

Do Payment Contracts in Healthcare Influence Medical Treatment Decisions?*

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Abstract

We estimate the causal effect of fee-for-service (FFS) contracts relative to less retrospective contracts between health insurers and healthcare providers on treatment decisions for deliveries. We find that covering c-sections under FFS increases the c-section rate by 6.5% while covering vaginal deliveries under FFS has no impact on procedure choice. Effects are explained by payment retrospectiveness rather than by the size of payments. 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 provider moral hazard 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 providers 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. 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 of the literature to date documents a correlation between FFS contracts and health care costs (e.g., Baker, 1999, 1997) and establishes incentives that insurers and providers 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-provider contracts and limited sources of exogenous variation in these bilateral contracting decisions.

In this paper, we estimate the aforementioned causal effect in the setting of the Colombian health care system, where multiple insurers negotiate with multiple providers over contracts for every health service. 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 providers may cover c-sections under a different contract than vaginal deliveries, resulting in contract variation within insurer-provider 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 variation over time in contracting decisions are unrelated to a wide range of insurer, provider, and women characteristics.

We take advantage of this quasi-random variation in contracts over time to estimate the plausibly causal effect of FFS contracts relative to CAP on c-section rates and other outcomes of interest.¹ We regress different outcomes on an indicator for whether c-sections or whether vaginal deliveries are covered under FFS. Our findings show that the c-section rate increases 6.5% when c-sections are covered under FFS but that contracts for vaginal delivery have no effect on the c-section rate. These results are consistent with the predictions of a toy model in which insurer-provider pairs may cover different procedures under different contract types. In this toy model, the impact of FFS is asymmetric across c-sections and vaginal deliveries due to differences in their prices and marginal costs.

We do not find that the impact of FFS varies according to pregnancy risk, which is particularly worrisome for high risk pregnancies for whom one procedure is likely to be medically recommended. We do find that responsiveness to contract type is stronger among small providers, where incentives between physicians and managers may be better aligned.

Our findings also show that providers are responsive to contract type even when controlling for the size of payments from insurers. This demonstrates that, conditional on the size of the payment, providers respond to the incen-

¹The c-section rate is the fraction of deliveries performed by c-section within an insurer, provider, type of woman, and year.

tives 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.² 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 provider moral hazard under different payment schemes (e.g., [Ellis and McGuire, 1996, 1986](#)). Early and recent papers have analyzed provider incentives by payment levels 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

²The 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.

exploiting variation in contracting decisions within insurer-provider 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 complement this work by showing that contracts between insurers and providers 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 raw data, Section 3 presents our empirical design, Section 4 shows our main results, and Section 5 concludes.

2 Setting and Data

We study the contracts established between insurers and providers participating in the contributory health care system in Colombia, which covers the half

of the population in the country who pay payroll taxes. 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 service coverage are strictly regulated.

Insurers negotiate with providers over contracts for each individual 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-provider pair. Insurers and providers can choose from a set of three contract types: FFS, bundled payments, and capitation.³ We detail how payments are made under each of these contract types in Section 2.2.

To describe these contracts, 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, provider, 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.⁴ We also categorize women as having severe maternal morbidity (SMM) based on the services and diagnosis codes

³Bundled payments involve payments from the insurer to the provider for an episode of care or for a particular diagnosis.

⁴These 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)

rendered between 1 week and 1 month after childbirth following the Centers for Disease Control and Prevention’s definition.⁵ We 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 343,967 deliveries. Whenever a delivery is performed at a provider organization such as a hospital, a clinic, or a physician practice, we observe the organization’s ID number, but we do not have information on the physician who performed the delivery procedure at this organization.

TABLE 1: Summary Statistics of Analysis Sample

	C-sections	Vaginal deliveries
<hr/>		
Delivery characteristics, mean (s.d.)		
Fee-for-service (FFS)	0.754 (0.430)	0.671 (0.470)
Age \leq 27	0.669 (0.471)	0.788 (0.408)
Age $>$ 27	0.331 (0.471)	0.212 (0.408)
High pregnancy risk	0.522 (0.500)	0.449 (0.497)
Severe maternal morbidity (SMM)	0.049 (0.216)	0.032 (0.176)
Birth weight (grams)	3040 (568.7)	3071 (414.4)
1-minute APGAR score	8.236 (0.887)	8.273 (0.859)
Spending on delivery day [†]	545.3 (557.2)	442.2 (336.9)
Spending up to delivery day [†]	625.2 (654.7)	531.9 (490.3)
<hr/>		
Number of observations, count (%)		
Deliveries	166,665 (48.5)	177,302 (51.5)
Insurer-provider	1986 (58.3)	2919 (85.8)
Provider	760 (52.6)	1258 (87.1)
Insurer	14 (100)	14 (100)

Note: Table shows the mean and standard deviation (in parenthesis) of the main variables in our analysis sample stratified 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, a higher score reflecting better infant health. ([†]) Measures of spending are reported in USD.

Table 1 presents summary statistics of our analysis sample. An observation

⁵See <https://www.cdc.gov/maternal-infant-health/php/severe-maternal-morbidity/icd.html>

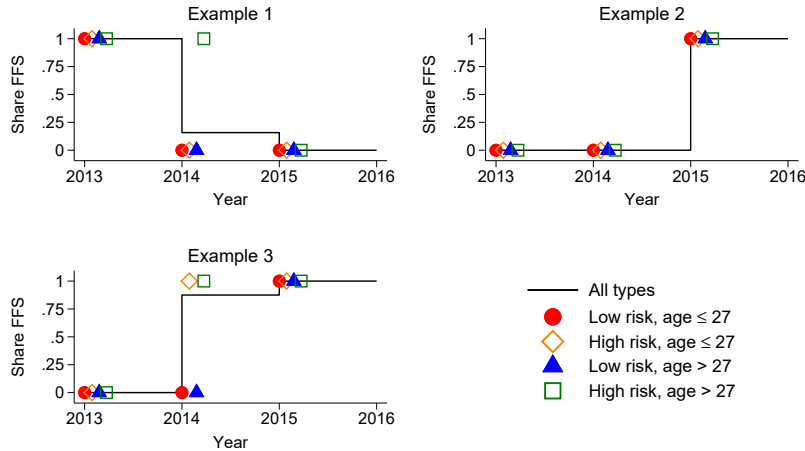
is a delivery claim. The c-section rate equals 49%. Most deliveries are reimbursed under a FFS contract, although the use of FFS is more prevalent for c-sections than for vaginal deliveries. More than half of deliveries performed correspond to women aged 27 or less. Around half of pregnancies are classified 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 are 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.

2.1 How are Contracts Chosen?

Insurers and providers 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-provider 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-provider pair in a given year as a combination of age-group (≤ 27 , >27) and pregnancy risk (high vs. low). We choose the age of 27 as the age group cutoff since this corresponds to the average age in the analysis sample and achieves the highest level of accuracy in the in-sample prediction of observed contract types. We assign to each insurer-provider-woman type-year its modal contract type; this modal contract accurately predicts the observed contract for 96% of deliveries in our data.

The primary source of variation we use in our empirical analyses is in the contract type used by an insurer-provider pair for a given woman type over time. Figure 1 illustrates this variation in the c-section contract for 3 of the 3,404 insurer-hospital pairs in our analysis sample. For each insurer-provider pair there is variation in contracts within a woman type. For some pairs, such as that in example 2, the timing of contract changes is the same for all women, while in examples 1 and 3, this timing varies across woman types. Across the three examples, there is a trend toward either a fully capitated system or a fully FFS system, but the direction of the trend varies across insurer-provider pairs.

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



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

For the temporal variation in contract type to be plausibly exogenous, it must be that these changes in contract type are uncorrelated with time-varying factors within an insurer-provider-woman type that might also affect

our outcomes of interest. To show whether this is the case, we collapse the data to the insurer-provider-woman type-year level, calculating average per capita measures of health care spending and health outcomes. We estimate the following equation:

$$Switch_{jhm t}^s = \mathbf{x}_{jhm t}'\beta + \gamma_{jhm} + \delta_j t + \tau_t + \varepsilon_{jhm t} \quad (1)$$

where $Switch_{jhm t}^s$ is a binary indicator for whether insurer j and provider h switch their contract type for delivery service $s \in \{\text{c-section, vaginal delivery}\}$ for women of type m relative to year $t - 1$. $\mathbf{x}_{jhm t}$ is a set of lagged average per capita delivery characteristics. We include insurer-provider-woman type fixed effects γ_{jhm} and year fixed effects τ_t , as well as insurer-specific linear time trends $\delta_j t$. Standard errors are clustered at the insurer-provider-woman type level. We estimate equation (1) separately for switches in the contract for c-sections and in the contract for vaginal deliveries. 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.

The estimation results are provided in Table 2. For both c-sections and vaginal deliveries, we find zero correlation between contract switches and lagged average per capita delivery characteristics. We include in our specification one contemporaneous measure given by the share of deliveries attributable to each woman-type within an insurer-provider-year. Correlation between contract switches and these contemporaneous delivery shares could reflect changes in diagnostic practices, such as upcoding, that are meant to

select women into particular contract types. We find no statistically significant effects for any measures across either specification. These results suggest that changes in contract type are quasi-random and are perhaps determined by idiosyncratic managerial preferences which have been shown in other settings to influence hospital performance (see e.g., [Otero and Munoz, 2022](#)).

TABLE 2: Correlates of Contract Switching

	Contract switch	
	(1) C-section	(2) Vaginal delivery
Woman-type share of deliveries	-0.139 (0.0834)	0.0410 (0.0850)
<u>Lagged delivery characteristics</u>		
SMM	-0.000341 (0.0774)	0.0199 (0.126)
Birth weight (kilograms)	-0.0218 (0.0296)	0.0140 (0.0395)
1-minute APGAR score	0.00298 (0.0161)	0.0166 (0.0172)
Log spending on delivery day	-0.0286 (0.0375)	0.0450 (0.0479)
Log spending up to delivery day	-0.0252 (0.0189)	-0.0189 (0.0231)
Woman-type share of deliveries	-0.0472 (0.0898)	-0.0636 (0.0943)
Constant	0.538 (0.360)	-0.156 (0.416)
N	2106	1668
R^2	0.140	0.223

Note: Table shows the correlates of contract switches for c-sections and for vaginal deliveries in columns 1 and 2, respectively. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Lagged delivery characteristics correspond to the lagged average per capita measure. Specifications include insurer-provider-woman type and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Measures of spending are averages per capita.

2.2 What are the Incentives under Each Contract?

The three contracts available to insurer-provider pairs in our setting are FFS, bundled payments, and capitation. If a service is covered under FFS, 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, the insurer negotiates a price per person, a service frequency per person, and a target population, and pays the provider 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.

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 the insurer does not pay for additional services provided during the episode of care that are not included in the bundle, and because payments will often not vary with the type of service provided. For example, if childbirth is covered under a bundled payment contract, then the provider will be reimbursed the same amount regardless of whether the infant is delivered by vaginal delivery or c-section. Given that capitation and bundled payments function similarly with respect to retrospectiveness in this setting, we will for the remainder of this

study distinguish only between FFS and non-FFS, where non-FFS refers to both capitation and bundled payments and will be referred to as simply CAP.

In the case of childbirth, and under fully retrospective contracts like FFS, the provider has an incentive to provide the service with the highest profit margin. Under prospective contracts like capitation and bundled payments, the provider has an incentive to provide the lowest cost treatment as payments do not vary with the services actually rendered. 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 consider the scenarios presented in Table 3, which depicts four possible contract type combinations for an insurer-provider pair. In all scenarios the price of a c-section is p_C and its marginal cost is m_C and the corresponding values for vaginal deliveries are p_V and m_V . The unit of payment depends on which contract type the service is covered under. When the services are covered under CAP, the column labeled “expected rate of use” summarizes the product of frequency of use and target population, normalized to one. We assume throughout that $m_C > m_V$.

Table 3 highlights that the choice of procedure will depend on prices, marginal costs, and payment retrospectiveness. For example, in the case where both procedures are capitated in scenario 1, providers 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

TABLE 3: Example of Contracting Scenarios and Incentives

Scenario (1)	Contract (2)	Service (3)	Expected rate of use (4)	Provider 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 provider 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, 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 provider conditional on each contracting scenario.

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 provider 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.

Table 3 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. For example, estimating the effect of covering c-section under FFS involves a comparison of scenarios 2 and 3 to scenarios 1 and 4. In the latter two scenarios the 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. Estimating the effect of covering vaginal delivery under FFS involves a comparison of scenarios 2 and 4 to scenarios 1 and 3. The incentives in the latter two scenarios diverge, favoring vaginal delivery in scenario 1 and c-section in scenario 3. The effect of covering vaginal delivery under FFS on the c-section rate is therefore ambiguous. In our empirical application, we will take advantage of variation in contracts across procedures to see whether providers are responsive to these asymmetric incentives.

We note that Table 3 is a simplified representation of the world and does not capture several other ways in which agents in this setting may respond to contracts: for example, providers under CAP have incentives to select low-risk patients who are less likely to need health care, while the insurer has an incentive to steer high-risk patients towards providers covered under CAP. There may be other unobserved determinants of delivery procedure choice such as convenience or capacity constraints, which we do not consider. However, to the extent that provider moral hazard is the predominant way in which contracts affect delivery procedure choice and outcomes, we can expect to estimate results in line with the incentives outlined in Table 3.

2.3 Who Chooses Which Contracts?

Insurers and providers negotiate contracts for different services to maximize profits. In the data, we see that in any given year, more than 50% of insurers contract with at least 50 providers, while more than 50% of providers contract with only one insurer. This suggests that in the context of delivery procedures, which are highly standardized, insurers have higher bargaining power than providers because they are on the short side of the market.⁶ In Figure 2, Panels A and C, we see this bargaining power resulting in a greater use of prospective contracts for c-sections within an insurer than within a provider, while in Panels B and D, we see a relatively higher use of CAP contracts for vaginal deliveries within provider than within insurer. These correlations are consistent with the asymmetric incentives that insurers and providers face under each contract across delivery procedures.

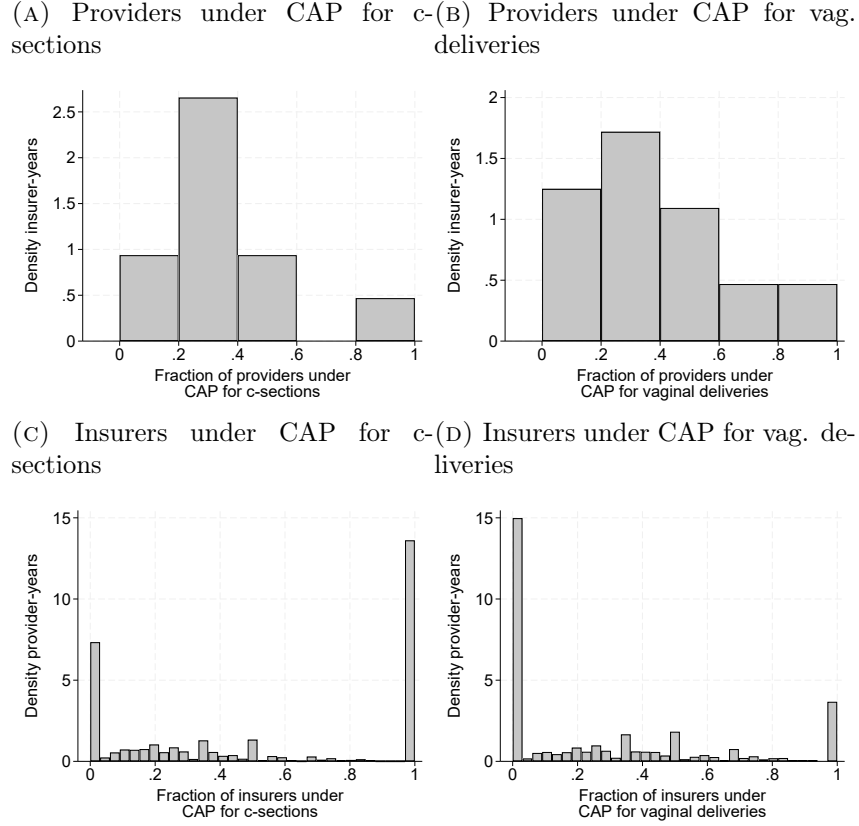
Figure 2 also shows that contract types for each delivery procedure vary to a greater extent within insurer than within provider. We worry that this variation might reflect endogenous selection of insurers into FFS or CAP contracts over time, which we will address in our empirical design.

3 Empirical Design

To study the effect of contracts on medical treatment decisions, we take advantage of the quasi-random variation in contracts within a service, insurer,

⁶In our conversations with agents who work for the contracting areas of insurers and providers we also learned that insurers typically make take-it-or-leave-it offers to providers for delivery services, corroborating our intuition on the relative bargaining power.

FIGURE 2: Distribution of Fraction of Providers and Insurers under CAP



Note: Panels A and B show the distribution of the fraction of providers covered under CAP for c-sections and for vaginal deliveries, respectively, across insurer-months. Panels C and D show the distribution of the fraction of insurers having a CAP contract for c-sections and for vaginal deliveries, respectively, across provider-months.

provider, and type of woman over time. Note that because contracts are established at the service level, it may be the case that c-sections are more likely to be covered under FFS than vaginal deliveries across all insurer-provider 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-provider pairs and services would yield a mechanically higher c-section rate under FFS than CAP because of selection.

Thus, the appropriate research design should instead exploit the variation in contracts within service, insurer, provider, and type of woman, which the Colombian setting uniquely provides.

We estimate models as follows:

$$y_{jhmt} = \alpha FFS_{jhmt}^s + \gamma_{jhm} + \delta_j t + \tau_t + \varepsilon_{jhmt} \quad (2)$$

where y_{jhmt} is an outcome for insurer j , provider h , and type of woman m in year t , FFS_{jhmt}^s is an indicator for whether procedure $s \in \{\text{c-section, vaginal delivery}\}$ is covered under FFS, γ_{jhm} is an insurer-provider-woman type fixed effect, $\delta_j t$ is an insurer-specific linear time trend, and τ_t is a year fixed effect. 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-provider-woman type, which defines a contract.

We include fixed effects at the level of insurer-provider-woman type to control for time-invariant factors that may be correlated with the use of FFS. For example, if insurer or provider quality are correlated with contract type, then the estimated effect of FFS would be biased. τ_t accounts for any aggregate trend or seasonality in contracting decisions. Lastly, the inclusion of an insurer-specific time trend accounts for changes in insurer quality or enrollee composition over time that may be correlated with our outcomes of interest. For example, if the insurers' population of enrollees grows or its health risk

changes over time in a way that is correlated with the use of FFS, then this would bias our estimate of α .

Appendix Figures 1 and 2 plot the residuals from a regression of contract types on insurer-provider-woman type fixed effects, year fixed effects, and insurer-specific time trends for c-section and vaginal delivery, respectively. Both figures show that substantial variation in contract type remains, which we can use to estimate our effects of interest.

4 Results

Table 4 presents the results of estimating equation (2) using the c-section rate as the dependent variable. In column (1) we find that covering c-sections under FFS generates a 6.5% increase in the c-section rate. Column (2) shows that there is no statistically or economically significant effect of covering vaginal delivery under FFS. These findings are in line with the predictions from Table 3: irrespective of whether vaginal deliveries are covered under CAP or FFS (scenarios 1 and 4), covering c-sections under FFS (scenarios 2 and 3) increases incentives to provide c-sections. The same is not true for vaginal deliveries. These findings show both that service profitability determines treatment decisions over and beyond patients' underlying health status, and that whether and how contracts impact delivery procedure choice may not be symmetric across services.

Table 5 further corroborates the intuition from our toy example in Table 3. In column (1), we test the prediction that, conditional on scenarios 1,

TABLE 4: Impact of FFS Use on C-section Rates

	C-section rate	
	(1)	(2)
C-section FFS	0.0316 (0.0124)	
Vaginal delivery FFS		-0.00002 (0.0106)
Constant	0.519 (0.0130)	0.375 (0.0119)
Sample	Full	Full
% change in outcome	6.5	-0.004
N	6354	6557
R^2	0.76	0.81

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on the c-section rate in columns 1 and 2, respectively. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

3, and 4, the effect of covering c-section under FFS is to increase c-section rates.⁷ We find indeed that the effect of a FFS contract for c-section in this subsample is large and statistically significant, associated to a 29% increase over the baseline c-section rate. We also test the prediction that while the contract type for vaginal delivery varies across scenarios 1 and 4, the optimal procedure choice does not. As expected, column (2) shows the the vaginal delivery contract has no effect on delivery procedure choice conditional on scenarios 1 and 4.

⁷The 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 c-sections and vaginal deliveries is CAP in year t and is FFS in year $t + 1$, then the $t + 1$ observation is not included in the estimation of column (1) which uses observations in scenarios 1, 3, and 4. Table 5 thus exploits variation in contract types across contracting units, which may be potentially endogenous. However, these results are informative about the intuition developed in Table 3.

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

	C-section rate	
	(1)	(2)
C-section FFS	0.141 (0.0326)	
Vaginal delivery FFS		-0.0228 (0.0457)
Constant	0.385 (0.0301)	0.395 (0.0392)
Sample	Scenarios 1, 3, and 4	Scenarios 1 and 4
% change in outcome	29.2	-4.7
N	544	463
R^2	0.81	0.80

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on the c-section rate in columns 1 and 2, respectively. Definition of samples is provided in Table 3. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

If payments to providers are higher under FFS than under CAP, then the responsiveness to contracts that we estimate above may be attributable to payment size rather than to each contract's degree of payment retrospectiveness. We are interested in evaluating whether providers respond to contract type conditional on payment size. To do so, we estimate equation (2) controlling for the log of average per capita health care spending incurred during the delivery day. We use this variable as a proxy for payment size since a direct comparison of prices across contract types is not possible (prices have different units across contract types).

Results are presented in Table 6. Column (1) shows that the impact of covering c-section under FFS is marginally significant and slightly attenuated

in magnitude relative to Table 4, but is still economically meaningful. In columns (3) and (4), we provide estimates for the specifications in Table 5 controlling for delivery day spending. Results show that the effect of FFS contracts for c-sections conditional on scenarios 1, 3, and 4 remains significant. In this case, the use of FFS for c-section is associated with a 28% increase in the c-section rate. Together these findings indicate that contracts affect medical treatment decisions mainly through an underlying preference of providers for retrospective payments.

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

	C-section rate			
	(1)	(2)	(3)	(4)
C-section FFS	0.0187 (0.0120)		0.136 (0.0310)	
Vaginal delivery FFS		-0.00882 (0.0103)		-0.0348 (0.0451)
Log spending on delivery day	0.153 (0.0107)	0.132 (0.0125)	0.0765 (0.0366)	0.0693 (0.0385)
Constant	-0.438 (0.0686)	-0.449 (0.0787)	-0.0757 (0.216)	-0.0161 (0.222)
Sample	Full	Full	Scenarios 1, 3, and 4	Scenarios 1 and 4
% change in outcome	3.9	-1.8	28.1	-7.2
N	6354	6557	544	463
R^2	0.78	0.82	0.82	0.80

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on the c-section rate controlling for the log of average per capita health care spending incurred during the delivery day. Columns 1 and 2 are estimated using the full analysis sample while Columns 3 and 4 are estimated using samples described in Table 5. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

4.1 Marginal Women and Marginal Providers

If FFS causes a significant change in c-section rates, who are the women affected by the contracting decision and which providers drive the effect? In this subsection, we characterize marginal women and providers by exploring heterogeneous effects. In Table 7, we explore heterogeneity in treatment effects by pregnancy risk, estimating equation (2) with the inclusion of an interaction between FFS_{jht}^s and an indicator for high-risk pregnancy. In both columns results indicate that there are no significant differences in responsiveness to contract type across high- and low-risk pregnancies. This finding is 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.

We now move to evaluating which providers are more likely to respond to the financial incentives generated by FFS contracts. We do so by estimating heterogeneous treatment effects by provider size, as measured by the annual number of deliveries. Our hypothesis is that relatively small provider organizations where administrators or managers who negotiate contracts are more likely to influence physicians' treatment decisions drive our main results.

We estimate equation (2) with the inclusion of an interaction between FFS_{jht}^s and an indicator for whether the provider renders less than 100 deliveries annually ("small provider"). In Table 8 we find that small providers are much more responsive to contracts: they are 12% more likely to use c-section when it is reimbursed under FFS. Small providers are also 12% less

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

	C-section rate	
	(1)	(2)
C-section FFS \times High risk	0.00069 (0.0215)	
C-section FFS	0.0313 (0.0147)	
Vaginal delivery FFS \times High risk		-0.00695 (0.0199)
Vaginal delivery FFS		0.00318 (0.0126)
Constant	0.519 (0.0129)	0.374 (0.0118)
Sample	Full	Full
% change in outcome for high risk pregnancies	6.6	-0.8
% change in outcome for low risk pregnancies	6.5	0.7
N	6354	6557
R^2	0.76	0.81

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on the c-section rate by pregnancy risk in columns 1 and 2, respectively. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS for high- and low-risk pregnancies, calculated as the coefficient on the interaction divided by the average c-section rate in the sample.

likely to use c-section when vaginal delivery is reimbursed under FFS, while large providers are 5% more likely to provide c-sections when vaginal delivery is covered under FFS.

Our result that contracts substantially influence the c-section rate at a provider organization suggests that contracts ultimately influence physicians' decisions within these organizations. This can happen if provider organizations give incentives to physicians to perform procedures when they are covered under FFS relative to CAP. Some examples of these incentives include better control over schedules and salaries and more flexibility in medical practice

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

	C-section rate	
	(1)	(2)
C-section FFS \times Small provider	0.0374 (0.0114)	
C-section FFS	0.0216 (0.0124)	
Vaginal delivery FFS \times Small provider		-0.0861 (0.0138)
Vaginal delivery FFS		0.0261 (0.0113)
Constant	0.515 (0.0131)	0.388 (0.0122)
Sample	Full	Full
% change in outcome for small providers	12.2	-12.4
% change in outcome for large providers	4.5	5.4
N	6354	6557
R^2	0.76	0.81

Note: Table shows the impact of the use of FFS for c-sections by provider size. A small provider is defined as one that provides fewer than 100 deliveries in a given year. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-type of woman and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS for small and large providers, calculated as the coefficient on the interaction divided by the average c-section rate in the sample.

style.⁸ In fact, the finding that treatment effects are significant only among relatively small providers where the distinction between who owns the provider organization and who performs medical procedures is less marked substantiates this claim.

⁸See <https://www.ama-assn.org/medical-residents/transition-resident-attending/it-matters-how-your-practice-paid-primer-young>

4.2 Risk Selection

As discussed in Section 2.2, contracts may influence incentives to engage in both risk selection and moral hazard. Under moral hazard, conditional on the pool of enrollees, providers 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 providers are disproportionately covered under FFS. Our exercises so far show evidence of substantial provider moral hazard, as c-section rates vary significantly with payment retrospectiveness conditional on 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 show whether insurers respond to risk selection incentives by regressing 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 send lower-cost patients to providers covered under FFS.

Table 9 presents the results. We find essentially no relation between women’s switching decisions and contracting decisions, and therefore no significant evidence that insurers engage in risk selection on the intensive margin. These results are both a test of the plausible exogeneity of contract variation

TABLE 9: Impact of FFS Use on Risk Selection Incentives

	Switch-in rate		Log lagged cost	
	(1)	(2)	(3)	(4)
C-section FFS	0.00432 (0.0111)		-0.0638 (0.0615)	
Vaginal delivery FFS		-0.0144 (0.0122)		-0.118 (0.0843)
Constant	0.115 (0.0130)	0.140 (0.0135)	13.47 (0.131)	13.32 (0.143)
Sample	Full	Full	Full	Full
N	6345	6533	3350	2950
R^2	0.48	0.49	0.65	0.65

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries 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. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level.

within insurer, provider, and woman type and an evidence that contracts affect treatment choices and intensity of care mainly through provider moral hazard.

4.3 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 quasi-random variation in

contracts for c-sections and for vaginal deliveries impact health.

In Table 10 we estimate equation (2) using as outcomes the average per capita birth weight and 1-minute APGAR score, and the fraction of women who experience SMM within 1 week and 1 month after giving birth. We find essentially no impacts on any of these measures of maternal or infant health (while the coefficient on use of FFS for vaginal deliveries is marginally significant, its size is not economically meaningful, implying an increase in birth weights of 1.5%). These results suggest that the effects of contracts on delivery procedure choice, while economically significant, are not large enough to adversely affect health outcomes.

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

	Birth weight		1-min APGAR score		Severe maternal morbidity	
	(1)	(2)	(3)	(4)	(5)	(6)
C-section FFS	0.00048 (0.0186)		-0.0431 (0.0407)		-0.0032 (0.00468)	
Vaginal delivery FFS		0.0465 (0.0224)		0.0185 (0.0318)		-0.0034 (0.00692)
Constant	3.091 (0.0226)	3.071 (0.0259)	8.231 (0.0430)	8.234 (0.0394)	0.0221 (0.00594)	0.0344 (0.00776)
Sample	Full	Full	Full	Full	Full	Full
% change in outcome	0.02	1.5	-0.5	0.2	-8.6	-9.2
N	4854	5146	4854	5146	6557	6354
R^2	0.58	0.57	0.59	0.61	0.45	0.47

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on maternal and infant health outcomes. We consider as outcomes the average per capita infant's birth weight and 1-minute APGAR score, as well as the fraction of women who experience severe maternal morbidity (SMM) between 1 week and 1 month after giving birth. We construct the SMM indicator following the CDC definition. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS, calculated as the coefficient on FFS divided by the average c-section rate in the sample. Variation in the number of observations across specifications is due to missing values in some of our outcome variables.

4.4 Robustness Checks

We perform several robustness checks of our model and estimation procedure to provide suggestive evidence that our results capture causal effects. First, Appendix Figure 3 shows that our estimates are robust to using randomization inference on either the coefficient on c-section FFS or vaginal delivery FFS (see [MacKinnon and Webb, 2020](#); [Carpenter and Churchill, 2023](#)). Therefore, our estimated coefficients are statistically larger than if they were generated by chance. Second, Appendix Table 1 shows that our main estimates are robust to including woman type-specific time trends, which may capture changes in delivery practice styles for women with certain conditions across insurers and providers. Appendix Table 2 also shows that our main estimates are robust to replacing the insurer-specific time trends with insurer-year fixed effects. Insurer-year fixed effects will better capture non-linear variation over time in delivery practices common across observations within an insurer. Lastly, in Appendix Table 3 we show that our main estimates are robust to replacing the insurer-specific time trends in our main set of controls with insurer-woman type-specific linear time trends.

5 Conclusions

There is an impressive amount of theoretical literature establishing the incentives that health insurers and health care providers face under different contracts such as fee-for-service (FFS), and capitation and bundled payments (CAP). Yet, empirical evidence on whether contracts causally influence medi-

cal 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-provider pair variation in contracts for c-sections and for vaginal deliveries using data from Colombia. In the Colombian health care system, insurers and providers 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 providers, and how these incentives vary across delivery procedures.

We find that covering c-sections under FFS increases the c-section rate by 6.5% while covering vaginal deliveries under FFS does not impact delivery procedure choice. We show that these effects are explained by the degree of payment retrospectiveness of each contract rather than by the size of the payments negotiated between insurers and providers. Our results indicate that bilateral contracting decisions between insurers and providers 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 causal relation between contracts and medical treatment decisions matters for health policy as improving patient and population health outcomes may require regulating insurer-provider bilateral contracting decisions.

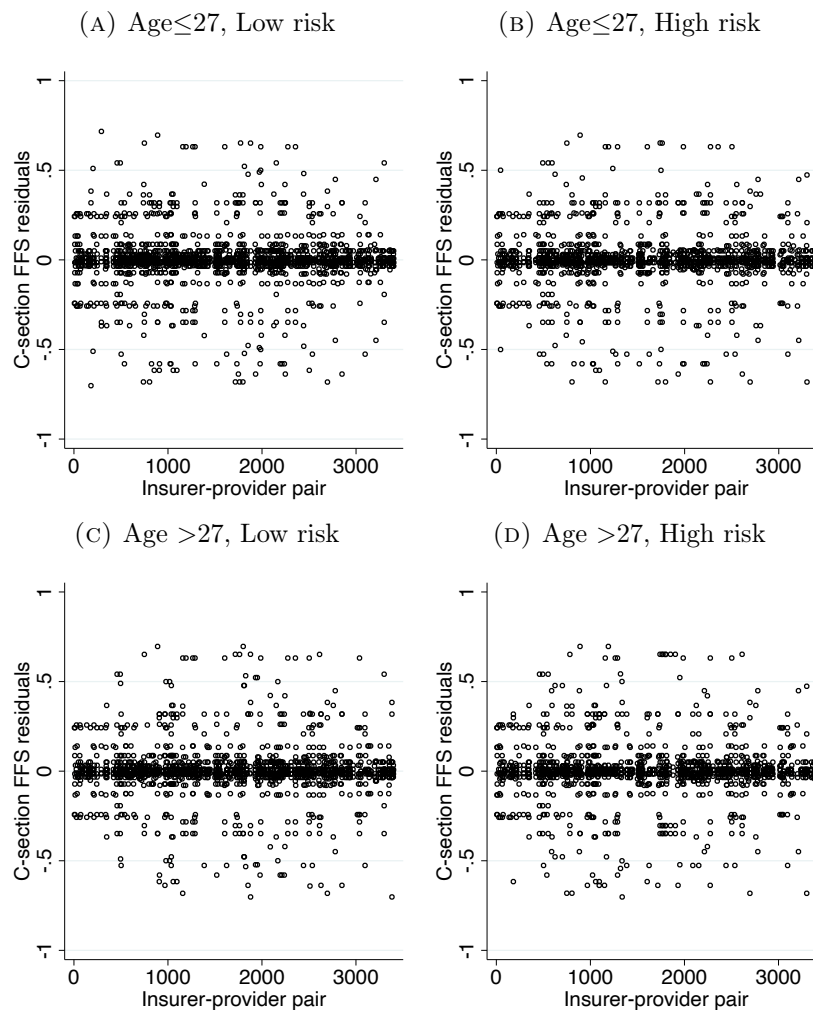
Appendix A Data Cleaning

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 is $N=521,408$. To obtain our final analysis sample we proceed in the following steps:

1. Keep singleton, non-breech, first-time births ($N=437,191$).
2. Keep deliveries that are reimbursed under fee-for-service, capitation, or bundled payment contracts ($N=343,967$).
3. Obtain the modal contract per service (c-sections and vaginal deliveries), insurer, provider, type of woman, and month. 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.
4. Collapse the data to the insurer, provider, 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.

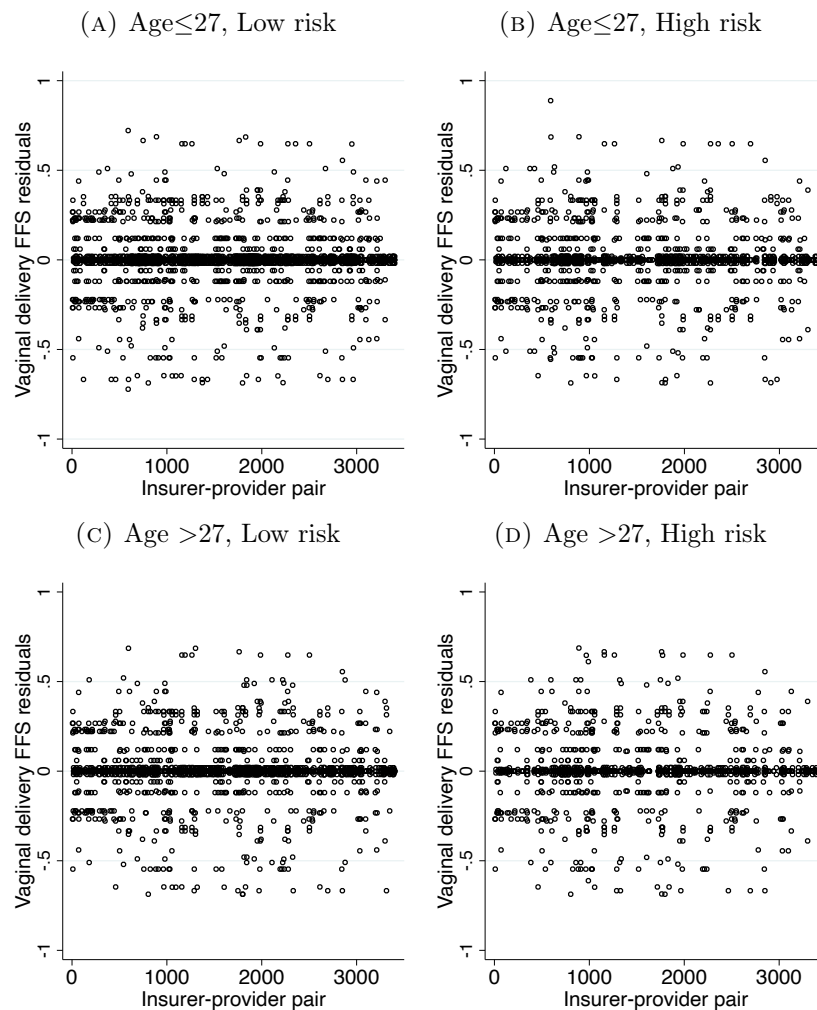
Appendix B Residual Variation in Contracts

APPENDIX FIGURE 1: Residual Variation in Use of FFS for C-sections within Insurer-Provider



Note: Figure shows the distribution of residuals from a regression of our predicted contract for c-sections on insurer-provider-woman type fixed effects, year fixed effects, and insurer-specific time trends. 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-Provider



Note: Figure shows the distribution of residuals from a regression of our predicted contract for vaginal deliveries on insurer-provider-woman type fixed effects, year fixed effects, and insurer-specific time trends. We report the distribution conditional on the woman's age group and pregnancy risk.

Appendix C Robustness Checks

APPENDIX TABLE 1: Impact of FFS Use on C-section Rates Controlling for Woman Type-Specific Time Trends

	C-section rate	
	(1)	(2)
C-section FFS	0.0322 (0.0124)	
Vaginal delivery FFS		-0.00004 (0.0106)
Constant	0.488 (0.0176)	0.347 (0.0190)
Sample	Full	Full
% change in outcome	6.7	-0.008
N	6354	6557
R^2	0.76	0.81

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on the c-section rate in columns 1 and 2, respectively. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer- and woman type-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

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APPENDIX TABLE 2: Impact of FFS Use on C-section Rates Controlling for Insurer-Year Fixed Effects

	C-section rate	
	(1)	(2)
C-section FFS	0.0214 (0.0127)	
Vaginal delivery FFS		-0.00628 (0.0106)
Constant	0.613 (0.0111)	0.375 (0.00917)
Sample	Full	Full
% change in outcome	4.4	-1.3
N	6354	6557
R^2	0.78	0.81

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on the c-section rate in columns 1 and 2, respectively. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type fixed effects, year fixed effects, and insurer-year fixed effects. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

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APPENDIX TABLE 3: Impact of FFS Use on C-section Rates Controlling for Insurer-Woman Type Specific Time Trends

	C-section rate	
	(1)	(2)
C-section FFS	0.0326 (0.0126)	
Vaginal delivery FFS		-0.000452 (0.0107)
Constant	0.524 (0.0273)	0.388 (0.0331)
Sample	Full	Full
% change in outcome	6354	6557
N	6.7	-0.09
R^2	0.76	0.81

Note: Table shows the impact of the use of FFS for c-sections and for vaginal deliveries on the c-section rate in columns 1 and 2, respectively. An observation is an insurer-provider-woman type-year. A woman type is a combination of age group (age ≤ 27 , age > 27) and pregnancy risk (high vs. low). Specifications include insurer-provider-woman type and year fixed effects as well as insurer-woman type-specific time trends. Standard errors in parenthesis are clustered at the insurer-provider-woman type level. Table reports the percentage change in the outcome due to covering the procedure under FFS, calculated as the coefficient on FFS divided by the average c-section rate in the sample.

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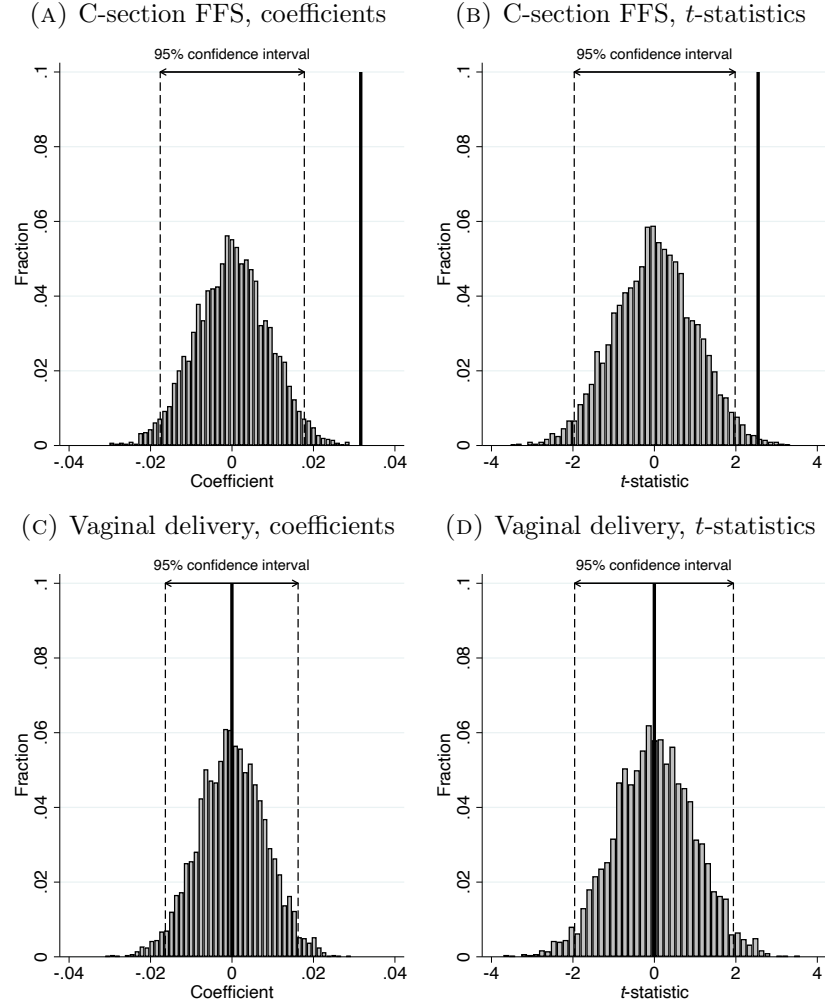
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APPENDIX FIGURE 3: Randomization Inference on Main Model Coefficients



Note: Figures show the distribution of placebo coefficients and cluster-robust t -statistics obtained from randomly assigning contract types 5,000 times and estimating Equation 2 using the full analysis sample and using the c-section rate as the dependent variable. The solid black line in each panel shows the estimated coefficient or t -statistic from using the actual contract type. These coefficients can be found in Table 4.