The Effect of Payment Contracts on C-section Use

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Abstract

C-sections are the leading cause for hospitalization among women and contribute to rising health care costs. In this paper we quantify the effect of payment contracts (fee-for-service vs. capitation) on c-section rates, health care costs, and health outcomes post-delivery. We estimate a structural model of delivery choice and hospital demand, and a reduced-form pricing model. We find that hospitals are more likely to provide c-sections when it is reimbursed under fee-for-service. However, patients are less likely to choose hospitals covered under fee-for-service. We use our model estimates to compute market outcomes under counterfactual contract regulation and find substantial declines in the number of c-sections and improvements in health outcomes when both c-sections and vaginal deliveries are capitated.

Keywords: Delivery, Hospital demand, Health Insurance, Fee-for-service, Capitation

JEL codes: I11, I13, I18.

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1 Introduction

Several countries in Latin America, including Brazil, Colombia, and Chile, have experienced a rapid increase in the number of c-sections in the last couple of decades; a phenomenon some call the "c-section epidemic". In Colombia, c-sections accounted for 61% of all deliveries in the statutory health system during 2013 (Ministerio de Salud, 2015). This c-section rate exceeds the predictions from the World Health Organization and is well above the rate in OECD countries. C-sections constitute the leading cause for hospitalization among women, contribute to rising health care costs since they are more expensive than vaginal deliveries, and are more commonly associated to bad maternal health outcomes (AHRQ, 2018b,a; Rizo Gil, 2009). It is therefore of policy interest to design mechanisms that help reduce the c-section rate. In this paper we focus on how the regulation of payment contracts between health insurers and hospitals impacts delivery choice, health care costs, and health outcomes after childbirth in the Colombian health care system.

The most common types of payment contracts between insurers and hospitals are capitation and fee-for-service (FFS). While use of capitation grew in many countries with the rise of managed care, FFS remains the dominant way in which insurers reimburse providers (Zuvekas and Cohen, 2016; Center for Studying Health System Change, 2008). These contracts generate starkly opposing incentives. Under capitation, hospitals have incentives to under-provide care because they are exposed to higher financial risk (Aizer, Currie, and Moretti, 2007; Frakt and Mayes, 2012; Chami and Sweetman, 2019; Brot-Goldberg and De Vaan, 2018). Under FFS, hospitals have incentives to over-provide services because their revenues are proportional to the number of services provided (Cadena and Smith, 2022; Hennig-Schmidt, Selten, and Wiesen, 2011; Shafrin, 2010; Helmchen and Lo Sasso, 2010; Liu, Kao, and Hsieh, 2009). At the same time, FFS increases the financial risk borne by insurers and may incentivize them to steer patients towards cheaper hospitals (Serna, 2021).

Insurers and hospitals in Colombia negotiate payment contracts and prices separately for each health service. They first choose between capitation and FFS to reimburse each health service under; and then, conditional on the payment contract, they negotiate prices based on expected demand and costs. This means that for a given insurer-hospital pair it is possible that c-sections and vaginal deliveries are reimbursed under different contracts. It also means that for a given insurer, demand for in-network hospitals will vary across payment contracts.

After contracts are signed, insurers and hospitals may have incentives to influence treatment decisions and patient choices because of adverse selection. Unobservably sick patients may sort into more expensive hospitals or hospitals covered under FFS in equilibrium, but this health risk can not be priced into the contracts ex-ante. To combat this adverse selection ex-post, insurers can steer patients towards cheaper hospitals and hospitals can provide more expensive treatments. Asymmetric information thus generates scope for payment contracts to affect delivery choice, and for its regulation to potentially achieve the goal of reducing unnecessary c-sections.

We start by providing descriptive evidence of substantial adverse selection in hospital choice consistent with insurers' inability to price in health risk during negotiations with hospitals. We then document that hospitals are more likely to provide c-sections if they are reimbursed on a FFS basis. Variation in c-section rates across payment contracts is likewise suggestive of hospital moral hazard. We also show that, conditional on delivery procedure, the cost of deliveries is higher at hospitals with FFS contracts than at hospitals with capitation contracts.

The descriptive evidence suggests that different incentives are in play for insurers and hospitals under capitation and FFS, consistent with economic intuition. To quantify the effect of such incentives under counterfactual contract regulations, we develop and estimate an equilibrium model of service prices, hospital demand, and delivery choice. In our model, insurers and hospitals first negotiate prices for vaginal delivery and c-section, taking observed payment contracts and enrollment decisions as given. Then, women choose an in-network hospital for their childbirth. Finally, hospitals choose whether to perform the childbirth by vaginal delivery or c-section.

We solve the model backwards, starting with the choice of delivery. We model the likelihood of having a c-section as a flexible function of delivery procedure prices and contracts as well as patient characteristics. Predicted procedure probabilities figure into the expected out-of-pocket (OOP) price faced by each woman when making her hospital choice. Hospital demand is a function of the woman's expected OOP price, payment contracts for c-sections and vaginal deliveries, and a measure of provider inertia. Following Abaluck, Gruber, and Swanson (2018); Prager (2020), we instrument for selection of individuals into insurers by leveraging insurer inertia using a control function approach. We derive a reduced-form equation for the price of vaginal deliveries and c-sections from a Nash-in-Nash bargaining model which is a function of estimated demand.

To estimate our model we use claims and enrollment data for all women who gave birth in the Colombian health care system during 2010 and 2011. These data are particularly well-suited for our analysis as they contain information on the payment contract under which each claim was reimbursed and the reimbursement that was paid by the insurer to the hospital. We focus on the subsample of women who had a baby in 2011 and who were continuously enrolled with the same insurer across both years.

Estimation of our delivery choice model shows that, conditional on the woman's health status, hospitals are more likely to perform c-sections the higher is the c-section price and the lower is the vaginal delivery price. The decision of which type of delivery to perform also varies significantly with the payment contract these delivery procedures are covered under. Our findings are consistent with hospitals providing more expensive treatments when they are reimbursed on a FFS basis.

Our demand estimates show that women are approximately 38 percent less likely to choose a hospital if the expected out-of-pocket delivery price increases by $10. All else equal, hospital demand is 62 percent lower if the expected payment contract under which the delivery is covered is FFS. The negative effect of payment contracts on hospital demand conditional on price is consistent with insurers steering patients towards hospitals where delivery is capitated and the insurer's marginal cost is zero.

Results of our reduced-form pricing model show that the average hospital markup for c-sections is $107, while that for vaginal deliveries is $104. We find substantial dispersion in markups across hospitals, suggestive of differences in bargaining power relative to insurers. Hospitals where deliveries are reimbursed on a FFS basis do not enjoy statistically different markups relative those reimbursed on a capitated basis.

We use our equilibrium model of delivery choice and hospital demand to simulate the expected number of c-sections, health care cost, and health outcomes under alternative payment contracts. Given that contracts arise endogenously as a result of insurer and hospital competition, which we do not model, we think of these counterfactuals as government mandates over which services can be covered under each payment contract. In particular, we find that moving to a fully capitated system, where both c-sections and vaginal deliveries are covered under capitation for every insurer-hospital pair, results in a 5 percent decrease in the expected number of c-sections per hospital and a 1 percent decrease in the third quantile of the distribution of delivery costs per hospital. Although we find similar reductions in the number of c-sections among high-risk and low-risk pregnancies in this counterfactual, our results suggest that maternal health outcomes improve with full capitation. The rate of bad maternal outcomes in the month after delivery falls 48 percent relative to the observed scenario.

Our paper contributes to the literature of payment contracts between insurers and hospitals. Perhaps the paper that is most similar to ours is Ho and Pakes (2014). The authors analyze referral decisions made by physician groups whose compensation is capitated. Our focus is on the interplay of contracts with hospital and procedure choice in the presence of negotiated prices. Our paper is also related to Acquatella (2022a,b) in considering that contracts have different effects on realized health care costs and providers' treatment decisions.

Our counterfactual results speak to the potential of different payment contracts to influence the type and cost of health care. These outcomes are important and topical in the context of childbirth for several reasons. First, c-section rates have been shown to vary considerably across hospitals without correlation with infant outcomes (Kozhimannil, Law, and Virnig, 2013; Baiker, Buckles, and Chandra, 2006; VanGompel, Perez, Datta, Wang, Cape, and Main, 2019). Second, c-sections among low-risk mothers or unnecessary c-sections are a contributor of rising healthcare costs (Podulka and Steiner, 2011; Sakala, Delbanco, and Miller, 2013; Teleki, 2020). Third, there is recent policy interest and policy implementations aiming at reducing c-section rates (see e.g, California Health Care Foundation, 2022; Rosenstein, S., Sakowski, Markow, Teleki, Lang, Logan, Cape, and Main, 2021).

The remainder of this paper is structured as follows. Section 2 provides a description of the Colombian health care system. Section 3 introduces our data. Section 4 provides a descriptive analysis. Section 5 presents our equilibrium model of hospital demand. Section 6 discusses parameter identification. Section 7 presents our estimation results. Section 8 provides our policy counterfactual results. Section 9 concludes.

2 Background

Colombia's statutory health care system is divided into a contributory regime and a subsidized regime. The contributory regime covers the 51% of the population that are above a monthly income threshold and are able to pay the required tax contributions to the system. The remaining 49% of the population who are below the income threshold are covered by the subsidized regime, which is fully funded by the government. The national health care system has nearly universal coverage and provides access to a national health insurance plan through private insurers.

The national plan covered a comprehensive list of more than 7 thousand services and procedures and more 700 prescription medications as of 2011. Cost-sharing rules are specified by the government based on the enrollee's monthly income level. Individuals are grouped according to whether they make less than two times the monthly minimum wage (MMW), between two and five times the MMW, or more than five times the MMW. Coinsurance rates, copays, and maximum out-of-pocket expenditures within each group are set by the government, increase monotonically across income brackets, and are standardized across insurers and hospitals.

In addition to regulating cost-sharing rules, the government sets insurance premiums to zero. Private insurers instead receive two types of transfers from the government for each of their enrollees. At the beginning of each year, the government makes transfers that are risk-adjusted for the enrollee's sex, age, and municipality of residence. At the end of every year, the government also compensates insurers for a non-exhaustive list of diseases. Insurers with a below-average share of patients with diseases in this list make payments to those with an above-average share. Both risk adjustment mechanisms are insufficient to control risk selection incentives in this health system (Serna, 2022; Riascos and Camelo, 2017; Riascos, 2013).

Insurers have discretion over which hospitals to cover for each service in the national plan. Insurers bargain over prices and contract types for each service with the hospitals in their network. The government allows insurers and hospitals to choose among the following set of payment contract to negotiate their terms: fee-for-service, capitation, fee-for-package, and fee-for-diagnosis. The most common payment contracts under which services are reimbursed in our data are capitation and FFS. Almost 51% of all claims filed during 2011 were reimbursed on a capitated basis and another 43% on a FFS basis.

When a service is reimbursed under a FFS contract, the insurer and the hospital will have negotiated a price that is paid each time the service is provided. For example, if the negotiated FFS price of a primary care visit is 10 thousand pesos and the price of a blood test is 20 thousand pesos, then the insurer of a patient who visits the primary care physician and receives two blood tests will pay 50 thousand pesos to the hospital that provided those services. Payments under FFS contracts are thus retrospective, and hospital revenue is proportional to the number of services provided. This payment contract incentivizes hospitals to over-provide services, or to provide relatively more expensive services. Insurers also bear the financial risk of over-provision of care. Insurers may therefore have incentives to steer patients away from hospitals with a high share of services reimbursed on a FFS basis.

Under a capitation contract, insurers and hospitals bargain over a per-enrollee price that covers the provision of all capitated services. This per-enrollee price is paid once in every contracting period (typically a calendar year) and does not vary with the number of capitated services provided. For example, if primary care visits and blood tests are both capitated and the capitation payment for these services is

30 thousand pesos, then insurer of the patient from our previous example who visits the primary care physician and gets two blood tests pays 30 thousand pesos to the hospital.[1]

3 Data

To study hospital choice and health care costs under different payment contracts, we use enrollment and claims data for all individuals enrolled in the Colombian contributory regime in 2010 and 2011. Our data comprise 187,389 unique women who have a first childbirth in 2011 at a hospital that performs at least 10 childbirths. Our analysis uses the subsample of women who do not switch to the subsidized system nor switch their insurer from 2010 to 2011 (N=135,791). Further sample restrictions, such as dropping hospitals that perform only one type of delivery and dropping women with missing values in their observed characteristics, reduce the number of observations for our analysis sample to 109,821.

In the claims data, we observe the date on which each claim was provided, the provider that rendered the claim, the insurer that reimbursed it, and the associated ICD-10 diagnosis code. We have basic demographic information such as age, income group, and municipality of residence. Using this information we can recover each enrollee's level of cost sharing and the risk adjustment payments that the government would have made to insurers for each of their enrollees.

We create patient-level diagnosis indicators by grouping ICD-10 codes recorded before the delivery date according to the methodology in Riascos, Alfonso, and Romero (2014). This results in the following conditions: arthritis, arthrosis, asthma, autoim-

[1] Hospitals and insurers in our setting do not negotiate "shared risk agreements" wherein costs over and above the capitation payment are split between the insurer and the hospital. In this sense, capitation contracts in our setting are global.

mune disease, cancer, cardiovascular disease, diabetes, epilepsy, genetic anomalies, HIV/AIDS, long-term pulmonary disease, renal disease, transplant, and tuberculosis. We also categorize women based on their pregnancy risk level. Women with high-risk pregnancies are those who receive an ICD-10 diagnosis code of O09, V23, O10-O16, O20-O29, and O25, related to supervision of high-risk pregnancy; edema, proteinuria, and hypertensive disorders in pregnancy, childbirth, and the puerperium; other maternal disorders predominantly related to pregnancy; and malnutrition in pregnancy. Low-risk pregnancy women are the rest. Unfortunately, we do not observe the woman's residence address to measure distance to each hospital. But because municipalities are small geographical units, hospitals in these geographies are all part of the choice set.

Importantly, we observe whether each claim was reimbursed under a FFS or a capitation contract and its price. We consider claims reimbursed under fee-for-package and fee-for-diagnosis forms of capitation as well. In the case of FFS, the reported price is the negotiated price for that service. For capitated claims, the reported price corresponds to the unit price of the service in the capitated service bundle. The sum of reported prices across all claims reimbursed under capitation equals the total capitation payment from the insurer to the hospital. In the claims data we do not observe the individual obstetrician at each hospital that performs deliveries. Our model implications later on therefore assume that doctors are perfect agents for the hospital or that doctors' and hospitals' incentives are perfectly aligned.

Because reported prices may differ from negotiated prices based on encounter characteristics that are unobserved at the time of negotiations, we obtain negotiated prices for vaginal deliveries and c-sections in the style of Gowrisankaran, Nevo, and Town (2015).[2] Negotiated prices are the average predictions of linear regressions of

[2] Reported prices may differ from negotiated prices along the patient's length-of-stay, for example.

reported prices on patient characteristics and hospital fixed effects, estimated separately for each insurer and type of delivery. Averages are taken across delivery claims within a hospital-insurer-contract triplet. We describe this procedure in more detail in Appendix A. We refer to the predictions obtained from this methodology as "prices" from now on.

We recover each insurer's network of delivery hospitals in each market from observed claims. Using observed claims to build patients' choice sets is a valid way to recover true networks since all claims in our data correspond to in-network providers, and since we focus on providers with at least 10 claims for delivery procedures. We define a market as a municipality. There are 1,123 municipalities in the country. Municipalities are smaller geographical units than Colombian states. We assume that women have their baby delivered at a hospital covered by their insurer in their municipality of residence. In practice, women typically do not go to a different state to receive obstetric care, and patients, especially those in labor, tend to visit nearby providers (Minion, Krans, Brooks, Mendez, and Haggerty, 2022; AHRQ, 2018c).

Summary statistics for our sample are provided in table 1. An observation in this table is a delivery. Column (1) uses the full sample of deliveries, column (2) conditions on vaginal deliveries, and column (3) conditions on c-sections. The full sample contains 429 unique providers and 14 unique insurers. The average price of a delivery in column (1) is \$274. C-sections are on average \$32 more expensive than vaginal deliveries. A fraction of 0.81 c-sections and a fraction of 0.75 vaginal deliveries are covered under FFS.

Women who receive a c-section are on average older and in worse health than those who receive a vaginal delivery. The rates of comorbidities including cancer, cardiovascular disease, and diabetes are all higher among women who receive c-sections.

Length-of-stay for each patient is observed only after the patient makes a claim.

Table 1: Summary statistics

		All (1)	Vaginal (2)	C-section (3)
Contracts	Price	276 (135.5)	261 (134.6)	293 (134.6)
	FFS	0.78 (0.41)	0.75 (0.43)	0.81 (0.39)
	C-section	0.50 (0.50)	—	—
Demographics	Age 18-24	0.28 (0.45)	0.31 (0.46)	0.24 (0.43)
	Age 25-29	0.31 (0.46)	0.32 (0.47)	0.30 (0.46)
	Age 30-34	0.25 (0.44)	0.24 (0.43)	0.27 (0.44)
	Age 35 or more	0.15 (0.36)	0.13 (0.33)	0.18 (0.38)
	Low income	0.77 (0.42)	0.77 (0.42)	0.78 (0.42)
	Medium income	0.19 (0.39)	0.19 (0.39)	0.19 (0.39)
	High income	0.04 (0.19)	0.04 (0.20)	0.03 (0.18)
	Urban municipality	0.51 (0.50)	0.58 (0.49)	0.44 (0.50)
	Rural municipality	0.49 (0.50)	0.42 (0.49)	0.56 (0.50)
Health	Cancer	0.05 (0.22)	0.04 (0.21)	0.06 (0.23)
	Cardiovascular	0.02 (0.15)	0.02 (0.13)	0.03 (0.17)
	Diabetes	0.00 (0.06)	0.00 (0.05)	0.00 (0.06)
	Cost up to delivery	378 (562.3)	332 (421.0)	419 (670.9)
	High-risk pregnancy	0.15 (0.36)	0.14 (0.34)	0.17 (0.37)
	Bad health outcome	0.15 (0.16)	0.14 (0.16)	0.15 (0.16)
	Maternal mortality	0.03 (0.10)	0.03 (0.10)	0.03 (0.11)
Providers		429	411	418
Insurers		14	14	14
N		109,821	54,680	55,141

Note: Mean and standard deviation in parenthesis of main variables in the full sample of deliveries in column (1), conditional on vaginal deliveries in column (2), and conditional on c-section in column (3). Prices and costs are measured in dollars.

C-sections are also more common than vaginal deliveries among high-risk pregnancies. Differences in health status across chosen delivery procedure are also reflected in differences in total health care costs up to but not including the delivery: women who receive c-sections are on average $87 more expensive than women who receive vaginal deliveries before the time of delivery.

There is little evidence of quality differences across hospitals according to the type of delivery. We see no difference in the hospital rate of negative post-delivery health outcomes in the three months following childbirth across delivery type. We also see no difference in hospital-level maternal mortality.[3]

Our goal is to quantify how changes in payment contracts affect the sorting of patients across hospitals and procedures, and how changes in this sorting vary across women according to their health status. The following section describes the sources of variation in our data that will allow us to quantify these effects.

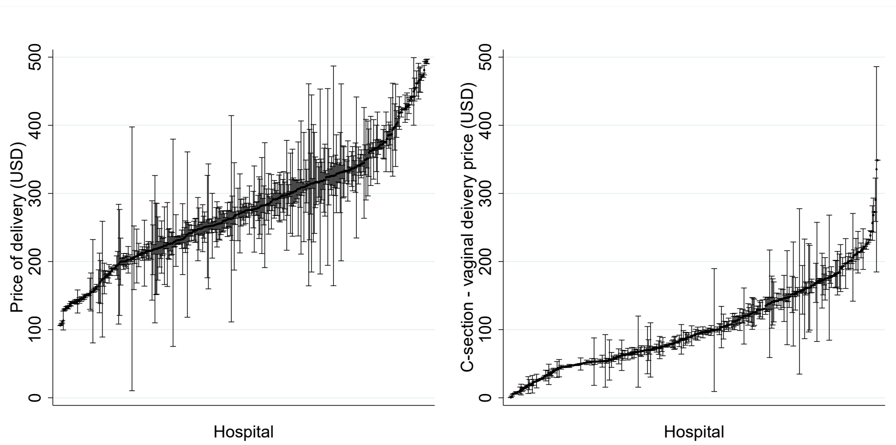
4 Descriptive analysis

Despite being very common procedures, prices for deliveries vary significantly across and within hospitals. Figure 1 summarizes each of these sources of variation. The left hand figure presents the mean and 95% confidence interval of delivery prices for each hospital in the horizontal axis. The right hand panel presents the same statistics for the difference between the price of a c-section and the price of a vaginal delivery. We use the price variation within hospital to identify the parameters of our demand model in section 5. The average price of a delivery ranges from $106 and $493. The average standard deviation of delivery prices within a hospital is $67. The mean difference

[3]The variable "Bad health outcome" is an indicator variable for hospitals were women have a hospitalization, hemorrhage (ICD10 code R85), puerperal sepsis (ICD10 code O85), or infection of obstetric surgical wound (ICD10 code O86), three months after childbirth.

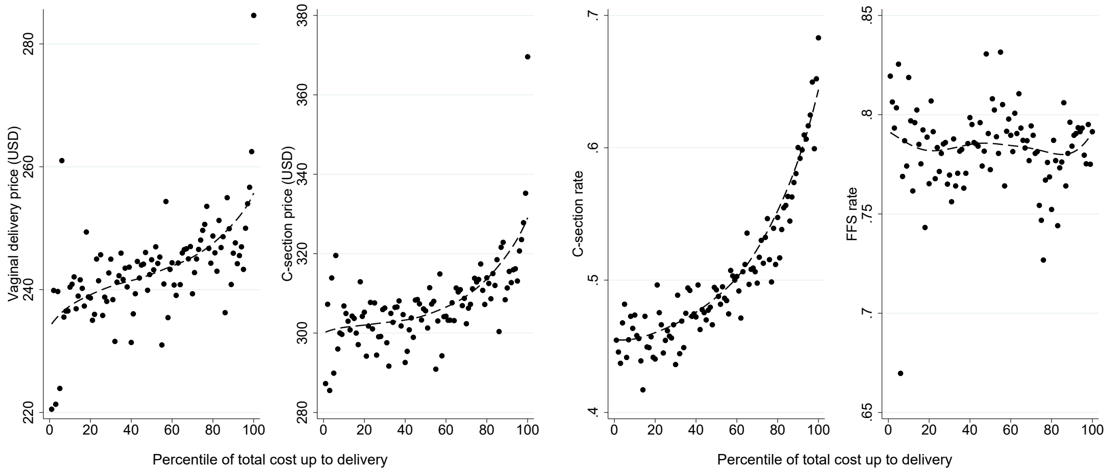
in delivery prices across hospitals is \$104, and the average standard deviation of this difference is \$29. Variation in the difference between the price of a c-section and the price of a vaginal delivery suggests that delivery choice can vary across hospitals and insurers conditional on payment contracts.

FIGURE 1: Variation in Delivery Prices



The fact that there is substantial variation in delivery prices may be the result of differences in bargaining power relative to insurers or of adverse selection in hospital demand. If patients randomly sort to hospitals, then we should see no correlation between measures of patient health and the characteristics of the hospitals they choose. The top two panels of 2 show the correlation between the price of each type of delivery and the woman's health care cost up to but not including the delivery, which we use as proxy for the woman's unobserved health status. We see that women who are costlier prior to childbirth choose more expensive delivery hospitals as measured by both vaginal delivery and c-section prices. Not only are prices higher at the hospitals chosen by costlier women, but so is the c-section rate as seen in the bottom left hand panel of figure 2. To the extent that health care costs are a good proxy for health status, these results are reflective of adverse selection in delivery hospital choice. We will capture this in our hospital demand model by allowing women's preferences over hospital characteristics to vary according to their demographics and diagnoses.

FIGURE 2: Patient sorting on prices, c-section rates, and contract types



While costlier patients tend to sort into hospitals with higher priced procedures, there is no evidence of patient sorting into hospitals according to payment contracts. The bottom left hand panel of 2 shows the correlation between women's delivery-weighted FFS rate and their health care costs up to the time of delivery. We see no correlation between the FFS rate and health status as measured by costs prior to delivery. Payment contracts are not observable to patients when making their enrollment, hospital, or delivery choices. They also do not directly influence patients' out-of-pocket costs, hence patients are unlikely to sort on contracts directly. Patient demand may respond to payment contracts based on their effect on prices or through insurer steering incentives. Our model will allow for contracts to affect hospital choice along both of these dimensions.

The evidence of adverse selection and the potential for provider moral hazard in this setting, raise the possibility for delivery choice to be influenced by payment contracts and patient characteristics. Table 2 reports c-section rates by type of woman

Table 2: Variation in c-section rates across patients and contracts

	Capitation	FFS
Age<30, Healthy	0.41	0.48
Age<30, Unhealthy	0.49	0.53
Age>=30, Healthy	0.51	0.55
Age>=30, Unhealthy	0.55	0.64

Note: Mean and standard deviation in parenthesis of c-section rate conditional on the woman's observable characteristics (age and having a chronic disease) and whether c-sections are covered under FFS.

and payment contract. Women are categorized based on age and on whether they have a chronic disease diagnosis. Consistent with previous literature, the table shows that conditional on the payment contract, c-sections are more common among older, sicker women than among young, healthy women. The table also shows that conditional on the type of woman, c-sections are more common when they are reimbursed on a FFS basis. Covariation between contract characteristics and treatment choice is suggestive of hospital moral hazard.

Table 3 reports the average delivery price conditional on the woman's observable characteristics and on whether the procedure is covered under FFS. We see that conditional on payment contract, c-sections are more expensive than vaginal deliveries. This pattern is consistent with the price differential reported in figure 1. Conditional on the type of delivery, capitation prices are higher than FFS prices. This pattern may be the result of insurers anticipating hospital moral hazard when negotiating FFS prices with hospitals. It may also be the result of hospitals anticipating their increased financial risk under capitation.

Which hospitals negotiate which contracts? Price variation across payment contracts conditional on the procedure raises questions about selection of hospitals into payment contracts. While we do not explicitly model how these contracts emerge in equilibrium, knowing which type of hospitals negotiate which contracts is important to understand the welfare implications of counterfactual contract regulation. Table

Table 3: Variation in price across patients and contracts

	C-section		Vaginal	
	Capitation	FFS	Capitation	FFS
Age<30, Healthy	427.7	274.5	379.5	202.9
Age<30, Unhealthy	430.1	280.5	374.6	207.2
Age>=30, Healthy	398.8	284.7	358.0	213.5
Age>=30, Unhealthy	421.6	281.1	373.8	205.6

Note: Mean of delivery price conditional on the woman's observable characteristics (age and having a chronic disease) and on whether the procedure is covered under FFS.

Table 4: Average hospital characteristics by payment contract

	Vaginal delivery		C-section	
	Cap	FFS	Cap	FFS
Beds	168.1	149.6	165.8	151.0
Rooms	8.19	6.56	8.05	6.67
Private	0.97	0.88	0.97	0.89
Any ambulance	0.03	0.29	0.03	0.28
Maternal mortality	0.03	0.04	0.02	0.05
Bad outcome	0.18	0.21	0.18	0.21

Note: Average hospital characteristics across deliveries by type of payment contract for vaginal deliveries and c-sections.

4 presents average characteristics of hospitals that negotiate capitation and FFS for vaginal deliveries and c-sections. For both procedures, we see that hospitals that negotiate capitation contracts are significantly larger and of relatively higher quality than those that negotiate FFS contracts. Hospitals under capitation have approximately 10 more beds and two more obstetric rooms than those under FFS. Hospitals under capitation also have lower rates of bad maternal health outcomes post-delivery and a slightly lower maternal mortality rate.

5 Model

To study the impact of payment contracts on c-section rates and delivery costs, we develop a model of hospital and delivery choice. Throughout the model we take observed contract types and hospital networks as given. The timing is as follows.

1. Insurers and hospitals negotiate delivery prices, conditional on contracts.

2. After observing prices, women choose a hospital in the network of their insurer to have their babies delivered.

3. Observing prices and contract types, hospitals choose to perform vaginal deliveries or c-sections.

In this setup, we abstract from the choice of insurer, which is typically modelled between stages 1 and 2. This implies that we need to correct for selection into insurers when estimating stage 2. We lay out our model starting from the choice of delivery procedure.

5.1 Delivery choice

Let d_i be an indicator for whether the woman enrolled with insurer j receives a c-section at hospital h, p_{jh} the negotiated price of a c-section, and q_{jh} the negotiated price of a vaginal delivery between insurer j and hospital h.Moreover, let f_{jh} be an indicator for whether c-sections are covered under FFS, and g_{jh} an indicator for whether vaginal deliveries are covered under FFS between insurer j and hospital h. Although obstetricians perform deliveries taking into account patient characteristics, we assume doctors are perfect agents for hospitals and therefore observe procedure prices and payment contracts. We model the probability of a c-section as a linear function of negotiated prices and contracts:

$$d_{ijh} = \theta_1 p_{jh} + \theta_2 q_{jh} + \theta_3 f_{jh} + \theta_4 p_{jh} \times f_{jh} + x_i' \theta_5 + \varphi_j + \delta_{t(h)} + \varepsilon_{ijh}$$

Here, x_i is a vector of the woman's observable characteristics including indicators for age group, having a chronic disease, being a high-risk pregnancy, day of delivery, and municipality of residence. The coefficients φ_j are insurer fixed effects and $\delta_{t(h)}$ are municipality fixed effects. The predicted likelihood of a c-section is

$$\hat{\phi}_{ijh} = \hat{E}[d_{ijh}|p_{jh}, q_{jh}, f_{jh}, x_i; \hat{\theta}]$$

The responsiveness of c-section choice to financial characteristics conditional on patient characteristics captures hospital moral hazard. The literature that studies provider moral hazard typically models physicians as altruistic agents that make treatment decisions taking into account their patient's utility (e.g, Godager and Wiesen, 2013). Providers may weigh patient's out-of-pocket (OOP) costs against their own reimbursements when responding to financial characteristics. A relatively higher weight on patient's OOP costs would bias providers in favor of vaginal delivery, since it is cheaper than a c-section. A relatively higher weight on own reimbursements would bias providers in favor of c-sections only in the case that it is reimbursed on a FFS basis. Our estimates captures the net effect of these two opposing forces.

5.2 Hospital demand

We model a woman's choice over hospitals as a function of her expected out-of-pocket price, procedure contracts, and an indicator for past visits to the hospital. The expectation of out-of-pocket price is taken over the type of delivery. The probability distribution over types of delivery is endogenous and comes from our model of delivery choice. In particular, define the expected delivery price $\hat{p}_{jh}$ as:

$$\hat{p}_{ijh} = \hat{\phi}_{ijh} p_{jh} + (1 - \hat{\phi}_{ijh}) q_{jh}$$

and the expected payment contract as

$$\hat{f}_{ijh} = \hat{\phi}_{ijh} f_{jh} + (1 - \hat{\phi}_{ijh}) g_{jh}$$

Pregnant woman i enrolled with insurer j has the following utility from choosing hospital h for delivery:

$$u_{ijh} = \alpha_i c_i \hat{p}_{ijh} + \lambda_j \hat{f}_{ijh} + \gamma_i \hat{\phi}_{ijh} + \delta_i y_i + x'_{ih}\beta + \eta_h + \varepsilon_{ijh} \quad (1)$$

where $\alpha_i = x'_i\alpha$, $\delta_i = x'_i\delta$, $\lambda_j = z_j\lambda$, and $\gamma_i = x'_i\gamma$. The variable c_i is the patient's coinsurance rate, and y_i is an indicator for whether the woman went to the hospital in the year prior to her childbirth for health care that may be unrelated to obstetric care. We include a vector x'_{ih} of observable hospital characteristics interacted with patient characteristics. We also include a hospital fixed effect η_h to capture hospital quality. We normalize the largest hospital (in terms of the number of women who choose it) in each choice set to zero following Ho and Pakes (2014). In this model, ε_{ijh} is a preference shock assumed to follow a type-I extreme value distribution.

The first term on the right side of equation (1) is the patient's expected out-of-pocket price. Contracts affect this payment both through their effect on the type of delivery provided and on delivery prices. Observed heterogeneity across women in their sensitivity to out-of-pocket payments is captured through interactions of α with indicators for age group, having a chronic disease, having a high-risk pregnancy, and zone of residence (urban or rural).

The second term in equation (1) captures differences in demand across hospitals reimbursed on a FFS basis relative to those reimbursed on a capitated basis. This coefficient is interacted with indicators for whether the woman was enrolled with any of three largest insurers in the country, z_j. These interactions capture whether large insurers are more likely to steer their patients away from hospitals covered under FFS. Since capitation payments are sunk, the marginal cost of deliveries at capitated hospitals is zero from the perspective of the insurer. We include the probability of receiving a c-section directly in the utility function to measure whether different women have different preferences over the procedures beyond the expected out-of-pocket payments as in Currie and MacLeod (2017).

The fourth term in equation (1) captures provider inertia. There is substantial evidence in the literature that patients are more likely to choose a hospital or a provider if they have had previous healthcare encounters at it (Drake, Ryan, and Dowd, 2022; Saltzman, Swanson, and Polsky, 2022). While we cannot distinguish between state dependence and unobserved changes in preferences as causes of provider inertia, this distinction is not needed for the purposes of conducting counterfactuals analyses on payment contracts. Inclusion of past choices in the utility function does help correct for the potential bias in price sensitivity arising from provider inertia. For example, if women visited cheap hospitals and continue to do so because of inertia, then our model would interpret women as having an aversion to expensive hospitals.

We include interactions between hospital and patient characteristics, x_{ih}, to capture patient preference heterogeneity for number of beds as well as the hospital's rate of negative post-delivery outcomes and rate of maternal mortality. This source of preference heterogeneity is important to account for the fact that sicker patients may have stronger preferences for larger or higher-quality hospitals.

Given the distribution of the preference shock, woman i's likelihood of choosing hospital h is

$$s_{ijh}(f_{jh}, \cdot) = \frac{\exp(\psi_{ijh})}{\sum_{k \in H_j} \exp(\psi_{ijk})}$$

where $\psi_{ijh} = \alpha_i c_i \hat{p}_{ijh} + \lambda_j \hat{f}_{ijh} + \gamma_i \hat{\phi}_{ijh} + \delta_i y_i + x'_{ih}\beta + \eta_h$ and H_j is the set of hospitals in insurer j's network.

Following McFadden (1996), the woman's expected utility for insurer j's network is

$$W_{ij}(f_{jh}, g_{jh}, \cdot) = \log\left(\sum_{h \in H_j} \exp(\psi_{ijh})\right)$$

We take this expected utility divided by $-\alpha_i$ as a monetized measure of consumer surplus to analyze the impact of contract regulation later on.

Why do payment contracts affect demand? Although contracts are not observed by patients either when making enrollment decisions nor when making hospital choices, there are several reasons to believe that they influence hospital demand beyond their effect on expected prices. First, hospitals reimbursed under FFS have an incentive to increase patient volume, as their profits are proportional to the number of deliveries provided, which may result in higher-than-expected demand. Second, the type of payment contract that insurers and hospitals agree on may be correlated with unobserved hospital quality or unobserved insurer quality. Third, patients may face choice frictions that induce correlation between the type of hospitals they choose and the payment contracts those hospitals have with the insurer. Fourth, insurers have incentives to steer patients away from hospitals reimbursed on a FFS basis and toward those whose delivery procedures are capitated. Insurers' marginal costs are increasing in the number of deliveries for the former, but are zero for the latter.

5.3 Pricing function

Denote by $s_{jh}(f_{jh}, \cdot) = \sum_i s_{ijh}(f_{jh}, \cdot)$ the demand for hospital h in the network of insurer j. In Appendix B, we derive a reduced-form expression for prices from a model of Nash-in-Nash bargaining between insurers and hospitals using our framework with two payment contracts, FFS and capitation. Our reduced-form expression of the pricing function for c-sections is

$$p_{jh} = \mu_j + \mu_{t(h)} - \Big(\frac{\partial s_{jh}}{\partial p_{jh}} + \Big(\frac{\partial W_j}{\partial p_{jh}} - \frac{\partial TC_j}{\partial p_{jh}}\Big)\Big)^{-1}\Big(\omega s_{jh} + \tau_j f_{jh}\Big) + \epsilon_{jh} \qquad (2)$$

An analogous expression can be written for vaginal deliveries with price q_{jh} and payment contract g_{jh}. In this equation, μ_j is an insurer fixed effect, $\mu_{t(h)}$ is a market fixed effect, and ω, and τ are parameters to be estimated. The value of insurer j's network, $W_j = \sum_i W_{ij}$, is our measure of insurer demand. Insurer j's total cost is given by $TC_j = \sum_{h \in H_j} \sum_i (1 - c_i) p_{jh} s_{ijh}$. In a setting where insurers and hospitals negotiate prices conditional on contracts, the insurer's disagreement payoff is not the profit it would enjoy by dropping the hospital from the network, as is usual in the health literature that uses Nash-in-Nash. We instead define the insurer's disagreement payoff when negotiating FFS prices as the profits it would enjoy by capitating the hospital but keeping it in the network. We only capture the effect of this disagreement payoff by having ω and τ be insurer-specific.

The first term to the right of equation (2) represents the fixed marginal cost of hospital h. The second term is our reduced-form approximation to hospital markups. The markup is a function of the level of hospital demand s_{jh}, the payment contract f_{jh}, the derivatives of hospital demand $\frac{\partial s_{jh}}{\partial p_{jh}}$, and the derivatives of insurer profits approximated by $\frac{\partial W_j}{\partial p_{jh}} - \frac{\partial TC_j}{\partial p_{jh}}$. Finally, ϵ_{jh} is our structural unobservable.

6 Identification and estimation

Delivery choice. Our delivery choice model includes insurer and municipality fixed effects. This implies that to identify the parameters θ, we rely on the variation in prices and payment contracts across the hospitals in an insurer's network for a given market. This type of variation is likely endogenous to unobserved hospital quality and unobserved health status. For example, if unobservably sicker women are more likely to visit higher quality hospitals, then our estimates of the price responsiveness of the delivery decision will be biased upwards. To correct for this type of endogeneity, we instrument prices and payment contracts with their lagged values and with the prices in other markets. We also include exogenous hospital characteristics that are reflective of hospital quality. We estimate the delivery choice function using a linear probability model.

Hospital demand. Enrollee's choice of insurer is one source of selection bias that threatens identification of the coefficients of interest in our demand model, α_i, λ_j, γ_j, and δ_i. An enrollee may choose her insurer because it has negotiated low delivery prices with her preferred hospitals. This correlation would bias our estimate of price sensitivity to zero. We follow Prager (2020) and Abaluck et al. (2018) to correct this source of selection bias. Our main sample is a set of enrollees who did not switch their insurer between 2010 and 2011 and who were continuously enrolled. By requiring individuals to be continuously enrolled, we control for the possibility that individuals non-randomly move from the contributory system to the subsidized system. Assuming that inertia plays a major role in the decision (or lack thereof) to switch insurers in this setting, the sorting of patients into cost-sharing rules and prices after the period of initial choice will be quasi-random.[4]

Our preferred demand estimation procedure is then one that uses a control function for the woman's out-of-pocket payments following Petrin and Train (2010). In the first stage, we regress the woman's out-of-pocket payments on an instrument,

[4]Inertia has been shown to be a major determinant of health care consumption decisions settings beyond insurer choice. See for example, Polyakova (2016); Handel (2013).

patient characteristics, and alternative fixed-effects. We use the c-section and vaginal delivery prices in other markets as instruments for the observed out-of-pocket payment. In the second stage, we estimate our demand model and include the residuals from the first-stage interacted with patient observables.[5]

The coefficient on the woman's out-of-pocket payment, α_i, is then identified from price variation across the hospitals that insurers include in their network. We also use variation in choice sets across patients in the same cost-sharing tier who are enrolled with different insurers or located in different markets. The coefficient on the indicator for a FFS contract, λ_i, is separately identified from α_i using variation in payment contracts within hospital and across insurers. In addition to this source of variation, we leverage variation in the fraction of women who reach their out-of-pocket maximum. For these patients the coinsurance rate is zero, so any difference in demand between two observably identical women will be driven by differences in payment contracts across hospitals.

Finally, the coefficient on provider inertia, γ_i, is identified from women who choose a different hospital for childbirth in 2011 than the hospitals they visited in 2010 for health care that may be unrelated to their pregnancy. The demand model in equation (1) is a conditional logit, which we estimate by maximum likelihood.

Pricing function. Our pricing function is a reduced-form representation of the equilibrium prices that would result from bilateral bargains between insurers and

[5] More formally, in the first stage we estimate the following linear regression:

$$c_i \hat{p}_{jh} = \tau_1 p'_{jh} + \tau_2 q'_{jh} + \tau_3 \hat{f}_{jh} + x'_i \beta + \eta_h + \nu_{ijh}$$

where p'_{jh} and q'_{jh} denotes the price in other markets for c-sections and vaginal deliveries, respectively. From this regression, we obtain the residuals $\hat{\nu}_{ijh}$. Under the assumption that $E[\hat{\nu}_{ijh}\varepsilon_{ijh}] \neq 0$ and that $E[c_i \hat{p}_{jh} \varepsilon_{ijh} | \hat{\nu}_{ijh}] = 0$, we incorporate these residuals in the second stage as:

$$u_{ijh} = \alpha_i c_i \hat{p}_{jh} + \lambda_j \hat{f}_{jh} + \gamma_i \hat{\phi}_{ijh} + \delta_i y_i + x'_{ih}\beta + \eta_h + x'_i \hat{\nu}_{ijh} + \varepsilon_{ijh}$$

and estimate the second stage by maximum likelihood using a conditional logit.

hospitals, taking contract types as given and taking expectations of hospital demand. OLS estimation of equation (2) would thus suffer from the standard simultaneity bias in linear supply models. The simultaneity bias arises because both the left-hand side and right-hand side variables in equation (2) are determined in equilibrium.

To identify the parameters of our pricing function associated with hospital demand and the type of contract, namely ω and τ, we use instrumental variables. In the case of the pricing function for c-sections, our instruments for hospital demand are the lagged negotiated c-section price and the price for vaginal deliveries. Our instrument for the c-section FFS indicator is the FFS indicator for vaginal deliveries (and vice-versa for the pricing function of vaginal deliveries). We estimate our pricing function separately for c-sections and vaginal deliveries using GMM.

7 Estimation results

Delivery choice. Estimation results for our delivery choice model are reported in table 5. First-stage regression results of prices on instruments and exogenous variables are presented in appendix table 1. Consistent with the previous literature (e.g, Currie and MacLeod, 2017), we find that the probability of a c-section for women aged 35 or older, women with chronic diseases, and women with high-risk pregnancies, is significantly higher than for women under 35, healthy women, and women with low-risk pregnancies, respectively. C-sections are less common during the weekends, when doctors are less available and staffing numbers are lower.

Our findings show that the financial characteristics of the contracts between insurers and hospitals significantly affect delivery choice. First, we find that the likelihood of a c-section increases by 3 percentage points (p.p) when the price of a c-section increases by \$100. This effect represents a 6% increase over the baseline fraction of c-sections. Women are also 4 p.p less likely to receive a c-section if the price of a vaginal delivery increases by $100. Second, we find that the likelihood of a c-section is 5 p.p higher if c-sections are covered under FFS.

Because our model includes insurer and municipality fixed effects, the effect of prices on delivery choice is identified from comparisons of c-section rates across hospitals conditional on women's observable characteristics. The fact that c-sections rates vary significantly across hospitals based on procedure prices is suggestive of hospitals responding to financial incentives in their treatment decisions. This finding is not unprecedented, qualitatively similar results are reported in Foo, Lee, and Fong (2017); Brekke, Holmås, Monstad, and Straume (2017); Shafrin (2010); Gruber, Kim, and Mayzlin (1999).

Hospital demand. Results of our hospital demand model are presented in table 6. Appendix table 2 presents first-stage results for our control function approach. We find that women are approximately 38 percent less likely to choose a hospital if its expected out-of-pocket delivery price increases by $10. The average elasticity of hospital demand with respect to own expected out-of-pocket delivery price equals -0.88.[6] Hospital demand is approximately 62 percent lower if the expected payment contract under which the procedure will be reimbursed is FFS. The negative effect of FFS in hospital demand is lower for large insurers, which suggests this type of insurer has fewer incentives to steer patients away from expensive hospitals.

We find that women generally dislike having c-sections, but that the preference for c-sections is higher among women with high-risk pregnancies and with chronic diseases than their counterparts. Results also provide evidence of substantial hospital inertia, as women are nearly 6 times more likely to visit a hospital they had been to in the

[6]Elasticities of hospital demand with respect of own expected out-of-pocket delivery prices are given by $\frac{p_{jh}}{s_{jh}} \sum_i \frac{\partial s_{ijh}}{\partial \hat{p}_{jh}}$

Table 5: Delivery Choice Model Estimates

		Estimates	
		coef	se
C-section	Price	2.98	(0.25)
	FFS	5.43	(0.42)
Vaginal delivery	Price	-3.91	(0.30)
Demographics and health	Age 24 or less	(ref)	(ref)
	Age 25-29	4.67	(0.24)
	Age 30-34	8.64	(0.26)
	Age 35 or more	14.23	(0.28)
	High risk pregnancy	4.79	(0.34)
	Chronic disease	2.66	(0.47)
Day of week	Monday	8.37	(0.37)
	Tuesday	9.19	(0.40)
	Wednesday	9.36	(0.39)
	Thursday	9.34	(0.39)
	Friday	9.59	(0.39)
	Saturday	5.53	(0.38)
	Sunday	(ref)	(ref)
R^2		0.12	
N		253,528	

Note: Maximum likelihood estimation of delivery choice model. Specification includes insurer and municipality fixed effects. Bootstrap standard error in parenthesis based on 100 resamples. Coefficients and standard errors are multiplied by 100.

Table 6: Hospital Demand Model Estimates

		Estimates coef	se
Expected OOP ($100)		-3.85	(0.33)
Expected FFS contract		-0.98	(0.03)
Expected C-section		-4.90	(0.36)
Previous visit		1.75	(0.04)
Missing C-section FFS		-1.06	(0.02)
Missing Vaginal delivery FFS		-1.15	(0.02)
Interactions			
Expected OOP ($100)	Age 30 or more	1.01	(0.13)
	Chronic disease	1.28	(0.25)
	High-risk pregnancy	-0.56	(0.20)
	Rural	-6.33	(0.96)
	Low income	-0.25	(0.13)
Expected FFS contract	Large insurer	1.27	(0.06)
Expected C-section	Age 30 or more	0.45	(0.38)
	Chronic disease	1.76	(0.71)
	High-risk pregnancy	2.85	(0.56)
Previous visit	Age 30 or more	-0.09	(0.05)
	Chronic disease	-0.10	(0.06)
	High-risk pregnancy	-0.25	(0.05)
	Rural	-0.99	(0.06)
Pseudo-R^2		0.39	
N		774,809	

Note: Maximum likelihood estimation of hospital demand model. Specification includes interactions between number of beds, an indicator for bad outcomes post-delivery, and maternal mortality rate for each hospital with patient characteristics including dummies for age group, having a chronic disease, having a high-risk pregnancy, and zone of residence. Specification also includes hospital fixed effects. Bootstrap standard errors in parenthesis based on 100 resamples.

previous year.

Interactions of expected out-of-pocket prices with patient characteristics show that women aged 30 or more are less responsive to price than women under 30. Women with a chronic disease and living in urban municipalities are also less price sensitive than healthy women and than those living in rural municipalities, respectively. Findings show that low-income women or those earning less than two times the monthly minimum wage are more responsive to expected out-of-pocket prices than high-income women. These results are consistent with the evidence of adverse selection presented in section 4.

Pricing function. We present results of our reduced-form pricing function for c-sections and vaginal deliveries in table 7. The table reports the estimates for ω and τ_j, the predicted average marginal cost, and the first-stage F statistics. First-stage regressions for the endogenous variables are reported in Appendix Table 5. We find that the average hospital markup is \$104 for vaginal deliveries and \$107 for c-sections.[7] Contract types do not have a statistically significant effect on markups beyond demand. Our estimates imply that the average marginal cost across insurer-hospital pairs equals \$142 for a vaginal delivery and \$233 for a c-section.

8 Equilibrium Effects of Contract Regulation

The rapid increase in c-section rates and the large variation in delivery prices across hospitals are problematic for health outcomes after childbirth and health care costs. While policies that cap the number of c-sections directly may halt this increase, they may not be efficient at eliminating price variation across hospitals nor at reducing c-sections among low-risk women necessarily.[8] In this section, we use our model estimates to assess the impact of contract regulation on the expected number of c-sections, negotiated delivery prices, and health outcomes.

We conduct two counterfactual exercises to this end. In the first counterfactual we set the payment contract for both c-sections and vaginal deliveries to be FFS across all insurer-hospital pairs. In the second counterfactual, we set the payment contract for

[7] Hospital markups are calculated as $\left(\frac{\partial s_{jh}}{\partial p_{jh}} + \left(\frac{\partial W_j}{\partial p_{jh}} - \frac{\partial TC_j}{\partial p_{jh}}\right)\right)^{-1}(\hat{\omega} s_{jh} + \hat{\tau}_j f_{jh})$. We report the average of this prediction across insurer-hospital pairs in the text.

[8] In trying to reduce the c-section rate, the state of California in the US for example established a cap on the number of c-sections certain hospitals could perform (California Health Care Foundation, 2022).

Table 7: Pricing Function Estimates

		C-section		Vaginal	
		coef	se	coef	se
Markup 1		5.15	(0.46)	4.62	(0.37)
Markup 2		-0.29	(0.09)	0.00	(0.05)
Interactions					
Markup 2	EPS001	(ref)	(ref)	(ref)	(ref)
	EPS002	0.43	(0.51)	0.87	(0.29)
	EPS003	0.10	(0.13)	0.09	(0.11)
	EPS005	0.02	(0.42)	-0.08	(0.18)
	EPS008	-7.76	(3.55)	-1.07	(6.22)
	EPS009	-5.50	(5.96)	6.81	(4.30)
	EPS010	-0.19	(0.13)	-0.24	(0.10)
	EPS012	0.11	(0.46)	-0.07	(0.40)
	EPS013	0.29	(0.13)	0.00	(0.08)
	EPS016	0.18	(0.31)	-0.19	(0.24)
	EPS017	-0.16	(0.38)	-0.16	(0.25)
	EPS018	-0.07	(0.56)	-0.47	(0.55)
	EPS023	0.33	(0.11)	-0.07	(0.07)
	EPS037	-0.16	(0.43)	-0.03	(0.17)
Avg. marginal cost		2.33	(1.25)	1.42	(1.11)
F-stat Markup 1		23.95		31.03	
N		598		598	
R^2		0.66		0.73	

Note: Instrumental variable regressions of the pricing function for c-sections and vaginal deliveries. Markup 1 corresponds to $\left(\frac{\partial s_{ijh}}{\partial p_{jh}} + \left(\frac{\partial W_j}{\partial p_{jh}} - \frac{\partial TC_j}{\partial p_{jh}}\right)\right)^{-1} s_{jh}$. Markup 2 corresponds to $\left(\frac{\partial s_{ijh}}{\partial p_{jh}} + \left(\frac{\partial W_j}{\partial p_{jh}} - \frac{\partial TC_j}{\partial p_{jh}}\right)\right)^{-1} f_{jh}$. Specifications include insurer and municipality fixed effects. Table reports the predicted average marginal cost and first-stage F statistic for Markup 1. Robust standard errors in parenthesis.

both services to capitation across all insurer-hospital pairs. For simplicity, we conduct our counterfactual simulations with data from Bogotá only, which is the capital city of Colombia and where 43 percent of all deliveries are performed. Even though payment contracts are endogenous and arise in equilibrium as a result of competition between insurer-hospital pairs, we think of these counterfactuals as government mandates over which types of services can be covered under which payment contracts.

8.1 Prices and Delivery Choice

Table 8: Counterfactual distribution of prices

	Mean	SD	Q1	Q3
C-section				
Full FFS	360.5	144.5	238.1	451.3
Full Cap	371.7	166.4	244.6	453.1
Observed	360.7	144.6	242.4	447.0
Vaginal delivery				
Full FFS	300.6	118.8	205.6	391.6
Full Cap	296.5	114.5	189.2	387.6
Observed	292.4	114.5	190.1	380.8

Note: Table shows mean, standard deviation, and 1st and 3rd quantiles of the distribution of c-section prices and vaginal delivery prices for the observed scenario and two counterfactuals: both procedures covered under FFS ("Full FFS"), and both procedures covered under capitation ("Full Cap").

Table 8 shows the distribution of counterfactual and observed delivery prices for c-sections in the top panel and for vaginal deliveries in the bottom panel. We find that a full FFS contract regime has little impact on the distribution of c-section prices. This is because most insurer-hospital pairs in the data already have c-sections covered under this payment contract. Instead, moving towards a fully capitated regime results in an $11 increase in average c-section prices, as well as in a more dispersed distribution. The price increase under full capitation is related to selection of hospitals into contracts. High-quality hospitals are more likely to negotiate fixed payment

TABLE 9: Counterfactual distribution of expected number of c-sections per hospital

	Number of c-sections						
	Mean	SD	Q1	Q3	C-section Likelihood	Total High Risk	Total Low Risk
Full FFS	301.0	379.7	12.7	524.7	0.453	2,161.0	11,082.0
Full Cap	263.0	334.1	10.9	445.0	0.401	1,913.1	9,660.4
Observed	276.2	323.5	8.1	538.7	0.417	2,005.7	10,148.2

Note: Table shows mean, standard deviation, and 1st and 3rd quantiles of the distribution of expected number of c-sections per hospital for the observed scenario and two counterfactuals: both c-sections and vaginal deliveries covered under FFS ("Full FFS"), and both c-sections and vaginal deliveries covered under capitation ("Full Cap"). Table also reports average c-section likelihood and total number of c-sections among high-risk and low-risk pregnancies.

contracts such as capitation, fee-for-diagnosis, or fee-for-package with insurers, and thus enjoy higher markups than low-quality hospitals.

For vaginal deliveries, we find that average prices are \$8 higher under full FFS and \$4 higher under full capitation relative to the observed scenario. The fact that prices increase by greater magnitude under full FFS than under full capitation, suggests that hospital selection into payment contracts for vaginal deliveries is less severe than it is for c-sections.

Table 9 shows the distribution of observed and counterfactual expected number of c-sections per hospital. The table also reports the average c-section likelihood per hospital and the total number of c-sections among high-risk and low-risk pregnancies. The expected number of c-sections is given by $\sum_{ij} \phi_{ijh} s_{ijh}$ and the average c-section likelihood is $(1/N_{ij}) \sum_{ij} \phi_{ijh}$.

We find that relative to the observed equilibrium, imposing a full FFS regime results in more c-sections, and greater variation in c-section rates across hospitals. Greater use of c-sections is consistent with hospital moral hazard in the presence of retrospective payment structures. In fact we find that the likelihood of a c-section increases 4 p.p under full FFS, a change that can only explained by the direct effect of payment contracts on delivery choice but not by the indirect effect on prices. Recall from table 8 that c-section prices do not change meaningfully in this counterfactual.

Imposing a full capitation regime results in a substantial reduction in the number of c-sections per hospital. The average number of c-sections falls by 13, while the third quantile of the distribution falls by 93. With prospective payment structures, hospitals shift towards vaginal deliveries, which are associated with lower post-delivery costs. Thus, the full capitation regime reduces the impact of hospital moral hazard on delivery choice. We find that the likelihood of a c-section goes from 41.7 percent in the observed scenario to 40.1 percent under full capitation.

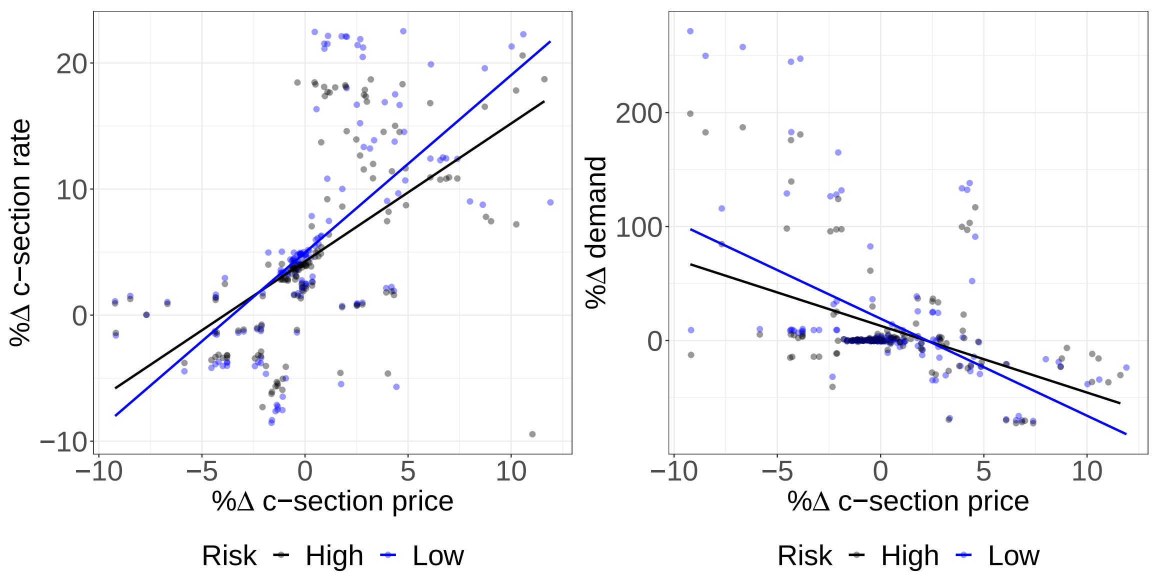
In the last two columns of table 9, we see that the increase in the number of c-sections under full FFS happens across both high-risk and low-risk pregnancies. However, the number of c-sections increases by a greater magnitude among the latter (9.2 percent) than among the former (7.8 percent). A fully retrospective payment regime therefore exacerbates the use of medically unnecessary c-sections and is detrimental for the purpose of reducing c-sections. In the case of full capitation, we find similar reductions in the total number of c-sections among high-risk and low-risk pregnancies relative to the observed scenario. This suggests that while capitation is effective at reducing c-section rates overall, the decline does not stem primarily from unnecessary procedures.

The significant changes in the number of c-sections conditional pregnancy risk raise the question of whether these changes are driven by variation in hospital moral hazard or by women sorting differently across hospitals relative to the observed equilibrium. In figures 3 and 4 we explore these mechanisms for the full FFS and the full capitation counterfactuals, respectively. The figures show, conditional on high- and low-risk pregnancies, the correlation between changes in c-section likelihood (ϕ_{ijh}) and changes in c-section prices in panel A; and the correlation between changes in demand (s_{ijh}) and changes in c-section prices in panel B. Each dot corresponds to an insurer-hospital pair. Blue lines represent a linear fit for low-risk pregnancies and black lines represent a linear fit for high-risk pregnancies.

FIGURE 3: C-section rate, demand, and c-section price by pregnancy risk under full FFS

(A) Hospital moral hazard

(B) Women sorting



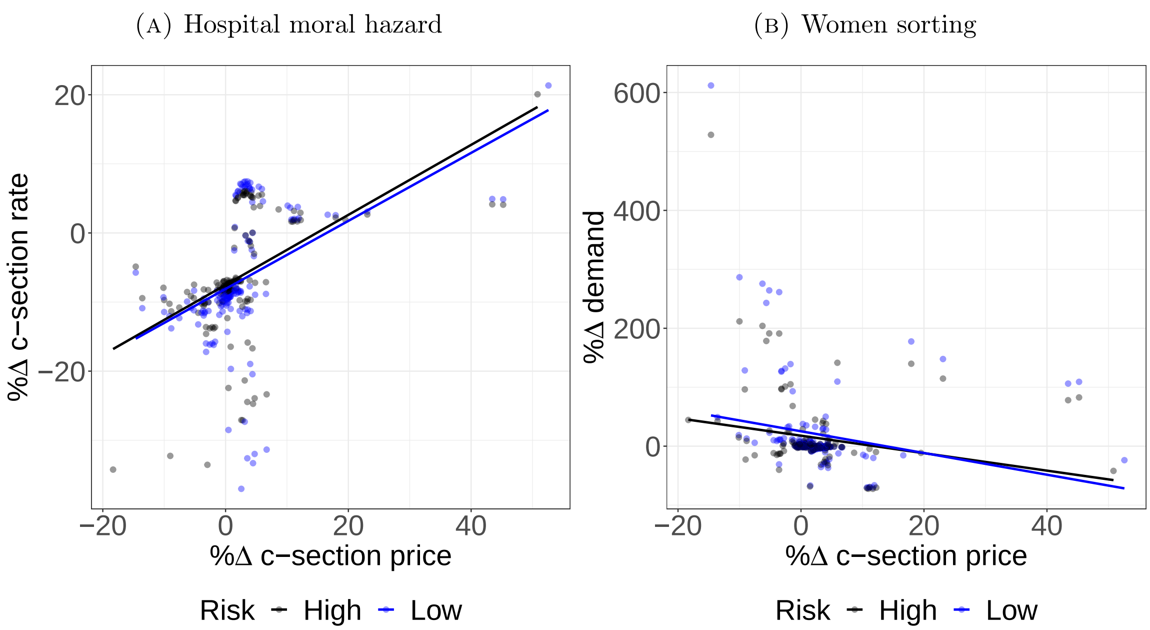
Under a full FFS regime, we find that hospital moral hazard –as measured by changes in the c-section likelihood– rather than women sorting, is the main driver of changes in the number of c-sections among low-risk pregnancies. Findings also show that the effect of hospital moral hazard is smaller among high-risk than among low-risk women. Panel A of figure 3 shows that the correlation between changes in c-section likelihood and changes in c-section price is smaller for high-risk pregnancies. Under a full capitation regime in figure 4, we find that the reduction in the number of c-sections is mainly explained by changes in women sorting rather than by changes in hospital moral hazard. The figure also shows that the effect of both mechanisms is of similar magnitude for high-risk and low-risk women.

Table 10: Counterfactual distribution of delivery costs per hospital

	Delivery costs			
	Mean	SD	Q1	Q3
Full FFS	2,667.7	3,574.2	71.4	4,577.3
Full Cap	2,686.4	3,610.2	71.9	4,570.0
Observed	2,697.1	3,759.3	59.4	4,613.9

Note: Table shows mean, standard deviation, and 1st and 3rd quantiles of the distribution of expected delivery costs per hospital for the observed scenario and two counterfactuals: both c-sections and vaginal deliveries covered under FFS ("Full FFS"), and both c-sections and vaginal deliveries covered under capitation ("Full Cap").

Figure 4: C-section rate, demand, and c-section price by pregnancy risk under full Cap



In table 10 we turn to the effect of payment contracts on total delivery costs per hospital given by $\sum_{ij} \phi_{ijh} p_{jh} s_{ijh} + (1 - \phi_{ijh}) q_{jh} s_{ijh}$. We report the mean, standard deviation, and 1st and 3rd quantiles of the distribution of this variable in the counterfactuals and in the observed scenario. Delivery costs per hospital fall under both counterfactual contract regimes. In the case of full capitation, the decrease in costs is attributable to both a decrease in the use of c-section –a relatively more expensive procedure– and a decrease in demand for hospitals where expected out-of-pocket prices increase. In the case of full FFS, the fall in total costs is attributable only to changes in demand.

8.2 Maternal Health Outcomes

To analyze the impact of payment contracts on maternal health outcomes post-delivery, we want to be able to predict health outcomes at every possible hospital in the woman's choice set with a regression in the spirit of Abaluck, Caceres Bravo, Hull, and Starc (2021):

$$y_{ijh} = \sum_{h} \mu_{jh} D_{ijh} + \theta f_{ijh} + \gamma 1\{\text{c-section}_{ijh}\} + x_i' \beta + \upsilon_{ijh} \quad (3)$$

Here y_{ijh} is an outcome of woman i enrolled to insurer j at hospital h in the network, D_{ijh} is an indicator variable for woman i choosing hospital h to have her baby delivered, f_{ijh} is an indicator variable for the procedure being covered under FFS, and x_i are the woman's characteristics. We include the FFS indicator directly into the health outcome function to capture the effect of hospital moral hazard on women's health.

The prediction of health outcomes nonetheless is biased due to selection: women may non-randomly choose their delivery hospital based on characteristics that are unobserved to us. We cannot control for such unobserved heterogeneity using individual fixed effects, since our data has one observation per woman. Instead, we estimate equation (3) on the sample of inertial women: those who do not switch insurer nor hospital. Inertial women in terms of hospital choice are those who visited the hospital the year prior to delivery. For inertial women, changes in prices, cost-sharing, and payment contracts are as-if-random. Appendix table 6 presents regression estimates and appendix figure 1 presents hospital fixed effects estimates.

We can then use the estimated parameters to simulate health outcomes under our counterfactual scenarios as:

$$y_{ijh}^{cf} = \sum_h \hat{\mu}_h s_{ijh}^{cf} + \hat{\theta}\hat{f}_{ijh}^{cf} + \hat{\gamma}\phi_{ijh}^{cf} + x_i'\hat{\beta}$$

where s_{ijh}^{cf} is the counterfactual choice probability, $\hat{f}_{ijh}^{cf}$ is the counterfactual expected payment contract, and ϕ_{ijh}^{cf} is the counterfactual expected delivery procedure. Table 11 shows the distribution of observed and counterfactual health outcomes. An observation for this table is a woman. We consider four types of health outcomes in the month after having the baby, all combined into one indicator variable: hospitalization, hemorrhage (ICD10 code R85), puerperal sepsis (ICD10 code O85), and infection of obstetric surgical wound (ICD10 code O86). Thus, y_{ijh} reflects the probability that the woman has a bad outcome the month after delivery.

We find that imposing a full FFS regime results in worse health outcomes, but that imposing a full capitation regime results in better health outcomes relative to the observed scenario. Under full FFS, 32 percent more women are hospitalized in the month after delivery and have an infection of obstetric wounds, an effect that is driven by the increase in c-section rates. Under full capitation, 48 percent fewer women are associated with bad health outcomes in the month after having the baby. The improvement in health stems primarily from women reallocating towards higher-quality hospitals.

9 Conclusions

Public payers seeking to reduce the use of intensive, expensive treatments might do so directly by capping its use, or indirectly by regulating reimbursements for

Table 11: Counterfactual distribution of health outcomes

	Bad health outcome			
	Mean	SD	Q1	Q3
Full FFS	0.140	0.012	0.130	0.147
Full Cap	0.055	0.012	0.045	0.061
Observed	0.106	0.029	0.079	0.130

Note: Table shows mean, standard deviation, and 1st and 3rd quantiles of the distribution of bad health outcomes in the month after delivery for the observed scenario and two counterfactuals: both c-sections and vaginal deliveries covered under FFS ("Full FFS"), and both c-sections and vaginal deliveries covered under capitation ("Full Cap"). Bad health outcome is an indicator variable for any of the following procedures/diagnoses received within one month after delivery: hospitalization, hemorrhage (ICD10 code R85), puerperal sepsis (ICD10 code O85), or infection of obstetric surgical wound (ICD10 code O86).

those services. In this paper, we quantify the impact of regulating payment contracts between insurers and hospitals on the decision to perform c-sections and on negotiated prices for deliveries. We study this question in the context of the Colombian health care system. In Colombia, as in many other countries, c-section rates have increased rapidly over the last two decades, contributing to rising health care costs and bad maternal health outcomes. Our results indicate that moving to a system where both c-sections and vaginal deliveries are reimbursed on a capitated basis rather than a fee-for-service basis, is effective at reducing the expected number of c-sections, but has little effect on the price variation across hospitals. However, the reduction in the c-section rate is of similar magnitude among low-risk and high-risk pregnancies.

Our findings speak more broadly to the type of regulation that can help align provider incentives with patient preferences when health care prices are negotiated. While our counterfactuals suggest that contract regulation is one such potential avenue, our framework does not allow us to study the implications of such policies on the insurers' decision of which hospitals to cover under which contracts. Future research may focus on endogeneizing the choice of payment contracts between insurers and hospitals.

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Appendix A Obtaining Negotiated Prices from Claims

Separately for every insurer j and type of delivery s (vaginal or c-section), we estimate the following linear regression:

$$\tilde{p}_{ijhs} = x_i'\beta_1 + \beta_2 f_{jhs} + \gamma_h + \epsilon_{ijhs}$$

where $\tilde{p}_{ijhs}$ is the reported price, x_i are patient characteristics including age, an indicator for whether the woman has a chronic disease, and the woman's length-of-stay; f_{jhs} is an indicator for whether the type of delivery s is covered under FFS between insurer j and hospital h; and γ_h is a hospital fixed effect.

Denote by $\hat{E}[\tilde{p}_{ijhs}|x_i, f_{jhs}, h]$ the predictions from these linear regressions. The negotiated price for each hospital-insurer-service under contract $k \in \{\text{FFS}, \text{Cap}\}$, p^k_{jhs}, is then:

$$p^k_{jhs} = \frac{1}{N_{j,h,s}} \sum_{j,h,s} \hat{E}[\tilde{p}_{ijhs}|x_i, f_{jhs} = k, h]$$

where $N_{j,h,s}$ is the number of women who had delivery claims of type s in insurer j and hospital h.

Appendix B Reduced-Form Pricing Model

Assume that insurers and hospitals bargain over the price of a service covered in a FFS contract, holding hospital networks fixed and holding transfers under a capitation contract fixed. In a more flexible model, that allows for consumer choice of insurer, we can generally write insurer profits as:

$$\pi^j = \sum_i r_i \sigma_{ij}(p_{jh}) - \sum_{h \in F_j} p_{jh} s_{jh}(p_{jh}) - \sum_{h \in K_j} t_{jh} \sigma_j(p_{jh})$$

where r_i is the risk-adjusted transfer from the government to the insurer for each of its enrollees, σ_{ij} is the choice probability of consumer i for insurer j, and $\sigma_j = \sum_i \sigma_{ij}$ is total insurer demand. Moreover, $s_{jh} = \sum_i s_{ijh}$ with s_{ijh} denoting consumer i's choice probability for hospital h, p_{jh} is the FFS price between insurer j and hospital h, F_j is insurer j's network of hospitals under FFS, t_{jh} is the payment under capitation between insurer j and hospital h, and K_j is insurer j's network of hospitals under a capitation contract. Conditional on the service, F_j and K_j are mutually exclusive, or $F_j \cap K_j = \oslash$.

In this framework, hospital profits are given by:

$$\pi^h = \sum_{j \in F_h} (p_{jm} - m_{jh}) s_j(p_{jh}) + \sum_{j \in K_h} t_{jh} \sigma_j(p_{jh})$$

where m_{jh} is the marginal cost to hospital h of providing the service to enrollees of insurer j, F_h is the set of insurers that cover hospital h under a FFS contract, and K_h is the set of insurers that cover hospital h under a capitation contract.

Define the log of the Nash surplus as:

$$\log(S_{jh}) = \beta \log\left(\pi^j_{F_j,K_j} - \pi^j_{F_j \setminus h, K_j \cup h}\right) + (1-\beta)\log\left(\pi^h_{F_h,K_h} - \pi^h_{F_h \setminus j, K_h \cup j}\right)$$

Here β represents the bargaining power of the insurer. Note that the outside option for the insurer is not to drop the hospital altogether from its network (as is typically specified in the literature), given that networks are fixed. Instead the outside option for the insurer is to drop the hospital from the set that is covered under FFS $F_j \backslash h$, and cover it under capitation $K_j \cup h$. For the hospital, the outside option is analogous.

The first-order condition of the joint surplus maximization problem is:

$$-\frac{\beta}{\left(\pi^j_{F_j,K_j} - \pi^j_{F_j\backslash h, K_j \cup h}\right)} \frac{\partial \pi^j_{F_j,K_j}}{\partial p_{jh}} = \frac{1-\beta}{\left(\pi^h_{F_h,K_h} - \pi^h_{F_h \backslash j, K_h \cup j}\right)} \frac{\partial \pi^h_{F_h,K_h}}{\partial p_{jh}}$$

Let $\mathbf{A} = \frac{\partial \pi^j_{F_j,K_j}}{\partial p_{jh}}$, $\mathbf{B} = \pi^j_{F_j,K_j} - \pi^j_{F_j\backslash h,K_j \cup h}$, $\Lambda = \frac{\beta \mathbf{A}}{(1-\beta)\mathbf{B}}$, $\mathbf{d} = \pi^h_{F_h\backslash j, K_h \cup j}$, $\Omega = \frac{\partial s_j}{\partial p_{jh}}$, and $\Gamma = \frac{\partial \sigma_j}{\partial p_{jh}}$

After writing the first-order condition in matrix form and re-arranging terms, we get the following expression for equilibrium prices:

$$\mathbf{p} = \mathbf{m} - (\Omega + \Lambda \mathbf{s})^{-1}(\mathbf{s} + (\Gamma - \Lambda\sigma)\mathbf{t} + \Lambda \mathbf{d})$$

The expression for prices is similar to the results in Cuesta, Noton, and Vatter (2019), which suggests that capitation contracts emulate vertical integration. The expression also tells us that FFS prices are lower the higher are capitation transfers and the higher is the hospital's disagreement payoff.

Let $TC_j = \sum_{h \in H_j} \sum_i (1-c_i) p_{jh} s_{ijh}$ be the insurer's total cost from deliveries, and $W_j = \sum_i \log \left(\sum_{h\in H_j} \exp(\delta_{ijh}) \right)$ be our approximation to insurer demand as in Gowrisankaran et al. (2015). we can derive a reduced-form expression for equilibrium prices in market t as follows:

$$p_{jh} = \underbrace{\mu_j + \mu_{t(h)}}_{\mathbf{m}} - \underbrace{\left(\frac{\partial s_{jh}}{\partial p_{jh}} + \left(\frac{\partial W_j}{\partial p_{jh}} - \frac{\partial TC_j}{\partial p_{jh}}\right)\right)^{-1} \left(\omega s_{jh} + \tau_j f_{jh}\right)}_{(\Omega+\Lambda\mathbf{s})^{-1}(\mathbf{s}+(\Gamma-\Lambda\sigma)\mathbf{t}+\Lambda\mathbf{d})} + \epsilon_{jh}$$

where τ, ω, and μ are parameters to be estimated.

Appendix C First-stage for Delivery Choice

Appendix Table 1: First-Stage Estimates for Delivery Choice

		C-section price		Vaginal price	
		coef	se	coef	se
C-section price other markets		432.2	(19.2)	320.5	(15.3)
Vaginal delivery price other markets		-229.6	(10.4)	-174.9	(8.60)
Lagged c-section price		94.6	(0.22)	14.3	(0.19)
Lagged vaginal delivery price		-17.9	(0.28)	62.9	(0.27)
Demographics and health	Age 25-29	-0.53	(0.16)	-0.33	(0.17)
	Age 30-34	-0.81	(0.17)	-0.85	(0.18)
	Age 35 or more	-0.83	(0.21)	-1.11	(0.22)
	High risk pregnancy	-0.39	(0.23)	0.33	(0.26)
	Chronic disease	0.76	(0.32)	-0.93	(0.35)
Day of week	Monday	0.29	(0.25)	0.33	(0.28)
	Tuesday	0.62	(0.26)	0.55	(0.28)
	Wednesday	0.87	(0.26)	0.45	(0.28)
	Thursday	0.58	(0.26)	0.85	(0.28)
	Friday	0.21	(0.26)	0.47	(0.28)
	Saturday	0.15	(0.27)	-0.08	(0.30)
	Sunday	(ref)	(ref)	(ref)	(ref)
Missing lagged c-section price		338.8	(1.14)	28.7	(1.09)
Missing lagged vaginal delivery price		-85.9	(1.09)	180.5	(1.15)
R^2		0.93		0.93	
N		253,528		253,528	

Note: First-stage results of delivery choice model. Linear regressions of c-section price and vaginal delivery price on the average price in other markets and lagged prices. Specifications include insurer and municipality fixed effects. Robust standard errors in parenthesis. Coefficients and standard errors are multiplied by 100.

Appendix D First-Stage for Hospital Demand

This appendix presents results for the first-stage regression for hospital demand. We estimate the following linear regression:

$$c_i\hat{p}_{jh} = \tau_1 p'_{jh} + \tau_2 q'_{jh} + \tau_3 \hat{f}_{ijh} + \tau_3 \hat{\phi}_{ijh} + x'_i\beta + \eta_h + \nu_{ijh}$$

where p'_{jh} and q'_{jh} are the average price for c-sections and vaginal deliveries in other markets, respectively; $\hat{f}_{ijh}$ is the expected payment contract; $\hat{\phi}_{ijh}$ is the c-section probability; and x_i is a vector of patient characteristics.

Appendix Table 2: First-Stage Estimates for Hospital Demand

	OOP Price	
	coef	se
Vaginal delivery price other markets	0.76	(0.31)
C-section price other markets	-45.01	(0.60)
Expected FFS contract	-9.71	(0.30)
Expected c-section	-49.28	(0.16)
Previous visit	-1.79	(0.09)
Missing C-section FFS	5.59	(0.05)
Missing Vaginal delivery FFS	-2.80	(0.06)
Chronic disease	1.60	(0.05)
High-risk pregnancy	4.67	(0.04)
Age 30 or more	-4.16	(0.03)
Rural	-7.63	(0.12)
Low income	-23.31	(0.04)
Number of beds	-1.03	(0.07)
Bad outcomes	9.27	(0.38)
Maternal mortality	-6.04	(0.22)
Adjusted R^2	0.61	
N	774,809	

Note: First-stage OLS regression of out-of-pocket prices on the lagged out-of-pocket price and patient characteristics. Coefficients and standard errors are multiplied by 100 for exposition. Specification includes hospital fixed effects.

Appendix E Robustness Checks on Demand

Table 3 in this appendix compares our main estimates of hospital demand against those without using a control function for the expected out-of-pocket price. Table 4 presents a robustness exercise to our sample selection criteria. Column (1) shows our main hospital demand specification estimated on the sample of women who do not switch their insurer and whose enrollment may not be continuous. Column (2) shows results on the sample of women who do not switch their insurer and have continuous enrollment spells. Column (3) shows results using the full sample of women without constraints on switching nor enrollment length.

Appendix Table 3: Hospital Demand Model Estimates Without Control Function

		(1) Main		(2) No control function	
		coef	se	coef	se
Expected OOP ($100)		-3.85	(0.33)	-1.04	(0.11)
Expected FFS contract		-0.98	(0.03)	-0.97	(0.03)
Expected C-section		-4.90	(0.36)	-3.95	(0.35)
Previous visit		1.75	(0.04)	1.81	(0.04)
Missing C-section FFS		-1.06	(0.02)	-1.17	(0.02)
Missing Vaginal delivery FFS		-1.15	(0.02)	-1.12	(0.02)
Interactions					
Expected OOP ($100)	Age 30 or more	1.01	(0.13)	0.97	(0.11)
	Chronic disease	1.28	(0.25)	1.19	(0.21)
	High-risk pregnancy	-0.56	(0.20)	-0.60	(0.18)
	Rural	-6.33	(0.96)	-0.06	(0.28)
	Low income	-0.25	(0.13)	-0.31	(0.12)
Expected FFS contract	Large insurer	1.27	(0.06)	1.30	(0.06)
Expected C-section	Age 30 or more	0.45	(0.38)	0.31	(0.37)
	Chronic disease	1.76	(0.71)	1.61	(0.69)
	High-risk pregnancy	2.85	(0.56)	2.92	(0.55)
Previous visit	Age 30 or more	-0.09	(0.05)	-0.09	(0.05)
	Chronic disease	-0.10	(0.06)	-0.10	(0.06)
	High-risk pregnancy	-0.25	(0.05)	-0.26	(0.05)
	Rural	-0.99	(0.06)	-0.88	(0.06)
Pseudo-R^2		0.39		0.39	
N		774,809		774,809	

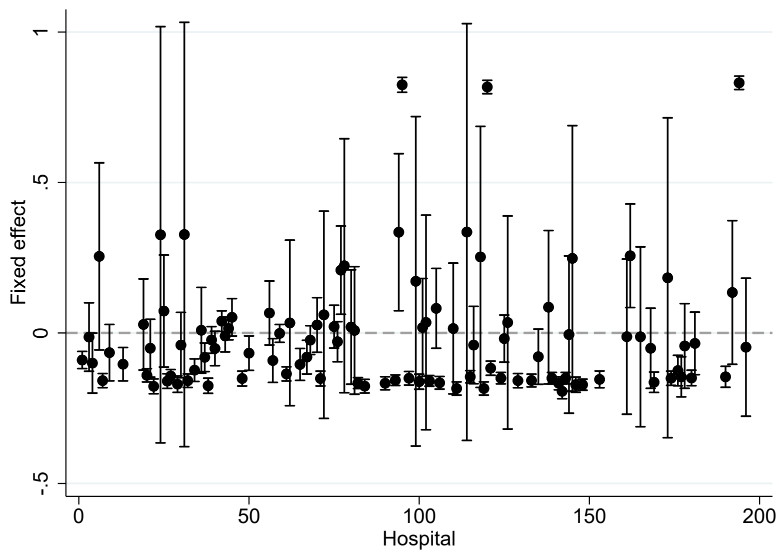
Note: Hospital demand in the main sample with control function in column (1) and without control function in column (2). Specifications include interactions between number of beds, an indicator for bad outcomes post-delivery, and maternal mortality rate for each hospital with patient characteristics including dummies for age group, having a chronic disease, having a high-risk pregnancy, and zone of residence. Specifications also include hospital fixed effects. Bootstrap standard errors in parenthesis based on 100 resamples.

Appendix F First-Stage for Pricing Equations

This appendix presents results for the first-stage regression of the pricing function for c-sections and vaginal deliveries. We use as instruments for demand and its derivatives, the lagged delivery prices. For c-sections, we also use the price and contract type of vaginal deliveries as instruments, and viceversa.

Appendix G Health Outcomes

Appendix Table 1: Hospital Fixed Effects in Health Outcomes Function



Appendix Table 4: Hospital Demand Model Estimates in Alternative Samples

		(1) No switch Not contin.	(2) No switch Continuous	(3) Switch Not contin.
Expected OOP ($100)		-3.85	-4.18	-4.12
		(0.33)	(0.38)	(0.29)
Expected FFS contract		-0.98	-1.00	-1.01
		(0.03)	(0.03)	(0.02)
Expected c-section		-4.90	-4.97	-5.01
		(0.36)	(0.41)	(0.32)
Previous visit		1.75	1.75	1.73
		(0.04)	(0.04)	(0.04)
Missing C-section FFS		-1.06	-1.08	-1.04
		(0.02)	(0.02)	(0.02)
Missing Vaginal delivery FFS		-1.15	-1.13	-1.18
		(0.02)	(0.02)	(0.02)
Interactions				
Expected OOP ($100)	Age 30 or more	1.01	1.17	1.01
		(0.13)	(0.15)	(0.11)
	Chronic disease	1.28	1.39	1.26
		(0.25)	(0.25)	(0.25)
	High-risk pregnancy	-0.56	-0.71	-0.60
		(0.20)	(0.21)	(0.20)
	Rural	-6.33	-6.60	-6.03
		(0.96)	(1.11)	(0.79)
	Low income	-0.25	-0.29	-0.05
		(0.13)	(0.15)	(0.12)
Expected FFS contract	Large insurer	1.27	1.31	1.28
		(0.06)	(0.07)	(0.05)
Expected c-section	Age 30 or more	0.45	0.58	0.85
		(0.38)	(0.44)	(0.32)
	Chronic disease	1.76	1.82	1.74
		(0.71)	(0.71)	(0.70)
	High-risk pregnancy	2.85	2.98	2.46
		(0.56)	(0.57)	(0.54)
Previous visit	Age 30 or more	-0.09	-0.07	-0.08
		(0.05)	(0.05)	(0.05)
	Chronic disease	-0.10	-0.11	-0.11
		(0.06)	(0.06)	(0.06)
	High-risk pregnancy	-0.25	-0.25	-0.25
		(0.05)	(0.05)	(0.05)
	Rural	-0.99	-0.98	-0.98
		(0.06)	(0.06)	(0.06)
N		774,809	563,664	1,056,035

Note: Hospital demand in the main sample with control function in column (1), in the sample of women who do not switch insurers and have continuous enrollment spells in column (3) and in the full sample of women in column (4). Specifications include interactions between number of beds, an indicator for bad outcomes post-delivery, and maternal mortality rate for each hospital with patient characteristics including dummies for age group, having a chronic disease, having a high-risk pregnancy, and zone of residence. Specifications also include hospital fixed effects. Bootstrap standard errors in parenthesis based on 100 resamples.

Appendix Table 5: First-Stage Estimates for Pricing Functions

	C-section		Vaginal	
	coef	se	coef	se
Lag price	0.03	(0.01)	0.03	(0.01)
Vaginal delivery price	0.18	(0.03)		
Vaginal delivery FFS	-0.01	(0.06)	—	—
C-section price	—	—	0.11	(0.01)
C-section FFS	—	—	-0.02	(0.04)
F-statistic	27.61		31.03	
N	598		598	

Note: First-stage regression of prices on lagged prices and contract characteristics for other services. Specifications include insurer and municipality fixed effects. Robust standard errors in parenthesis.

Appendix Table 6: Health Outcome Function Estimates

	coef	se
C-section	2.59	(0.79)
FFS	8.39	(0.91)
Age less than 30	1.89	(0.81)
Chronic disease	1.71	(0.88)
High-risk pregnancy	1.55	(0.81)
Low income	0.72	(0.85)
Rural	0.72	(1.03)
Constant	2.59	(1.15)
R^2	0.05	
N	7,258	

Note: Linear regression of an indicator for bad health outcomes in the month after delivery on payment contract characteristics and women characteristics. Includes hospital fixed effect. The estimation sample are women who do not switch insurers nor hospitals. Coefficient and standard errors in parenthesis are multiplied by 100 for exposition.