition over time that may be correlated with our outcomes of interest. These fixed effects also help control for any aggregate trend or seasonality in contracting decisions for each insurer.

To correctly identify the effect of interest, we subset the data to observations that fall within the contracting scenarios delineated by our theoretical model. For instance, the impact of covering c-sections under FFS is identified from observations in scenarios 1 and 3, where the contract for vaginal deliveries is fixed at CAP and the contract for c-sections changes between CAP and FFS. We also subset the data to observations in scenarios 1 and 4 which identify the impact of covering vaginal deliveries under FFS, to scenarios 2-4 which identify the effect of covering c-sections under CAP, and to scenarios 2 and 3 which identify the effect of covering vaginal deliveries under CAP.

TABLE 3: Prevalence of Contracting Scenarios and Transitions Between Scenarios

			Transition probabilities			
	Count (share) of deliveries (1)	Count (share) of observations (2)	Scenario 1 (3)	Scenario 2 (4)	Scenario 3 (5)	Scenario 4 (6)
Scenario 1	89528 (27.55)	1421 (11.08)	68.62	20.98	6.42	3.99
Scenario 2	216760 (66.72)	10558 (82.36)	2.96	93.63	2.15	1.26
Scenario 3	12496 (3.84)	536 (4.18)	15.74	43.75	38.43	2.08
Scenario 4	6092 (1.89)	305 (2.38)	13.36	51.29	2.59	32.76

Note: Table summarizes the number of observations in each contracting scenario and transition probabilities between scenarios. Scenarios are described in Table 1. Columns (1) and (2) provide the counts and shares in parenthesis of deliveries and observations (contracting unit-half year pairs) with non-missing contract data that belong to each contracting scenario. Columns (3)-(6) provide the share of contracting unit-half year pairs that transition from the contracting scenario denoted by the row to the one denoted by the column.

Table 3 reports the number of deliveries and contracting units under each scenario as well

as the transition probability across scenarios. 28% of deliveries (11% of contracting units) are in scenario 1 and 67% (82% of contracting units) are in scenario 2. On average, 6% of contracting units in scenario 1 transition to scenario 3 over the next half-year, but 69% remain in scenario 1. For contracting units in scenario 3 and scenario 4, transitions toward scenario 1—where both procedures are covered under capitation—are common, reflecting the broader decline in the use of FFS.

Our regression specification is agnostic about the type of contract variation that identifies the impact on medical treatment decisions. For example, to identify the effect of covering c-sections under FFS we leverage insurer-practice-woman types that switch from scenario 1 to 3 and from scenario 3 to 1. The implicit assumption is that the impact of FFS is symmetric across these types of switches. In this case, α can be interpreted either as how much lower c-section rates were among contracting units that switched from FFS to CAP, or as how much higher c-section rates were among those that switched from CAP to FFS.

Our preferred specification exploits this symmetry in contract switches—rather than analyzing each type of switch separately, in the style of a event study design—for several reasons. The first is that our theoretical model predicts that the main heterogeneity is across procedures rather than across types of switches. That is, we can rationalize heterogeneous effects when the contract switches from CAP to FFS between c-sections and vaginal deliveries but not when the contract switches from CAP to FFS and from FFS to CAP conditional on the procedure. The second is statistical power: as seen in Table 3 the sample sizes associated with each type of switch are relatively small when analyzed separately.

4.1 Identifying Variation

Identification of the plausibly causal effect of FFS through the temporal variation in contracts is mainly threatened by endogenous selection of insurers into FFS based on unobserved changes in their relative bargaining power. In section 3.1 we showed evidence of a stronger decline in the use of FFS across practices than across insurers, suggesting that insurers have

increasing bargaining power, potentially because they are on the short side of the market.[12] In any given year, more than 50% of insurers contract with at least 50 practices, while more than 50% of practices contract with only one insurer.

For this temporal variation to be plausibly exogenous, it must be that changes in contract type are uncorrelated with time-varying factors within an insurer-practice-woman type that might also affect our outcomes of interest. For example, if low-risk women have increasing preferences for c-sections and this prompts the insurer to use FFS contracts with the practices in its network, then we would wrongly attribute the increase in c-section rates to the contract rather than to women's unobserved preferences.[13] Another example is changes in doctors' ability to perform c-sections. If Colombian obstetricians are getting better at performing c-sections with practices that have FFS contracts with insurers, this could also violate the identifying assumption. More generally, our estimates of the impact of FFS contracts can be biased if the insurer offers FFS contracts to practices that, for unobservable reasons, already have a high c-section rate.

To show whether the temporal variation is plausibly exogenous, we estimate the following equation for the different types of contract switches that identify the plausibly causal effect:

$$Switch^{s}_{jhmt} = \mathbf{x}'_{jhmt}\beta + \gamma_{jhm} + \delta_{jt} + \varepsilon_{jhmt}$$

where $Switch^{s}_{jhmt}$ is a binary indicator for whether insurer j and practice h switch their contract type for delivery procedure $s \in$ {c-section, vaginal delivery} for women of type m relative to half year $t-1$. $\mathbf{x}_{jhmt}$ is a set of lagged average per capita delivery characteristics. We include insurer-practice-woman type fixed effects γ_{jhm} and insurer-by-half year fixed ef-

[12] In our conversations with agents who work for the contracting areas of insurers and health care practices we also learned that insurers typically make take-it-or-leave-it offers for delivery services, corroborating our intuition on the relatively higher bargaining power of insurers.

[13] Gaviria (2017) documents that some of the variation in c-section rates across Colombian states might be due to differences in women's attitudes or preferences towards c-sections. The author notes a 15 percentage point difference in the c-section rate among women with higher education relative to those without education, controlling for measures of health status and access to healthcare. This suggests that preferences for c-sections indeed vary across women depending on their level of education.

fects δ_{jt}. As with our main regression model we impose a two-way clustering of standard errors at the insurer-practice-woman type level and insurer-practice level. A lack of statistically significant associations between these lagged characteristics and contract switching is evidence in favor of contracts driving changes in delivery practices and against causality in the other direction.

TABLE 4: Correlates of Contract Switching

	C-section		Vaginal	
	CAP to FFS	FFS to CAP	CAP to FFS	FFS to CAP
	(1)	(2)	(3)	(4)
Woman-type share of deliveries	0.0398	0.00400	-0.00208	0.0332
	(0.196)	(0.0151)	(0.143)	(0.0213)
Lagged delivery characteristics				
C-section rate	-0.0739	0.00831	0.0703	-0.0182
	(0.0949)	(0.00710)	(0.0643)	(0.0118)
SMM	-0.250	0.00971	0.156	0.0610*
	(0.220)	(0.0268)	(0.280)	(0.0318)
Birth weight (kilograms)	-0.0387	-0.00605	0.0211	-0.00900
	(0.0643)	(0.00995)	(0.0783)	(0.0120)
1-min APGAR	0.0495**	0.00493	-0.00892	-0.00720
	(0.0246)	(0.00506)	(0.0222)	(0.00517)
Gestational age	0.0104	-0.00496**	0.00379	-0.00261
	(0.0204)	(0.00229)	(0.0206)	(0.00314)
Spending on delivery day	0.0108	-0.000171	-0.00393	-0.0134
	(0.0282)	(0.00560)	(0.0338)	(0.00860)
Spending up to delivery day	-0.0995	-0.00775	-0.0594*	-0.000119
	(0.0599)	(0.00591)	(0.0326)	(0.00450)
Constant	-0.0297	0.227**	0.273	0.298**
	(0.767)	(0.0923)	(0.775)	(0.139)
Sample	Scenarios 1, 3	Scenarios 2, 4	Scenarios 1, 4	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
N	776	4973	694	5171
R^2	0.410	0.389	0.499	0.437

Note: Table shows the correlates of contract switches for c-sections in columns (1) and (2) and for vaginal deliveries in columns (3) and (4). An observation is contracting unit-half year, where a contracting unit is defined as an insurer-practice-woman type. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type and insurer-half year fixed effects. Estimation samples exclude the first half year for each contracting unit as switching cannot be measured for these observations. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level.

The estimation results are provided in Table 4. For both c-sections and vaginal deliveries, we find generally zero correlation between contract switches and lagged average per

capita delivery characteristics.[14] This helps us rule out potential biases coming, for example, from insurers strategically switching practices with high c-section rates to CAP contracts. We also include in our specifications one contemporaneous measure given by the share of deliveries attributable to each woman-type within an insurer-practice-half year. Correlation between contract switches and these contemporaneous delivery shares could reflect changes in diagnostic patterns, such as upcoding, that are meant to select women into particular contract types. We find no statistically significant effects associated with this variable. These results suggest that changes in contract type are plausibly random and are perhaps determined by idiosyncratic managerial preferences, which have been shown to influence hospital performance (see e.g., Otero and Munoz, 2022).

Appendix Figure 3 provides additional evidence of the plausibly exogenous variation in contracts. The figure compares the trend in c-section rates among insurer-practice-woman types that switch their contract against those that never switch, revealing evidence of parallel pre-trends in outcomes.[15] Finally, Appendix Figures 1 and 2 plot the residuals from a regression of contract types on insurer-practice-woman type and insurer-by-half year fixed effects for c-section and vaginal delivery, respectively. Both figures show that there is substantial residual variation in contract type to estimate our effects of interest.

5 Results

Table 5 presents results of the impact of contracts on procedure choice comparing scenarios 1-3, 1-4, 2-4, and 2-3 from Table 1.[16] The dependent variable in all specifications is the

[14] In the cases where we find significant correlations with contract switches, these effects are all economically small. For example, the coefficient on lagged average per capita gestational age in column (2) corresponds to a reduction of less than 0.05% in the outcome.

[15] To produce this appendix figure we assign a placebo switch half year to contracting units that never switch equal to the median half year of contracting units that do switch their contract.

[16] The exercises in Table 5 might not include all the observations for a given contracting unit. For example, if for a given jhm the contract type for both c-sections and vaginal deliveries is CAP in period t and is FFS for both procedures in period $t+1$, then the $t+1$ observation is not included in the estimation in column (1).

c-section rate. In column (1) we find that covering c-sections under FFS while holding vaginal deliveries fixed at CAP generates a 16% increase in the c-section rate. Columns (2) and (3) show that there is no statistically or economically significant effect of covering vaginal delivery under FFS while holding c-sections fixed at CAP or of covering c-sections under CAP while holding vaginal deliveries fixed at FFS, respectively. Analogous to our first result, in column (4) we find that covering vaginal delivery under CAP while holding c-sections fixed at FFS increases the c-section rate by 11%. These findings are in line with our model's predictions: conditional on vaginal deliveries being covered under CAP, covering c-sections under FFS increases incentives to provide c-sections, while the same is not true for vaginal deliveries.

TABLE 5: Impact of FFS Use on C-section Rates for Different Contract Combinations

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section	0.0760*		-0.00482	
	(0.0427)		(0.0238)	
Vaginal delivery		-0.00744		0.0546**
		(0.0402)		(0.0261)
Constant	0.428***	0.436***	0.504***	0.501***
	(0.0106)	(0.00599)	(0.000646)	(0.00118)
Sample	Scenarios 1, 3 Vag. fixed CAP	Scenarios 1, 4 C-sec. fixed CAP	Scenarios 2, 4 Vag. fixed FFS	Scenarios 2, 3 C-sec. fixed FFS
% change in outcome	15.86	-1.551	-1.005	11.39
N	1826	1586	10767	10974
R^2	0.637	0.667	0.507	0.508

Note: Table shows the impact of contract combinations on c-section rates. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Appendix Table 1 further corroborates the intuition developed from our model. In column (1), we test that when using information from all contracting scenarios, the effect of covering c-section under FFS will be biased toward zero because of the confounding changes in the

contract for vaginal deliveries. Indeed, we find that the effect of a FFS contract for c-section on the c-section rate is positive (but insignificant) and equals only 3.3% compared to the 16% reported in Table 5. We find similar results in column (2) where the coefficient on the use of FFS for vaginal deliveries is negative but insignificant.

If payments to practices are higher under FFS than under CAP, then the responsiveness to contracts that we estimate above may be attributable to payment amount rather than to each contract's degree of payment retrospectiveness. Put differently, the contracts considered here are two-dimensional, varying in both *when* payments are made—ex ante vs ex post relative to the time of treatment—and the payment *amount*. We are interested in evaluating whether healthcare practices' respond to retrospectiveness, conditional on payment amount. To do so, we estimate equation (1) controlling for the log of average per capita healthcare spending incurred during the delivery day. We use this variable as a proxy for payment amount for two reasons. First, controlling for the marginal price of each procedure across contract types is not possible because these prices have different units and, in particular, are equal to zero for capitation contracts. Second, using the marginal price as independent variable would constitute a "bad control" since these prices change with contract switches. Using spending on the delivery day helps alleviate these two concerns.[17]

Results are presented in Table 6. Column (1) shows that the impact of covering c-section under FFS while holding vaginal delivery fixed at CAP is largely unaffected by the inclusion of spending on the delivery day relative to Table 5. In this case, the use of FFS for c-section is related to a 14% increase in the c-section rate. Column (4) also shows that c-section rates increase 16% when vaginal delivery is covered under CAP and c-sections are fixed at FFS, an effect that is similar in size to Table 5. Taken together, these findings suggest that medical treatment decisions are mainly influenced by the retrospective nature of payments.

[17]There may still be reasons to believe that this more aggregated measure of spending constitutes a "bad control" if providing a c-section leads to more services being provided during the delivery day. Therefore, we take our results in Table 6 only as suggestive evidence of the effect of payment retrospectiveness.

TABLE 6: Impact of FFS Use on C-section Rates Controlling for Spending

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section	0.0682*		0.00256	
	(0.0411)		(0.0245)	
Vaginal delivery		-0.0259		0.0773***
		(0.0400)		(0.0264)
Log spending on delivery day	0.187***	0.139***	0.220***	0.225***
	(0.0495)	(0.0445)	(0.0148)	(0.0143)
Constant	-0.722**	-0.421	-0.865***	-0.898***
	(0.305)	(0.275)	(0.0916)	(0.0886)
Sample	Scenarios 1, 3 Vag. fixed CAP	Scenarios 1, 4 C-sec. fixed CAP	Scenarios 2, 4 Vag. fixed FFS	Scenarios 2, 3 C-sec. fixed FFS
% change in outcome	14.22	-5.412	0.535	16.13
N	1826	1586	10767	10974
R^2	0.651	0.677	0.541	0.543

Note: Table shows the impact of contract combinations on c-section rates, controlling for the log of average per capita health care spending incurred during the delivery day. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

5.1 Marginal Women and Marginal Practices

If FFS causes a significant change in c-section rates, who are the women affected by the contracting decision and which healthcare practices drive the effect? In this subsection, we characterize marginal women and practices by exploring whether there are heterogeneous treatment effects. In Table 7 we explore heterogeneity in treatment effects by pregnancy risk, estimating equation (1) with the inclusion of an interaction between FFS^s_{jhmt} and an indicator for high-risk pregnancy. Our results indicate that there are no significant differences in responsiveness to contract type across high- and low-risk pregnancies. This finding can be considered troubling given that for high-risk pregnancies, changes in delivery procedure choice due to financial incentives may lead to worse health outcomes compared to low-risk pregnancies.

TABLE 7: Impact of FFS Use on C-section Rates by Pregnancy Risk

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section x High risk	-0.0491		0.0281	
	(0.0528)		(0.0550)	
C-section	0.102*		-0.0163	
	(0.0529)		(0.0280)	
Vaginal delivery x High risk		-0.00509		-0.0349
		(0.0411)		(0.0343)
Vaginal delivery		-0.00522		0.0703**
		(0.0417)		(0.0294)
Constant	0.427***	0.436***	0.504***	0.501***
	(0.0107)	(0.00596)	(0.000640)	(0.00118)
Sample	Scenarios 1, 3	Scenarios 1, 4	Scenarios 2, 4	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome for interaction	11.13	-2.150	2.468	7.386
% change in outcome for baseline	21.37	-1.090	-3.393	14.66
N	1826	1586	10767	10974
R^2	0.637	0.667	0.507	0.508

Note: Table shows the impact of contract combinations on c-section rates by pregnancy risk. A woman is defined as high risk if she receives a diagnosis indicating that her pregnancy was high risk at any time during the 9 months of pregnancy. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

We now move to evaluating which healthcare practices are more likely to respond to the financial incentives generated by FFS contracts. We do so by estimating heterogeneous treatment effects by practice size, as measured by the total number of deliveries each practice renders over the sample period. Our hypothesis is that relatively small practices where administrators or managers who negotiate contracts are more likely to influence physicians' treatment decisions drive our main results.

We estimate equation (1) with the inclusion of an interaction between FFS^s_{jhmt} and an indicator for whether the practice renders less than 300 deliveries (denoted "small practice" and reflecting the median number of deliveries per practice). Even though the coefficients are marginally significant, in Table 8 we find that small practices are much more responsive

to contracts: they are 59% more likely to use c-section when it is reimbursed under FFS compared to 11% for large practices, while holding vaginal deliveries fixed at CAP. Small practices are also 21% more likely to use c-section when vaginal delivery is reimbursed under CAP and c-sections are fixed at FFS, compared to 9% for large practices.

TABLE 8: Impact of FFS Use on C-section Rates by Practice Size

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section x Small practice	0.229		-0.0658	
	(0.170)		(0.0576)	
C-section	0.0538		0.0165	
	(0.0421)		(0.0248)	
Vaginal delivery x Small practice		-0.133		0.0598
		(0.112)		(0.0678)
Vaginal delivery		0.0126		0.0429
		(0.0392)		(0.0277)
Constant	0.426***	0.439***	0.504***	0.501***
	(0.0107)	(0.00648)	(0.000647)	(0.00117)
Sample	Scenarios 1, 3	Scenarios 1, 4	Scenarios 2, 4	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome for interaction	58.91	-25.08	-10.29	21.43
% change in outcome for baseline	11.22	2.631	3.437	8.949
N	1826	1586	10767	10974
R^2	0.640	0.668	0.507	0.508

Note: Table shows the impact of contract combinations on c-section rates by practice size. A small practice is defined as one that provides fewer than 250 deliveries over the sample period. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age ≤ 27, age > 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Our result that contracts substantially influence the c-section rate at these healthcare practices suggests that contracts ultimately influence physicians' decisions within these organizations. This can happen if practices give incentives to physicians to perform procedures when they are covered under FFS relative to CAP. These incentives may include better control over schedules and salaries and more flexibility in medical practice style.[18] In fact,

[18]See Smith (2024) for a description of these patterns.

the finding that treatment effects are economically meaningful only among relatively small practices where the distinction between who owns the practice and who performs medical procedures is less marked substantiates this claim.

5.2 Risk Selection

As discussed in section 2, contracts may influence incentives to engage in both risk selection and moral hazard. Under moral hazard, conditional on the pool of enrollees, healthcare practices will choose to perform the most profitable procedure. Under risk selection, insurers will choose to enroll women with low risk scores or low ex-ante health care costs if in-network practices are disproportionately covered under FFS. Our exercises so far show evidence of substantial moral hazard at the practice level, since c-section rates vary significantly with payment retrospectiveness conditional on enrollment and women's characteristics.

In this subsection, we explore whether contracts generate outcomes consistent with risk selection. First, we show whether enrollment responds to contracts by regressing the switch-in rate for insurer j on our FFS indicators for this insurer. The switch-in rate is the fraction of women enrolled with j in year t who were enrolled with $-j$ in $t-1$. Second, we regress the log of lagged average per capita health care spending on our FFS indicators. This specification captures risk selection on the intensive margin as in Brown et al. (2014), as a negative correlation with the FFS indicators would suggest that insurers tend to send lower-cost patients to practices covered under FFS.

Table 9 presents the results. We find no relation between women's switching decisions across insurers and procedure contracts, and therefore no significant evidence that insurers engage in risk selection on the extensive margin. We also find insignificant correlations between procedure contracts and lagged healthcare costs, indicating limited selection of women into contracts on the intensive margin. These results are both a test of the plausible exogeneity of contract variation within insurer, practice, and woman type and an evidence that contracts affect treatment choices and intensity of care mainly through moral hazard

TABLE 9: Impact of FFS Use on Risk Selection Incentives

	Switch-in rate		Log lagged cost	
	(1)	(2)	(3)	(4)
C-section	-0.0172		-0.0669	
	(0.0141)		(0.161)	
Vaginal delivery		0.0136		0.0884
		(0.0321)		(0.226)
Constant	0.137***	0.140***	11.31***	11.61***
	(0.00330)	(0.00483)	(0.0399)	(0.0336)
Sample	Scenarios 1, 3 Vag. fixed CAP	Scenarios 1, 4 C-sec. fixed CAP	Scenarios 1, 3 Vag. fixed CAP	Scenarios 1, 4 C-sec. fixed CAP
N	1670	1480	1826	1586
R^2	0.454	0.448	0.968	0.970

Note: Table shows the impact of contract combinations on the fraction of women who switch into an insurer (columns 1 and 2) and the log of lagged average health care cost per capita (columns 3 and 4). For year t the fraction of women who switch-in is calculated as the number of women who change their insurer in t relative to $t-1$ divided by the total number of women enrolled with the insurer in t. To calculate the log of lagged average health care cost per capita we first compute for every woman her total annual health care cost and then we average the lagged measure across all women within a contracting unit. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level.

at the practice level.

5.3 Health Outcomes

The public policy sphere has had a longstanding concern regarding the impacts on maternal and infant health outcomes from using c-sections among women who have a low suitability for the procedure (California Health Care Foundation, 2022). In fact, evidence on whether c-sections affect maternal health outcomes is mixed (Card et al., 2023; Fischer et al., 2023). In light of our results showing that contracts affect treatment decisions above and beyond patient health status, we investigate whether variation in contracts for c-sections and for vaginal deliveries impact health.

In Table 10 we estimate equation (1) using as outcomes the average per capita birth weight, 1-minute APGAR score, and gestational age (Kennedy and O'Nions, 2021), and the fraction of women who experience SMM within 1 week and 1 month after giving birth. We

find no impacts on any of these measures of maternal or infant health. Thus, the effects of contracts on delivery procedure choice, while economically significant, do not necessarily affect health outcomes.

TABLE 10: Impact of FFS Use on Maternal and Infant Health Outcomes

	Birth weight (1)	1-min APGAR (2)	SMM (3)	Gestational age (4)
C-section FFS	0.0364	0.00782	0.000871	0.0424
	(0.0382)	(0.0501)	(0.0102)	(0.121)
Constant	3.064***	8.246***	0.0339***	38.36***
	(0.00905)	(0.0119)	(0.00253)	(0.0245)
Sample	Scenarios 1, 3 Vag. fixed CAP	Scenarios 1, 3 Vag. fixed CAP	Scenarios 1, 3 Vag. fixed CAP	Scenarios 1, 3 Vag. fixed CAP
% change in outcome	1.180	0.0947	2.405	0.110
N	1741	1741	1826	1483
R^2	0.597	0.711	0.486	0.526

Note: Table shows the impact of contract combinations on maternal and infant health outcomes. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average value of the relevant outcome in the sample.

5.4 Robustness Checks

We perform several robustness checks of our sample selection criteria and estimation procedure to provide suggestive evidence that our results capture plausibly causal effects. Appendix Figure 4 shows that our estimates are robust to using randomization inference on the coefficient on c-section FFS using observations in scenarios 1 and 3 and on the coefficient on vaginal delivery FFS using observations in scenarios 1 and 4 (MacKinnon and Webb, 2020; Carpenter and Churchill, 2023). Therefore, our estimated coefficients are statistically larger than if they were generated by chance. Appendix Table 2 shows that our main estimates are robust to including woman type-by-half year fixed effects, which may capture changes in delivery practice styles for women with certain conditions across insurers and healthcare practices.

To account for potential endogenous changes in the composition of women over time—such as changes generated by women switching across insurers or across practices based on the contracts—we provide two additional sets of results. First, in Appendix Table 3 we construct our analysis sample focusing only on women who never switched their insurer over the sample period, finding that the magnitude of our estimates is robust albeit with larger standard errors due to the reduction in sample size. Second, in Appendix Table 4 we use only information from women who visited their delivery practice in the first trimester of their pregnancy and made at least 10 claims there. This sample restriction helps ensure that women's choice of delivery practice is largely unrelated to the delivery procedure contracts. We find that our results on the impact of covering c-sections under FFS remain robust in this sample of women.

Another potential endogeneity concern stems from the correlation between women's unobserved preferences for c-sections and delivery procedure contracts, which may explain, for example, why highly educated women in Colombia or those with higher incomes tend to have higher c-section rates (Gaviria, 2017). We test whether our results are robust to controlling for average per capita income as a proxy for preferences towards c-sections in Appendix Table 5. We find that our main coefficients remain unchanged when interacting them with this variable.

Finally, we provide results excluding the 4% of observations for which the modal contract does not equal the observed contract in Appendix Table 6 and excluding bundled payments from our analysis sample in Appendix Table 7. In the first case we find that our results are robust, and in the second case we find that our estimates grow in magnitude, which goes in line with bundled payments being less that fully retrospective.

6 Conclusions

There is an impressive amount of theoretical literature establishing the incentives that health insurers and healthcare practices face under different contracts such as fee-for-service (FFS), capitation, and bundled payments (CAP). Yet, empirical evidence on whether contracts causally influence medical treatment decisions as the theory predicts is scant. Moreover, most empirical studies do not observe the contracting unit, the timing of contracts, and in many cases the contracts themselves. With our data and setting, we are able to overcome each of these limitations.

In this paper, we estimate the plausibly causal effect of FFS contracts relative to CAP contracts in the context of delivery procedures. We exploit within insurer-practice pair variation in contracts for c-sections and for vaginal deliveries using data from Colombia. In the Colombian health care system, insurers and healthcare practices may cover c-sections and vaginal deliveries under different contracts. We describe how contracts are determined in this setting, what are the resulting incentives for insurers and practices, and how these incentives vary across delivery procedures.

We find that covering c-sections under FFS while holding vaginal deliveries fixed at CAP increases the c-section rate by 16%. Instead, covering vaginal deliveries under FFS while holding c-sections under CAP does not impact delivery procedure choice. We show that these effects are explained mainly by the degree of payment retrospectiveness of each contract rather than by the payment amount negotiated between insurers and healthcare practices. Our results indicate that bilateral contracting decisions between insurers and practices causally impact the type, cost, and intensity of care that women receive. While we find no effect of contracts on short-run measures of maternal and infant health, we are unable to test whether there are long-run impacts on health outcomes. This plausibly causal relation between contracts and medical treatment decisions matters for health policy as improving patient and population health outcomes may require regulating insurer-practice

bilateral contracting decisions.

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Appendix A Data Cleaning

The raw data contains all the delivery procedures for women enrolled with insurers participating in the contributory health care system during 2013 to 2015. The total number of observations in this data set is N=521,408. To obtain our final analysis sample we proceed in the following steps:

1. Keep singleton, non-breech, first-time births (N=370,191).

2. Keep women in reproductive age (N=369,300).

3. Keep deliveries that are reimbursed under fee-for-service, capitation, or bundled payment (N=343,135).

4. Drop women with missing pregnancy risk (N=324,876).

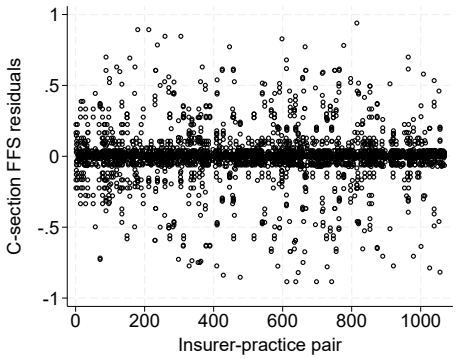
5. Obtain the modal contract per service (c-sections and vaginal deliveries), insurer, practice, type of woman, and half year. A type of woman is defined by a combination of age group (<=27, >27) and pregnancy risk. The age group cutoff represents the average age in the data.

6. Collapse the data to the insurer, practice, type of woman, and year, retaining the modal contract and computing c-section rates and average per-capita measures of health care spending and of maternal and infant health outcomes.

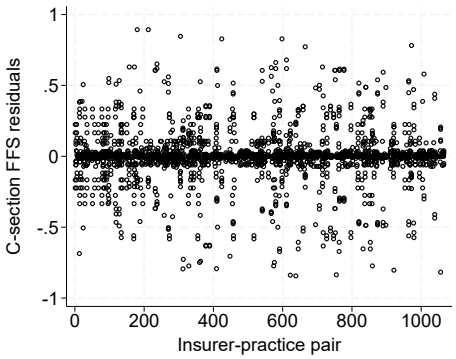
Appendix B Residual Variation in Contracts

Appendix Figure 1: Residual Variation in Use of FFS for C-sections within Insurer-Practice

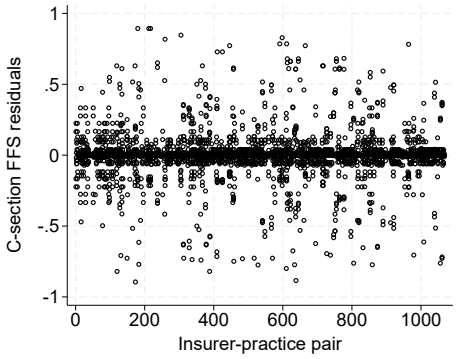
(A) Age≤27, Low risk



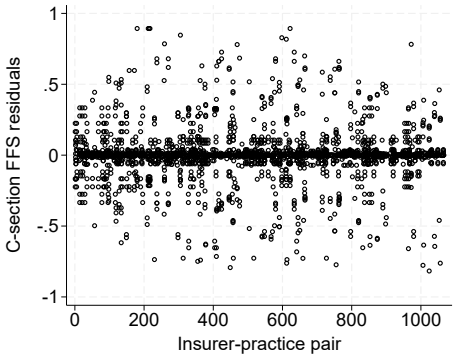
(B) Age≤27, High risk



(C) Age >27, Low risk

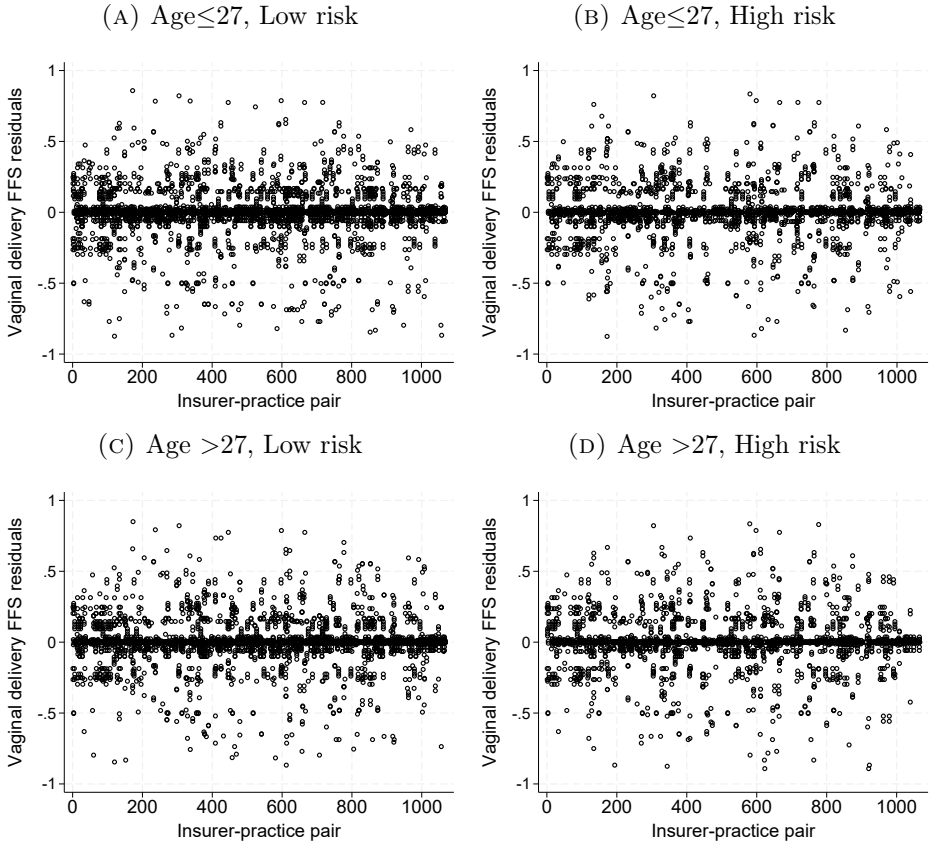


(D) Age >27, High risk



Note: Figure shows the distribution of residuals from a regression of an indicator for c-section being reimbursed under FFS on insurer-practice-woman type fixed effects and insurer-half year fixed effects. We report the distribution conditional on the woman's age group and pregnancy risk.

Appendix Figure 2: Residual Variation in Use of FFS for Vaginal Deliveries within Insurer-Practice

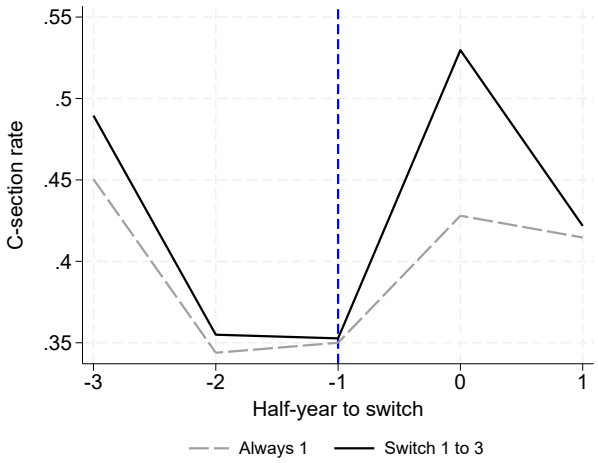


Note: Figure shows the distribution of residuals from a regression of an indicator for vaginal delivery being reimbursed under FFS on insurer-practice-woman type fixed effects and insurer-half year fixed effects. We report the distribution conditional on the woman's age group and pregnancy risk.

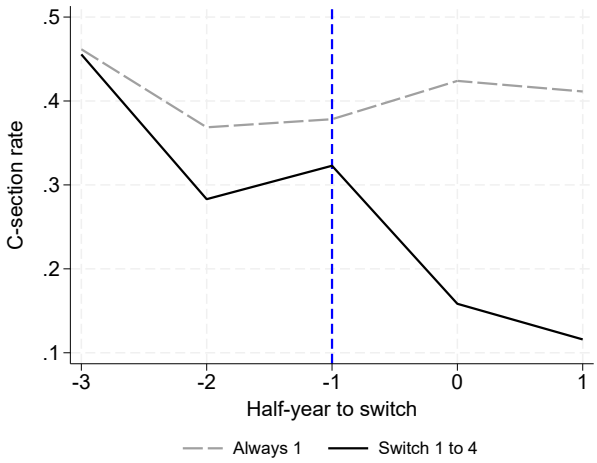
Appendix C Robustness Checks and Additional Results

Appendix Figure 3: Test of Parallel Pre-Trends

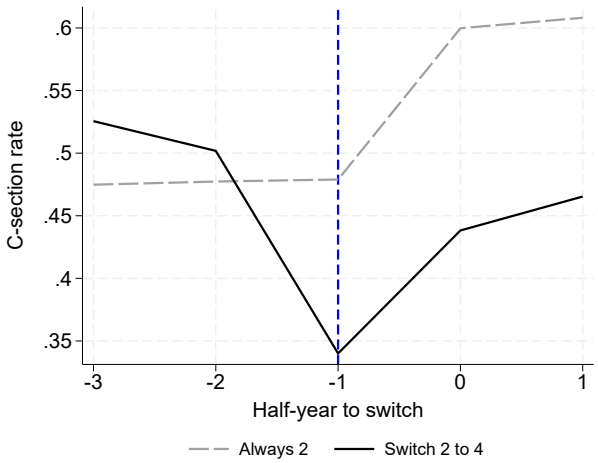
(A) Scenarios 1, 3



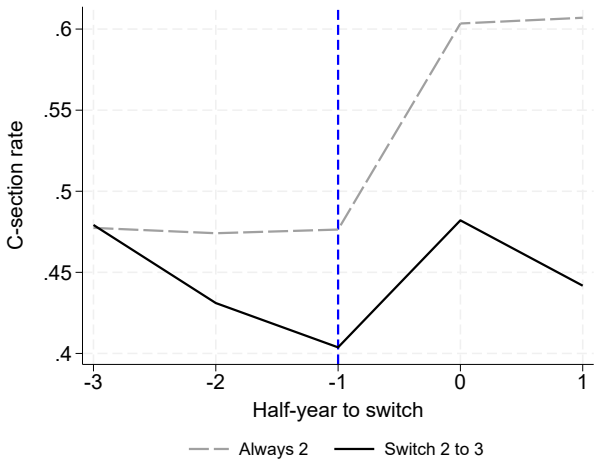
(B) Scenarios 1, 4



(C) Scenarios 2, 4



(D) Scenarios 2, 3



Note: Figure shows the trend in average c-section rates across observations stratified by their contracting scenario and transition history across scenarios. Contracting scenarios are described in Table 1 in the main text. We report trends relative to the half-year in which the contract switch occurred. We assign a placebo half-year of contract switch for contracting units that never switch scenarios. The placebo half-year switch is the median of that among switchers.

Appendix Table 1: Impact of FFS Use on C-section Rates

	C-section rate	
	(1)	(2)
C-section FFS	0.0159	
	(0.0156)	
Vaginal delivery FFS		-0.0157
		(0.0158)
Constant	0.482***	0.509***
	(0.0135)	(0.0134)
% change in outcome	3.311	-3.273
N	12816	12816
R^2	0.508	0.508

Note: Table shows the impact of FFS reimbursement of c-section and vaginal delivery on c-section rates in columns (1) and (2), respectively. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

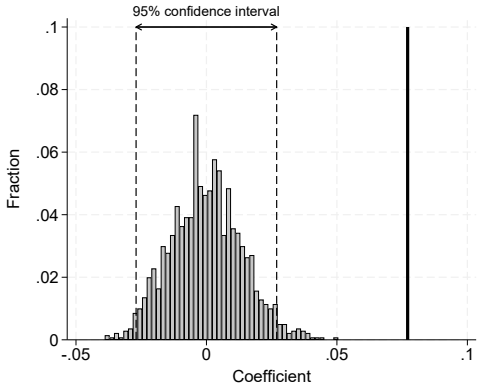
Appendix Table 2: Impact of FFS Use on C-section Rates Controlling for Woman Type-Time Fixed Effects

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section	0.0764*		-0.00330	
	(0.0432)		(0.0239)	
Vaginal delivery		-0.00958		0.0561**
		(0.0391)		(0.0261)
Constant	0.428***	0.436***	0.504***	0.500***
	(0.0107)	(0.00582)	(0.000648)	(0.00118)
Sample	Scenarios 1, 3	Scenarios 1, 4	Scenarios 2, 4	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome	15.93	-1.998	-0.688	11.71
N	1826	1586	10767	10974
R^2	0.642	0.674	0.508	0.509

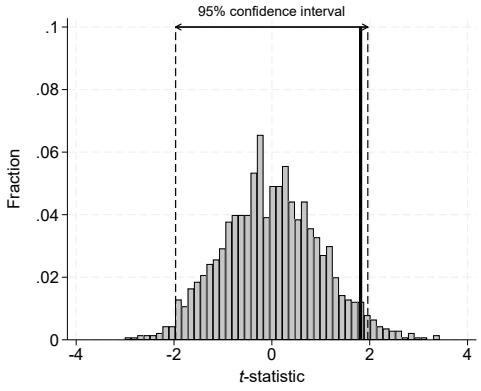
Note: Table shows the impact of contract combinations on c-section rates. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects, insurer-half year fixed effects, and woman type-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Appendix Figure 4: Randomization Inference on Main Model Coefficients

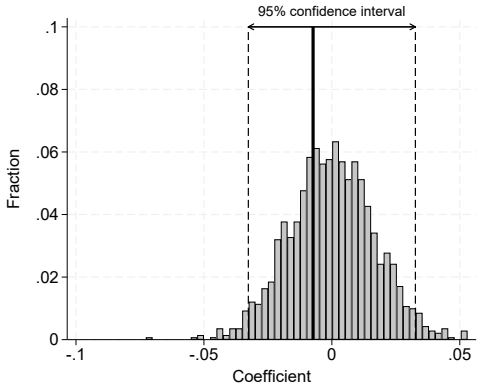
(A) C-section FFS, coefficients



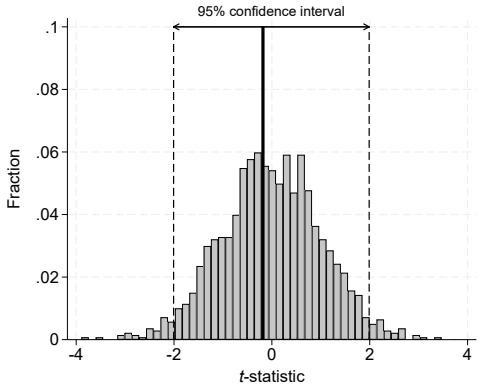
(B) C-section FFS, *t*-statistics



(C) Vaginal delivery FFS, coefficients



(D) Vaginal delivery FFS, *t*-statistics



Note: Figures show the distribution of placebo coefficients and cluster-robust *t*-statistics obtained from randomly assigning contract types 5,000 times. Panels A and B provide results from regressions estimated using scenarios 1 and 3 (Column 1 of Table 5), while Panels C and D provide results from regressions estimated using scenarios 1 and 4 (Column 2 of Table 5). The solid black line in each panel shows the estimated coefficient or t-statistic from using the observed contract type.

Appendix Table 3: Impact of FFS Use on C-section Rates for Subsample of Women Inertial to their Insurer

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section	0.0669		-0.0108	
	(0.0428)		(0.0267)	
Vaginal delivery		0.0128		0.0306
		(0.0381)		(0.0259)
Constant	0.433***	0.434***	0.505***	0.502***
	(0.0105)	(0.00555)	(0.000725)	(0.00118)
Sample	Scenarios 1, 3	Scenarios 1, 4	Scenarios 2, 4	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome	13.88	2.644	-2.244	6.341
N	1810	1572	10343	10543
R^2	0.622	0.655	0.498	0.499

Note: Table shows the impact of contract combinations on c-section rates for the subsample of women who are inertial to their insurer, defined as those who never switched their insurer over the sample period. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Appendix Table 4: Impact of FFS Use on C-section Rates for Subsample of Women Inertial to their Practice

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section	0.138***		0.00404	
	(0.0523)		(0.0283)	
Vaginal delivery		0.0113		-0.00808
		(0.0602)		(0.0306)
Constant	0.441***	0.464***	0.536***	0.536***
	(0.0137)	(0.00993)	(0.000735)	(0.00122)
Sample	Scenarios 1-3	Scenarios 1-4	Scenarios 2-4	Scenarios 2-3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome	25.68	2.098	0.753	-1.506
N	1296	1133	9171	9305
R^2	0.581	0.599	0.476	0.478

Note: Table shows the impact of contract combinations on c-section rates for the subsample of women who are inertial to their practice, defined as those who visited their delivery practice in the first trimester of their pregnancy and made at least 10 claims there. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Appendix Table 5: Impact of FFS Use on C-section Rates by Income Level

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section x High income	-0.107**		0.0781**	
	(0.0432)		(0.0381)	
C-section	0.134***		-0.0457	
	(0.0454)		(0.0292)	
High income	-0.00253	0.0231	-0.0533***	-0.0529***
	(0.0235)	(0.0247)	(0.00902)	(0.00901)
Vaginal delivery x High income		0.0117		-0.0113
		(0.0447)		(0.0319)
Vaginal delivery		-0.0117		0.0580*
		(0.0496)		(0.0308)
Constant	0.432***	0.421***	0.530***	0.526***
	(0.0166)	(0.0176)	(0.00438)	(0.00455)
Sample	Scenarios 1, 3	Scenarios 1, 4	Scenarios 2, 3	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome for interaction	5.613	-0.00227	6.758	9.726
% change in outcome for baseline	27.93	-2.440	-9.532	12.09
N	1826	1586	10767	10974
R^2	0.642	0.668	0.510	0.511

Note: Table shows the impact of contract combinations on c-section rates by the average per capita income level. High income is defined as average per capita income above the sample mean. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Appendix Table 6: Impact of FFS Use on C-section Rates Excluding Contracts that do not Equal Mode

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section	0.0801*		-0.0215	
	(0.0447)		(0.0227)	
Vaginal delivery		-0.0556		0.0700***
		(0.0446)		(0.0261)
Constant	0.426***	0.438***	0.507***	0.504***
	(0.0109)	(0.00638)	(0.000606)	(0.00118)
Sample	Scenarios 1, 3	Scenarios 1, 4	Scenarios 2, 4	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome	16.80	-11.67	-4.503	14.69
N	1789	1552	10373	10571
R^2	0.639	0.661	0.517	0.517

Note: Table shows the impact of contract combinations on c-section rates, excluding deliveries for which the observed contract type does not equal the modal contract type for the insurer-practice-woman type-half year. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under CAP. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under CAP, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Appendix Table 7: Impact of FFS Use on C-section Rates Excluding Bundled Payments

	C-section rate			
	Procedure under FFS		Procedure under CAP	
	(1)	(2)	(3)	(4)
C-section	0.845***		-0.210**	
	(0.106)		(0.0959)	
Vaginal delivery		0.0597		0.125
		(0.0988)		(0.103)
Constant	0.290***	0.338***	0.506***	0.506***
	(0.0219)	(0.0187)	(0.000325)	(0.000437)
Sample	Scenarios 1, 3	Scenarios 1, 4	Scenarios 2, 4	Scenarios 2, 3
	Vag. fixed CAP	C-sec. fixed CAP	Vag. fixed FFS	C-sec. fixed FFS
% change in outcome	166.7	11.78	-41.49	24.63
N	184	174	11515	11523
R^2	0.825	0.873	0.497	0.496

Note: Table shows the impact of contract combinations on c-section rates, excluding deliveries reimbursed as part of a bundled payment. Columns (1) and (2) show the effect reimbursing c-section and vaginal delivery under FFS, respectively, holding the other delivery procedure fixed under pure capitation. Columns (3) and (4) show the effect of reimbursing c-section and vaginal delivery under pure capitation, respectively, holding the other delivery procedure fixed under FFS. An observation is an insurer-practice-woman type-half year. A woman type is a combination of age group (age $\leq$ 27, age $>$ 27) and pregnancy risk (high vs. low). Specifications include insurer-practice-woman type fixed effects as well as insurer-half year fixed effects. Standard errors in parenthesis are two-way clustered at the insurer-practice-woman type level and the insurer-practice level. Table reports the percentage change in the outcome due to the given contract change, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

Appendix D Extension to the Stylized Model

Consider the parameters of the model in the main text. The price of a c-section is p_C and that of a vaginal delivery is p_V. The expected rate of use of each procedure when covered under CAP is π_C for c-sections and $1-\pi_C$ for vaginal deliveries. Suppose practices cannot perfectly predict the cost of providing each procedure, since there may be unexpected complications or delays during the delivery. These delays are more common for vaginal deliveries than c-sections, which means that the cost of providing the former procedure may have higher variance than the latter. We model this uncertainty over the practice's marginal cost by imposing a random normal cost shock to each procedure. Formally, the marginal cost of a c-section is $m_C + \frac{\epsilon}{2}$ and the marginal cost of a vaginal delivery is $m_V + \epsilon$, where $\epsilon \sim N(0, \sigma^2)$. For simplicity, we assume a unit demand.

Practices are risk averse and maximize expected profits per woman type by choosing a procedure. The profit function for procedure $s \in \{C, V\}$ conditional on the contracts and the type of woman follows a CARA representation as follows:

$$\Pi_s(\mathbf{FFS}) = \frac{1}{\rho}(-\exp(-\rho(R_s(\mathbf{FFS}) - m_s)))$$

where $R_s(\mathbf{FFS})$ is the revenue per woman from the main text, $\mathbf{FFS}$ is the vector of contracts for c-sections and vaginal deliveries, m_s is the marginal cost of procedure s, and ρ is the risk aversion coefficient. Finally, we assume the risk aversion coefficient is bounded from above: $\rho < \frac{4(m_C - m_V)}{\sigma^2}$. This assumption means that practices are willing to pay less than the difference in expected marginal cost between the delivery procedures for a one standard deviation reduction in uncertainty over costs.

The provider's problem is:

$$\max_{s \in \{C,V\}} \{E[\Pi_C(\mathbf{FFS})], E[\Pi_V(\mathbf{FFS})]\}$$

Under these assumptions, the practice's profit and optimal procedure choice for each possible combination of contracts are provided in Appendix Table 8. The table shows that the predictions on the optimal choice of procedure when practices are risk averse are similar to when practices are risk neutral in the main text. If both procedures are covered under CAP, the practice would choose vaginal deliveries because the lower average marginal cost overcompensates the higher variance. When both procedures are covered under FFS, the prediction is ambiguous because of the higher prices and marginal cost of c-sections. If c-sections are covered under FFS and vaginal deliveries are covered under CAP, the practice chooses to render c-section due to their higher revenue and retrospectiveness. Finally, if c-sections are covered under FFS and vaginal deliveries are covered under CAP, the practice uses vaginal deliveries also because of their higher revenue and retrospectiveness.

Appendix Table 8: Example of Contracting Scenarios and Incentives

Scenario (1)	Contract (2)	Service (3)	Expected rate of use (4)	Expected practice profit (5)	Choice (6)
1	CAP	C-section	π_C	$1/\rho(-\exp(\pi_C p_C + (1-\pi_C)p_V - m_C - \rho\sigma^2/4))$	0
	CAP	Vaginal delivery	$1-\pi_C$	$1/\rho(-\exp(\pi_C p_C + (1-\pi_C)p_V - m_V - \rho\sigma^2/2))$	1
2	FFS	C-section	—	$1/\rho(-\exp(p_C - m_C - \rho\sigma^2/4))$	?
	FFS	Vaginal delivery	—	$1/\rho(-\exp(p_V - m_V - \rho\sigma^2/2))$	
3	FFS	C-section	—	$1/\rho(-\exp(p_C + (1-\pi_C)p_V - m_C - \rho\sigma^2/4))$	1
	CAP	Vaginal delivery	$1-\pi_C$	$1/\rho(-\exp((1-\pi_C)p_V - m_V - \rho\sigma^2/2))$	0
4	CAP	C-section	π_C	$1/\rho(-\exp(\pi_C p_C - m_C - \rho\sigma^2/4))$	0
	FFS	Vaginal delivery	—	$1/\rho(-\exp(\pi_C p_C + p_V - m_V - \rho\sigma^2/2))$	1

Note: Table shows examples of the profit maximizing choice of procedure for the practice under four possible contracting scenarios in which c-sections and vaginal deliveries are either covered under the same contract or under different contracts. The price and marginal cost of a c-section are p_C and m_C, respectively, and the corresponding values for vaginal delivery are p_V and m_V. The expected rate of use π_C summarizes the product of frequency of use and target population in a CAP contract, normalized to 1. ρ and σ^2 are the risk aversion coefficient and variance of the random component of marginal cost, respectively. The procedure choice is the one that maximizes profits for the practice conditional on each contracting scenario.