Too Much Care?
Private Healthcare Sector and Caesarean Sections in India

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In the context of India where public expenditure on healthcare is low, the private sector plays an important role in delivering healthcare during childbirth. An analysis of the latest round of National Family Health Survey data to estimate the differential probability of caesarean sections in private medical facilities relative to government facilities, and focusing on unplanned c-sections, reveals that the probability of an unplanned c-section is 13.5–14 percentage points higher in the private sector. These results call for a critical assessment of the role of private sector in healthcare in the context of inadequate public provision, expanding private provision and weak governance structures.

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The private sector plays a major role in healthcare provisioning in India. It provides nearly 70% of outpatient and 60% of inpatient care in the country (NSSO 2016). High absenteeism, inadequate infrastructure, unavailability of medicines, overcrowding, long waiting times and lack of respectful behaviour, combined with little effort on the part of doctors in the public sector have made private providers a preferred option, despite them charging (higher) fees for their services as compared to the public sector (Banerjee et al 2004; Gill 2009; GoI 2011; NSSO 2016). Even though private providers might be more responsive to patients and exert more effort, they are also more likely to provide over-intensive treatments either as a response to demand from patients (Das and Hammer 2007; Das et al 2008) or due to financial incentives (Arrieta 2011; Papanicolas and McGuire 2015; Johnson and Rehavi 2016; Chalkley and Listl 2018).

Private healthcare providers are set to play an even greater role in India with the National Health Policy, 2017 envisioning a tax-financed healthcare system with "strategic purchasing" from the private sector (GoI 2017), and the announcement of Pradhan Mantri Jan Arogya Yojana (loosely translated as Prime Minister's scheme towards health for all), which provides a cover of ₹5 lakh for poor households to seek secondary or tertiary care in any government or empanelled private hospital. The scheme aims to cover 40% of India's population (roughly 50 crore), and is touted as the world's largest health programme. Therefore, it is important to evaluate whether the private sector can be an effective partner in this endeavour.

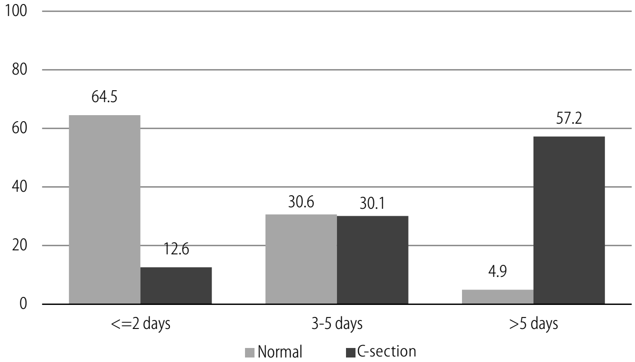
This paper evaluates the role of the private sector in India in providing delivery care. More specifically, we investigate the role of private sector providers in the probability of caesarean section (c-section) births in India. A c-section is an important surgical intervention during childbirth, and when medically justified, can prevent maternal and perinatal mortality and morbidity (Jensen and Wüst 2015). But if performed when "not needed," they impose a huge burden on the mother and the child that go beyond large out-of-pocket expenses (Hyde et al 2012; Gregory et al 2012; WHO 2015). Calculations using the latest round of National Family Health Survey (NFHS-4) data (IIPS 2017) suggest that c-section deliveries are associated with longer hospital stays (Figure 1, p 40), delayed initiation of breastfeeding (Figure 2, p 40) and higher out-of-pocket expenses (Table 1).

Table 1: Mode of Delivery and Average Out-of-Pocket Expenses (₹)

	Normal	C-section
Public	2,614	7,036
Private	10,814	23,978
Total	4,786	17,960

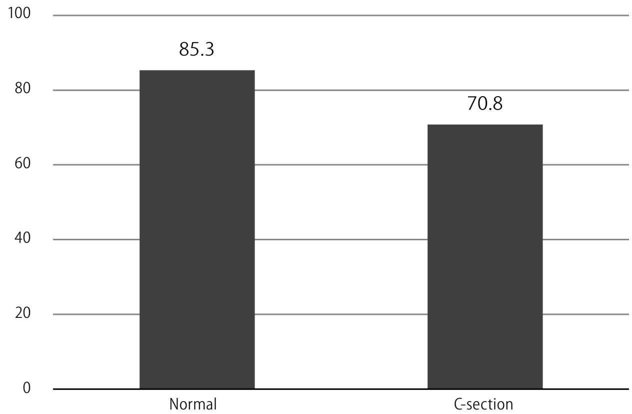
Source: Authors' calculations using NFHS-4.

Figure 1: Mode of Delivery and Length of Hospital Stay



Source: Authors' calculations using NFHS-4 data.

Figure 2: Mode of Delivery and Breastfeeding (%)



Source: Authors' calculations using NFHS-4 data.

Moreover, an "unnecessary" C-section can lead to higher morbidity among mothers and newborns, lower birth weight and lower Apgar scores—all of which could have adverse short- and long-term consequences on the mother, including increased chance of C-section for subsequent births (Pai 2000; Jachetta 2016; Lobel and DeLuca 2007; Clark and Silver 2011; Schulkind and Shapiro 2014; Johnson and Rehavi 2016).

As per the NFHS-4, which was carried out in 2015–16, 40.9% of births in private facilities in India were through C-section, as against 11.9% in public facilities (Singh et al 2018). Thus, the gap in C-section rates between private and public sector is 29 percentage points. However, it would be incorrect to entirely attribute this difference to the private sector, since the decision about location of delivery is endogenous. Women who opt for private facilities are different in various observable and unobservable dimensions from women who opt for public facilities. Observable dimensions can be controlled but unobservable factors, such as preference for C-section and pregnancy-specific (risk) factors that are not captured in the data are difficult to control for. More importantly, such unobservable factors are likely to be correlated with the location of delivery. As a consequence, the extent of difference (if any) in C-section rates due to location of delivery will yield a biased estimate.

This paper therefore uses two approaches to control for unobservables—household fixed effects (HFE) estimation and coarsened exact matching (CEM). An important contribution of the paper is that it uses a question introduced for the first time in NFHS which allows the identification of planned (and unplanned) C-sections. Under the assumption that planned C-sections largely reflect the demand for C-section from women (or from their families), or certain medical risks that necessitated C-section, keeping these observations in the analysis will contribute to the increased bias of the estimate. Hence, we drop these observations and re-estimate the model (similar to Halla et al [2016] and Costa-Ramón et al [2018]).

We find that a woman opting for private facility is 13.5–14 percentage points more likely to undergo an unplanned C-section. This estimate provides a lower bound for the difference in the probability of C-section between the public and private sectors. We also perform meaningful subsample analysis to rule out alternative explanations for the differential probability of C-section between public and private sectors, such as the private sector might be catering to riskier pregnancies or the public facilities might be ill-equipped to carry out C-sections. The results from our subsample analysis are consistent with our main results.

Data

As mentioned, the paper utilises raw data from the fourth wave of the NFHS which was carried out during 2015–16. Funded by the Ministry of Health and Family Welfare and other international organisations, NFHS-4 covered all states in India, and was designed to provide estimates of key demographic and health indicators for India, each of her states and 640 districts within these states. The survey sample is a stratified two-stage sample. The latest census carried out in 2011 served as the sampling frame for the selection of primary sampling units (PSU). These PSUs were sampled from strata with probability proportional to size. Sampling of PSUs was followed by sampling of households in the PSU in a pre-specified manner.

Four survey questionnaires were canvassed to each sampled household—household questionnaire, woman's questionnaire, man's questionnaire and biomarker questionnaire. For this study, we use data collected through the household and woman's questionnaires. The household questionnaire collected information on the socio-economic and demographic characteristics of the household. The woman's questionnaire was canvassed to all women in the reproductive age group of 15–49 years and provides detailed information on prenatal, delivery and postnatal care for all births between January 2010 and the date of the survey.

The sample of women in NFHS-4 gave birth to 2,59,627 children in the reference period, that is, between January 2010 and the date of survey. To construct our analytic sample, we first drop the births which did not take place in an institutional facility (that is, home deliveries), which leaves us with 1,93,610 unique institutional births. Further, questions related to utilisation of antenatal care, problems experienced during pregnancy (difficulty with vision during daylight, convulsions not from fever, swelling of the legs, body or face) and complications during delivery (breech presentation, prolonged labour, excessive bleeding) were asked only for the 1,48,185 most recent births. Additionally, information on whether the previous delivery was through c-section—which is an important determinant of whether the current delivery will be through c-section—is available only for those births (out of 1,48,185) where the previous birth was also within the reference period. Hence, restricting the sample to the most recent births, for which we know whether the previous delivery was through c-section, yields a sample of 92,780 births. This is the final sample of births that we analyse in this paper.

Methodology

Consider the following regression model:

$$CS_{is} = \alpha + \beta Private_{is} + \gamma X_{is} + \mu_s + \kappa_y + \epsilon_{is} \quad \text{... (1)}$$

In the above model, the dependent variable, CS_{is} is whether the birth i in state s was delivered through c-section. The key explanatory variable of interest is whether the delivery was in a private facility. X is a vector of other explanatory variables, which include household-level factors (rural/urban residence, religion, caste, and wealth), mother-level factors (maternal education and her height), and birth-level variables, such as maternal age at birth, birth order (parity), size of the newborn, whether it was a multiple birth situation, prior termination of pregnancy, whether the previous birth was through c-section, complications during pregnancy, utilisation of antenatal care services and complications during delivery. Literature suggests that these variables are strongly correlated with probability of c-section delivery (Padmadas et al 2000; Mishra and Ramanathan 2002; Leone 2014; Neuman et al 2014).

Since health is a state subject in India and health-related policies are formulated and implemented at the state level, we add state fixed effects (SFE) (μ_s) to control for any state-specific factors that may drive the difference in the probability of c-section between private and public facilities. We also include year of birth fixed effects (κ_y) to control for time trend. Since the choice of location of delivery is endogenous, the above specification yields a biased estimate of β. For example, it could be that women (or families) who prefer c-section (due to say fear of pain or the flexibility it gives to schedule a birth) might opt for private facilities. If that is the case, the above model will overestimate the difference in c-section rates between public and private sector. An unbiased estimate can be obtained only through controlling for such unobservable variables. First, we adopt the HFE approach to control for unobservable factors which vary across households. The specification is as follows:

$$CS_{ih} = \tilde{\alpha} + \tilde{\beta} Private_{ih} + \tilde{\gamma} X_{ih} + \pi_h + \tilde{\kappa}_y + \tilde{\epsilon}_{ih} \quad \text{... (2)}$$

where h refers to household and π_h are HFE. This approach takes advantage of the fact that there are some households that would have experienced more than one birth during the reference period, and there is likely to be variation in the location of delivery across these births. Thus, the HFE approach utilises variation in the location of delivery within the same household to assess its correlation with the mode of delivery (vaginal or c-section). As a result, unobservable factors across households (such as lifestyle, risk aversion or household-specific preference for c-section) that might affect the location and mode of delivery are automatically accounted for. As a result, an HFE approach yields, at least conceptually, a less biased estimate compared to an estimation without HFE, if the source of unobservables is at the household level. However, not all households have more than one birth during the reference period. Characteristics of these households might differ from the households that had only one birth, which have implications for the generalisability of the results.

The second approach we adopt to obtain a less biased estimate is CEM. It consists of temporarily coarsening (or grouping) determinants of treatment (in this case, birth in a private facility) by recoding so that substantively indistinguishable values are grouped and assigned the same numerical value. To give an example, years of education can be grouped into groups such as no schooling, below elementary (Class 8), elementary completed but below higher secondary (Class 12), and finally, higher secondary and above. Through an "exact matching" algorithm, observations with the same values for all the

Table 2: Summary Statistics

	Mean	Standard Deviation
C-section delivery	0.24	0.43
Delivery in private institution	0.35	0.48
Household specific variables		
Urban	0.32	0.47
Hindu	0.81	0.39
Muslim	0.14	0.34
Christian	0.02	0.14
Other Backward Classes	0.44	0.50
Scheduled Castes	0.21	0.41
Scheduled Tribes	0.09	0.29
Woman specific variables		
Mother's height above 150 centimetres	0.63	0.48
No education or incomplete primary	0.24	0.43
Completed primary but incomplete secondary	0.49	0.50
Completed secondary	0.12	0.32
Higher	0.16	0.37
Birth specific variables		
Prior termination[a]	0.10	0.29
Age at birth <20 years	0.16	0.37
Age at birth 20–24 years	0.51	0.50
Age at birth 25–29 years	0.25	0.43
Age at birth >=30 years	0.08	0.27
Birth order = 1	0.57	0.50
Birth order = 2	0.25	0.43
Birth order >=3	0.18	0.38
Size of child at birth—small	0.12	0.32
Size of child at birth—average	0.67	0.47
Size of child at birth—large	0.21	0.41
Experienced pregnancy problems[b]	0.43	0.50
Experienced delivery complications[c]	0.56	0.50
No of antenatal care visits >4	0.47	0.50
Previous C-section	0.06	0.24
Observations	92,780	

a: Mother had prior pregnancy that terminated in miscarriage, abortion or still birth.
b: 1 if during pregnancy had difficulty with daylight vision or had convulsions not from fever or had swelling of the legs, body or face.
c: 1 if during delivery experienced a breech presentation or experienced prolonged labour or experienced excessive bleeding.
Weighted by NFHS sampling weights.
Source: Same as Table 1.

coarsened variables form a stratum. Observations in strata that contain at least one treatment and one control observation are retained, while observations in the remaining strata are dropped for further analysis (Iacus et al 2011). CEM has been shown to be superior to other popular matching methods, including propensity score matching (Iacus et al 2011; King and Nielsen 2016).

Results

Table 2 (p 41) presents the descriptive statistics for all variables used in this study. Overall, 24% of the deliveries in our sample were through C-section. Table 3 shows characteristics of births in public and private facilities separately. Forty-four percent of births in private sector are through C-section while the corresponding fraction is 14% in the public sector. The difference of 30 percentage points is large and statistically significant. The table clearly shows that the background characteristics of births in the public sector are different from the births in the private sector. Women who deliver at private facilities or households that they belong to are more likely to be from urban areas and more likely to be socio-economically and educationally advantaged (as reflected in caste, wealth quintiles, education and age profiles). Since these characteristics also affect the probability of C-section, a simple comparison of C-section rates between public and private providers will be biased.

Table 3: Household, Woman and Birth Level Characteristics for Deliveries in Public vs Private Sector

	Public	Private	Difference in Means	t-statistic for Difference in Means
C-section delivery	0.14	0.44	0.30	110.0***
Household characteristics				
Urban	0.25	0.44	0.20	62.6***
Other Backward Classes	0.42	0.48	0.06	17.8***
Scheduled Castes	0.25	0.14	−0.11	−37.8***
Scheduled Tribes	0.11	0.05	−0.07	−33.8***
Bottom wealth quintile	0.23	0.07	−0.16	−63.7***
Second wealth quintile	0.25	0.11	−0.14	−50.8***
Third wealth quintile	0.23	0.19	−0.04	−13.1***
Fourth wealth quintile	0.18	0.27	0.09	33.2***
Top wealth quintile	0.10	0.35	0.25	95.8***
Woman characteristics				
Mother's height above 150 centimetres	0.60	0.68	0.08	23.7***
No education or incomplete primary	0.29	0.14	−0.16	−54.2***
Completed primary but incomplete secondary	0.52	0.42	−0.10	−28.1***
Completed secondary	0.10	0.15	0.05	24.4***
Higher	0.09	0.29	0.20	82.2***
Birth characteristics				
Prior termination	0.09	0.11	0.02	9.8***
Age at birth <20 years	0.18	0.13	−0.04	−16.9***
Age at birth 20–24 years	0.51	0.50	−0.02	−4.4***
Age at birth 25–29 years	0.23	0.28	0.05	16.8***
Age at birth >=30 years	0.08	0.08	0.01	4.2***
Experienced pregnancy problems	0.43	0.44	0.01	3.1***
Experienced delivery complications	0.57	0.55	−0.02	−5.7***
Previous C-section	0.04	0.10	0.06	37.6***
Observations	66,318	26,462		

Weighted by NFHS sampling weights. *** significance level at 0.001.
Source: Same as Table 1.

Fixed effect estimation results: Table 4 shows results from estimating specification (1)—a linear probability model with robust standard errors clustered at the state level. Column 1 has no controls other than the location of delivery. It indicates that a woman delivering in a private medical facility is 28.7 percentage points more likely to deliver through C-section compared to delivering in a public medical facility. Once household, woman and birth-level controls are added, the coefficient drops to 22.4 percentage points (column 2). As we add previous C-section in column 3, the coefficient drops to 18.3 percentage points. Adding previous C-section increases the explanatory power of the regression considerably. When we add state dummies (column 4) and year dummies (column 5), the estimated coefficient increases marginally from 18.3 percentage points to 19.4 percentage points. In other words, variations across states and over time do not explain much of the public–private differential once other factors have been accounted for. Thus, baseline specification suggests that delivery in a private facility increases the probability of a C-section by 19.4 percentage points, controlling for observable factors. We run exactly the same specification with district fixed effects and PSU fixed effects instead of SFE, and the results remain unchanged (Table A3 in the appendix, p 47).

Table A1 (p 47) (in the appendix) shows estimated coefficients on other variables. Whether the previous delivery was through C-section is the strongest determinant of the current C-section. A woman who delivered through a C-section is 68.8 percentage points more likely to give current birth through C-section. Birth order and maternal age at birth are other important determinants—higher the birth order and lower the maternal age at birth, lower is the probability of a C-section. Problems during pregnancy, even if statistically significant, have relatively less impact on the probability of C-section. The variable indicating complications during delivery is not even statistically significant. The religion of the household is also not an important determinant of C-section, while the social group of the household matters. Table A2 (p 47) (in the appendix) shows

Table 4: Delivery in a Private Medical Facility and Probability of C-section (State Fixed Effects)

	1	2	3	4	5
Delivery in private institution	0.287*** (0.022)	0.224*** (0.021)	0.183*** (0.017)	0.194*** (0.015)	0.194*** (0.015)
N	92,780	92,780	92,780	92,780	92,780
R-squared	0.10	0.16	0.30	0.31	0.31
Household, woman and birth level controls	N	Y	Y	Y	Y
Previous C-section	N	N	Y	Y	Y
State FE	N	N	N	Y	Y
Birth year FE	N	N	N	N	Y

Standard errors in parentheses. *** significance level at 0.001.
FE stands for fixed effects and Y and N stand for yes and no respectively.
Source: Same as Table 1.

Table 5: Delivery in a Private Medical Facility and Probability of C-section (Household Fixed Effects)

	1
Delivery in private institution	0.203*** (0.022)
N	7,811
No of households	3,824
R-squared	0.20
Woman and birth level controls	Y
Previous C-section	Y
Household FE	Y
Birth Year FE	Y

Standard errors in parentheses.
*** significance level at 0.001.
FE stands for fixed effects and Y for yes.
Source: Same as Table 1.

odds ratios from logistic regression. Consistent with the linear probability model results, women have significantly higher odds of a C-section birth when they deliver in a private facility. Table 5 (p 42) shows results from HFE, that is, specification (2). The estimated coefficient, at 20.3 percentage points, is not very different from what we obtained through baseline specification.

CEM results: The first step in CEM is to match the treatment observations (births in private facilities) to the control observations (those in public facilities) based on the following variables: social group, religion, wealth quintile, rural/urban residence, and state of residence of the household, mother's education and age at birth, prior experience of pregnancy termination, complications during pregnancy and previous C-section. We select these variables since they are determinants of location of delivery. Tables 6 and 7 show the outcome of matching procedure. The original sample contains 66,318 untreated (that is, births in public facilities) and 26,462 treated (that is, births in private facilities) observations with an overall imbalance score (as measured by L1 statistic) of 0.629 (Table 6). The matched sample consists of 58,633 births (out of 92,780 births), of which 18,290 are in the treatment group, and 40,343 are in the control group. The marginal distribution of each variable is perfectly balanced as indicated by the univariate L1 statistic which is close to zero for each variable (Table 7).

The overall multivariate L1 imbalance score post-matching is also close to zero, suggesting balance in the treatment and control groups with respect to the full joint distribution of the covariates. We estimate specification (1) using this matched sample and the generated CEM weights. The results are shown in Table 8. We obtain an estimate of 18.6 percentage points which is marginally lower in magnitude than our earlier estimates. To summarise, a woman who delivers in a private facility is 18.6–20.3 percentage points more likely to deliver through C-section.

Table 6: Coarsened Exact Matching: Matched and Unmatched Sample

	Public	Private
Matched	40,343	18,290
Unmatched	25,975	8,172
All sample#	66,318	26,462

Overall Multivariate L1 Statistic (pre-matching) = 0.629.
Source: Same as Table 1.

Table 7: Summary Results for Coarsened Exact Matching for Private and Public

	L1 Statistic	Mean Difference
Mother's education	9.2e-15	2.2e-15
Mother's age at birth	8.0e-15	2.1e-14
Experienced pregnancy problems	6.9e-15	−8.0e-15
Prior termination experience	2.8e-15	−1.9e-15
Previous C-section	2.5e-15	−9.5e-16
Wealth	1.4e-14	−1.6e-14
Social group	1.2e-14	6.9e-15
Religion	1.2e-14	−4.7e-14
Sector	1.3e-14	−1.0e-14
State	1.8e-14	−7.3e-13
Overall multivariate L1 Statistic	1.7e-14	

Also matched on the quantiles of the distribution for each variable.
Source: Same as Table 1.

Table 8: Delivery in a Private Medical Facility and Probability of C-section (Matched Sample)

	1
Delivery in private institution	0.186*** (0.013)
N	58,633
R-squared	0.23
Household, woman and birth level controls	Y
Previous C-section	Y
State FE	Y
Birth year FE	Y

Standard errors in parentheses. *** significance level at 0.001.
FE stands for fixed effects and Y for yes.
Source: Same as Table 1.

Planned and Unplanned C-sections

NFHS-4 added a question that was not asked in previous waves: When was the decision made to have a C-section—before or after the onset of labour? This question allows us to identify planned and unplanned (or scheduled and non-scheduled) C-sections. Planned C-sections constitute 53.6% of all C-sections in our sample, and this percentage is similar in both public and private sectors. Planned C-sections can be driven by medical reasons. For example, the American College of Obstetricians and Gynaecologists (2014, 2018) recommends a C-section before the onset of labour in first births for: breech or transverse lie, placenta previa, triplets and higher order multiples, uterine rupture, certain rare maternal cardiac or neurologic conditions, or a history of certain uterine surgeries. Planned C-sections may also reflect a demand for C-sections, that is, women who prefer C-sections due to fear of pain in natural births, or preference for the birth of the child on a specific day or time driven by cultural or religious beliefs, or monetary incentives would lead to planned C-sections (Lo 2003; Gans and Leigh 2009; Schulkind and Shapiro 2014; Wang 2017). Hence, we drop the observations with planned C-sections and re-estimate the model. Halla et al (2016) also follow a similar approach.

But dropping planned C-sections also implies losing observations where the medical professional might have misled a woman to go for a scheduled C-section when not justified, due to financial incentives or convenience (Gans et al 2007; Halla et al 2016). Further, in the Indian context, private facilities that provide maternal care predominantly consist of small hospitals

Table 9: Delivery in a Private Medical Facility and Probability of C-section after Excluding Planned C-sections

	1 State FE	2 Household FE	3 Matched Sample +State FE
Delivery in private institution	0.141*** (0.012)	0.139*** (0.018)	0.135*** (0.011)
N	82,910	6,420	53,581
No of households	–	3,141	–
R-squared	0.21	0.14	0.14
Household level controls	Y	N	Y
Woman and birth level controls	Y	Y	Y
Previous C-section	Y	Y	Y
State FE	Y	N	Y
Household FE	N	Y	N
Birth Year FE	Y	Y	Y
Exclude planned C-sections	Y	Y	Y

Standard errors in parentheses. *** significance level at 0.001.
FE stands for fixed effects and Y and N stand for yes and no respectively.
Source: Same as Table 1.

or nursing homes, typically owned by a single doctor or a family. These are characterised by limited assistance from other doctors, difficulties in maintaining round the clock monitoring or obtaining a second opinion, inadequate facilities, and lack of skilled human power—including nurses. In these conditions, planned C-sections might be preferred by the provider (Pai 2000). Thus, the estimate we derive is probably a lower bound for the difference in probability of C-sections in public and private sectors. Table 9 (p 43) shows the results from SFE, HFE and CEM when we drop the planned C-sections. The results suggest that opting for the private sector increases the probability of an unplanned C-section by 13.5–14 percentage points.

Subsample Analysis

Now we turn to subsample analysis and address some of the concerns with the estimates obtained above. Results from this analysis are shown in Table 10. Panel A presents results without excluding planned C-sections, while panel B presents results after excluding planned C-sections.

Private providers catering to riskier pregnancies: One concern could be that private providers handle riskier pregnancies which then lead to higher C-sections. We have controlled for risk factors during pregnancy and delivery. We have also eliminated planned C-sections as discussed above. Here, we take an even stricter approach. We attempt to address this concern by analysing two separate subsamples. In the first case, we create a subsample of low-risk women, that is, women who were between 20 years and 24 years of age when they gave birth and who did not experience foetal mal-representation, complications during pregnancy and prior C-section delivery (Kozhimannil et al 2014). Thus, medical risk factors that might necessitate a C-section are very low in this group and it is less likely that women going to public and private facilities would differ along unobservable medical risk factors within this subsample.

In the second case, we drop the deliveries in lower-level public facilities (dispensary, sub-centres, primary health centres or community health centres, etc) and compare deliveries in government hospitals and municipal hospitals to that of private facilities. Government and municipal hospitals function as secondary referral units for the lower level public health institutions and thus receive more serious and riskier cases. Therefore, using the births in government and municipal hospitals as the reference group, in addition to controlling for complications and eliminating planned C-sections, helps in ruling out case-mix differences as a potential explanation for our estimate of the effect of private sector on C-section births. The results for these subsamples are shown in columns 1 and 2 of Table 10. Though the magnitude of the estimate drops marginally, the effect of the private sector on unplanned C-sections within these subsamples is still considerably large, that is, between 11.2 percentage points and 12.4 percentage points.

Table 10: Delivery in a Private Medical Facility and Probability of C-section: Sub-sample Analysis

	(1) Low Risk Pregnancies	(2) Include only Those Public Sector Births Which were in Govt/Municipal Hospital#	(3) Urban	(4) First Order Births
Panel A: Without excluding planned C-sections				
Delivery in private institution	0.179***	0.154***	0.166***	0.230***
	(0.0165)	(0.0136)	(0.0150)	(0.0158)
N	16,503	35,093	13,670	34,124
R-squared	0.17	0.21	0.20	0.14
Household, woman and birth level controls	Y	Y	Y	Y
Previous C-section	Y	Y	Y	N
State FE	Y	Y	Y	Y
Birth year FE	Y	Y	Y	Y
Panel B: Excluding planned C-sections				
Delivery in private institution	0.124***	0.112***	0.116***	0.175***
	(0.0122)	(0.0112)	(0.0115)	(0.0133)
N	15,502	30,574	11,659	30,078
R-squared	0.12	0.14	0.14	0.09
Household, woman and birth level controls	Y	Y	Y	Y
Previous C-section	Y	Y	Y	N
State FE	Y	Y	Y	Y
Birth year FE	Y	Y	Y	Y

Standard errors in parentheses. *** significance level at 0.001.
exclude public sector births in lower level public facilities - primary health centre/additional primary health centre/community health centre/rural hospital/block primary health centre/urban health centre/urban health post/urban family welfare centre/government dispensary.
FE stands for fixed effects and Y and N stand for yes and no respectively.
Source: Same as Table 1.

Low C-section rate in public sector due to lower level health facilities: Government facilities at lower levels often lack equipment and expertise to carry out procedures such as C-sections (Vora et al 2009; GOI 2015). It is not a surprise then that a higher fraction of deliveries in lower level government facilities, such as primary health centres or community health centres, are vaginal deliveries and not C-sections. Hence, to ensure that supply-side constraints in the public sector are not driving our results, we estimate the model for two separate subsamples where such constraints are less binding—(i) births to women who reside in urban areas (Table 10 column 3), and (ii) public sector births restricted to those that take place in government and municipal hospitals (Table 10 column 2). We find that our results are robust within these subsamples.

First order births: The profile and pattern of risks in higher order pregnancies are likely to be governed by what happened during the first pregnancy and childbirth. Hence, we also obtain estimates only for the first order births as indicated in Table 10 (column 3). D Card et al (2018) and E M Johnson and M M Rehavi (2016) follow a similar approach. We find that the estimates are even higher for primary births (Table 10; column 4).

Discussion

The objective of this study was to investigate the role of private sector providers on the probability of C-section births in India. This research uses HFE and CEM techniques to account for the selection of women into private facilities, and finds that the probability of C-sections is 18.6–20 percentage points higher in private facilities. Further, we distinguish between planned and unplanned C-sections to ensure that our estimates are not biased by demand for C-sections or pregnancies characterised by certain medical risks. After excluding planned C-sections, we find that the likelihood of an unplanned C-section birth is 13.5–14 percentage points higher in a private facility. Even though this is a very conservative estimate, because some of the planned C-sections could be a result of supplier-induced demand, this effect is quite large. With around 70 lakh births (of the 260 lakh births in India in 2016) in private facilities, even a conservative estimate of 13.5 percentage points for the effect of private sector implies that there were potentially nine lakh preventable C-sections in the private sector. We also perform additional tests to rule out alternative explanations such as the private sector might be catering to riskier pregnancies or the public facilities might be ill-equipped to carry out C-sections.

Overall, our results indicate that the probability of C-sections in private medical facilities remains significantly higher than the public sector after controlling for various background characteristics, risk factors and demand factors. What could explain higher C-sections in the private sector when the characteristics of pregnancies are not very different? The medical providers' concern about malpractice liability or fear of legal consequences is unlikely to be an important factor in the Indian context (Pai 2000; Fuglenes et al 2009; Litorp et al 2015). The supplier-induced demand driven by financial incentives—especially when the patient has limited information—is probably an important explanation. As per NFHS-4, a natural birth in private facility costs on an average ₹10,814, while a C-section costs ₹23,978, more than twice the cost of a natural birth (Table 1).

In addition to economic incentives, convenience can be another important factor as the duration of labour is uncertain in case of a vaginal delivery. While we have accounted for scheduling convenience by excluding planned C-sections, it is possible that private maternal care facilities, which are typically owned by a single doctor or a family in the Indian context, perform unplanned C-sections in the absence of medical indications to avoid attending to lengthy labour at night. Prior studies in different contexts have presented evidence on the role played by the provider's demand for leisure in determining the mode of delivery (Fraser et al 1987; Brown 1996; Arrieta and Prado 2016; Costa-Ramón et al 2018).

What is the way forward? Before we discuss how to deal with rising (medically unjustified) C-sections, it might be pertinent to point out the paucity of relevant data in India. There has been a gap of almost a decade between two rounds of the NFHS, the only representative survey carried out in India. In the absence of such data, underlying trends and determinants of these trends remain unknown. In addition, the absence of facility-level data in the public domain on the type of delivery and the background characteristics of patients prevents a robust analysis of facility-level determinants of the type of delivery. Thus, the need to augment data from multiple sources cannot be overemphasised.

Coming back to the ways to counter rising C-section rates in the private sector, one strategy advocated is to reduce the difference in fees between vaginal and caesarean deliveries. However, if the time costs of waiting for labour to progress in a vaginal delivery are higher (lost leisure or lost time to attend to other patients), then the provider will prefer to deliver via a C-section even if the payment is the same for both. It is not a surprise then that such policy interventions have met with limited success (Walker et al 2002). Another strategy is to have certain guidelines that define the conditions under which the decision for a caesarean surgery can be taken. As of now, no such guidelines exist in India. However, some indications such as dystocia are subjective and therefore allow for diagnostic discretion (Barber et al 2011). Hence, guidelines are less likely to be effective in practice as providers can always use discretionary interpretation to justify an unnecessary C-section.

An online petition in India has urged the health ministry to make it mandatory for all hospitals to publicly display data on vaginal and C-section deliveries.[1] Public dissemination of C-section rates could help in reducing the information asymmetry between the provider and the patient and therefore could be an interesting policy intervention. Further, strengthening of public sector facilities, not just in terms of equipment and staffing, but also in terms of facility timings, absenteeism and attitudes of service providers can provide an alternative to the private sector and help bringing down c-sections that are not needed (Banerjee et al 2004; Besley and Malcomson 2018). A lot more thought, context-specific understanding of reasons for increase in C-sections, and dialogue that takes into account views and experiences of all stakeholders and a combination of strategies might be required to guide the eventual policy response.

Our findings, more generally, call for a critical assessment of the role of the private sector in delivering the optimal intensity of care during childbirth. This is particularly important in the context of India (and other developing countries) where public health spending is low (1.3% of the gross domestic product in India in 2015–16) and the private sector plays an important and ever-expanding role in healthcare provisions (NSSO 2016; GOI 2016).

NOTE

1 The petition has been started by Subarna Ghosh and can be found on Change.org on the following link: https://www.change.org/p/make-it-mandatory-for-all-hospitals-to-declare-number-of-caesarean-deliveries-safebirth.

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Appendix

Table A1: Delivery in a Private Medical Facility and Probability of C-section (State FE): Complete Results

	Coefficient	Standard Error
Delivery in private institution	0.194***	(0.015)
Household-specific variables		
Rural	-0.019***	(0.005)
Religion–Muslim	-0.008	(0.009)
Religion–Christian	-0.020	(0.014)
Religion–Other	0.005	(0.011)
Social group–Other Backward Classes	-0.023***	(0.004)
Social group–Scheduled Castes	-0.014*	(0.006)
Social group–Scheduled Tribes	-0.039***	(0.009)
Wealth quintile 2	0.003	(0.004)
Wealth quintile 3	0.026**	(0.007)
Wealth quintile 4	0.046***	(0.010)
Wealth quintile 5	0.059***	(0.010)
Woman specific variables		
Education–Completed primary but incomplete secondary	0.006	(0.003)
Education–Completed secondary	0.018**	(0.005)
Education–Higher	0.034***	(0.007)
Mother's height above 150 cm	-0.032***	(0.003)
Birth-specific variables		
Prior termination	0.042***	(0.006)
Age at birth 20–24 years	0.044***	(0.005)
Age at birth 25–29 years	0.090***	(0.008)
Age at birth >=30 years	0.134***	(0.014)
Birth Order = 2	-0.166***	(0.014)
Birth Order >=3	-0.175***	(0.014)
Size of child at birth–average	0.001	(0.003)
Size of child at birth–large	0.026***	(0.005)
Experienced pregnancy problems	0.026***	(0.003)
Experienced delivery complications	0.003	(0.011)
No of antenatal care visits >4	0.027***	(0.005)
Previous CS	0.688***	(0.015)
Constant	0.109***	(0.015)
N	92,780	
R-squared	0.31	

The regression includes state and birth year fixed effects. *** significance level at 0.001
Omitted category for religion—Hindu; Social group—General; Education— no education or incomplete primary; Age at birth— less than 20 years; Size of child at birth—small
Source: Authors' calculations using NFHS-4 data.

Table A2: Delivery in a Private Medical Facility and Probability of C-section (State FE): Odds Ratios from Logistic Regression

	1	2	3	4	5
Delivery in private institution	4.995*** (0.726)	3.681*** (0.465)	3.504*** (0.378)	4.037*** (0.407)	4.047*** (0.408)
N	92,780	92,780	92,780	92,780	92,780
Household, woman and birth level controls	N	Y	Y	Y	Y
Previous C-section	N	N	Y	Y	Y
State FE	N	N	N	Y	Y
Birth year FE	N	N	N	N	Y

Standard errors in parentheses. *** significance level at 0.001. FE stands for fixed effects and Y and N stand for yes and no respectively.
Source: Same as Table 1.

Table A3: Delivery in a Private Medical Facility and Probability of C-section (District and PSU FEs)

	1	2	3	4
Delivery in private institution	0.196*** (0.014)	0.144*** (0.012)	0.199*** (0.015)	0.147*** (0.013)
N	92,780	82,910	92,780	82,910
R-squared	0.26	0.18	0.23	0.17
Household, woman and birth level controls	Y	Y	Y	Y
Previous C-section	Y	Y	Y	Y
District FE	Y	Y	N	N
PSU FE	N	N	Y	Y
Birth Year FE	Y	Y	Y	Y
Exclude planned C-sections	N	Y	N	Y

Standard errors in parentheses. *** significance level at 0.001. FE stands for fixed effects and Y and N stand for yes and no respectively.
Source: Same as Table 1.