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Too much care? Private health care sector and surgical interventions during childbirth in India

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Abstract

This paper evaluates the role of the private sector in performing one of the common surgical interventions, i.e. caesarean sections during childbirth in India. We use the latest round of National Family Health Survey to estimate the differential probability of C-section in private medical facilities relative to government facilities. We employ two estimation techniques, Household Fixed Effects and Coarsened Exact Matching, to reduce the extent of selection bias in the choice of delivery location. We also take advantage of a new question introduced in the survey which allows identification of planned C-sections which are more likely to be the result of either demand for C-section or unobservable (in the data) medical risks. We find that the probability of an unplanned C-section is 13.5-14 percentage points higher in the private sector. Given that some of the planned C-sections could be a result of supplier-induced demand, this is a very conservative estimate. Our results suggest that there were potentially 0.9 million preventable C-sections in the private sector in 2016. These results therefore 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.

Keywords: Private Health Care Providers, India, Caesarean Section (C-section), Fixed Effects, Coarsened Exact Matching (CEM), National Family Health Survey (NFHS)

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1. Introduction

Private sector plays a major role in health care provisioning in India. It provides nearly 70% of out-patient and 60% of in-patient care in the country (NSS, 2016). High absenteeism, inadequate infrastructure, unavailability of medicines, over-crowding, long waiting times and lack of respectful behavior combined with little effort on 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; Government of India, 2011; NSS, 2016). But 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 (Government of India, 2017), and announcement of *Pradhan Mantri Jan Aarogya Yojana* (loosely translated as Prime Minister's scheme towards Health for All), which provides a cover of Rs. 5 lakh for poor households to seek secondary or tertiary care in any government or empaneled private hospital. The scheme aims to cover 40% of India's population or roughly 50 crore, and is touted as world's largest health program. Therefore, it is important to evaluate whether the private sector can be an effective partner in providing health services.

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 under situations such as 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 (ACOG, 2014 2018). When medically justified, C-sections prevent maternal and perinatal mortality and morbidity (Jensen and Wüst, 2015). But if performed when 'not needed', they impose 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). For the new-born, it means delayed breastfeeding, lower birth-weight, respiratory morbidities, increased rate of hospitalization, lower Apgar scores and its implication in the long run (Lobel and DeLuca, 2007; Schulkind and Shapiro, 2014; Jachetta, 2015; Johnson and Rehavi, 2016; Card et al., 2018; Costa-Ramón et al., 2018). For the mother, it can mean pain, higher chances of infection, breastfeeding challenges, complications related to future pregnancies, reduction in fertility and psychosocial consequences (Clark and Silver, 2011; Halla et al., 2016).

As per the latest nationally representative demographic and health survey, namely the fourth round of National Family Health Survey (NFHS), 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. Thus, the gap in C-section rates between private and public sector is equal to 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 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 (FE) estimation and Coarsened Exact Matching (CEM). To our knowledge, these approaches have not been utilized to explore the role of private sector in C-section deliveries in a developing country context. In addition, the paper uses a question about planned C-sections, which was introduced first time in NFHS. If planned C-sections largely reflect 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 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 un-planned C-section. This estimate provides a lower bound for the difference in probability of C-section between public and private sector. We also perform meaningful sub-sample analysis to address some of the concerns with these estimates. The results from our sub-sample analysis are consistent with our main results.

2. Data

The paper utilizes 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 organizations, NFHS IV 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 IV gave birth to 2,59,627 children in the reference period i.e. 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 (i.e. home deliveries), which leaves us with 1,93,610 unique institutional births. Further, questions related to utilization 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 labor, 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 analyze in this paper.

3. Methodology

Consider the following regression model

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

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, utilization 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 (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 flexibility it gives to schedule a birth) might opt for private facilities. If that is the case, the above model will over-estimate 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 household Fixed Effects (FE) approach to control for unobservable factors which vary across households. The specification is as follows:

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

where h refers to household and π_h are household fixed effects. 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 location of delivery across these births. Thus, household FE approach utilizes variation in location of delivery within the same household to assess its correlation with 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 location and mode of delivery are automatically accounted for. As a result, a household FE approach yields, at least conceptually, a less biased estimate compared to an estimation without FE 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 generalizability of the results.

The second approach we adopt to obtain less biased estimate is Coarsened Exact Matching (CEM). CEM 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 (grade 8), elementary completed but below higher secondary (grade 12), and finally higher secondary and above. Through an 'exact matching' algorithm, observations with the same values for *all* the coarsened variables form a stratum. Observations in strata that contain at least one treatment and one control observation are retained, while observations in remaining strata are dropped for further analysis (Iacus et al., 2011). The remaining difference is thus all only within the small coarsened strata, and therefore can be accounted for through statistical model without risk of much model dependence. CEM has been shown to be superior to other popular matching methods including Propensity Score Matching (Iacus et al., 2011; King and Nielsen, 2016).

4. Results

Table 1 presents the descriptive statistics for all variables used in this study. 24% of the deliveries in our sample were through C-section and 35% were carried out in private facilities.

Table 1: Summary statistics

	Mean	SD
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
OBC	0.44	0.50
SC	0.21	0.41
ST	0.09	0.29
Woman Specific Variables		
Mother's height above 150 cm	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 CS	0.06	0.24
Observations	92,780	

Weighted by NFHS sampling weights. 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 labor Or experienced excessive bleeding

Table 2: HH, 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***
OBC	0.42	0.48	0.06	17.8***
SC	0.25	0.14	-0.11	-37.8***
ST	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 cm	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 CS	0.04	0.10	0.06	37.6***
Observations	66,318	26,462		

Weighted by NFHS sampling weights. *** significance level at 0.001

Table 2 shows characteristics of births in public and private facilities separately. 44% of births in private sector are through C-section while corresponding fraction is 14% in public sector. The difference of 30 percentage points is large and statistically significant. The table clearly shows that background characteristics of births in public sector are different than 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.

Fixed Effect estimation results

Table 3 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 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 to 19.4 percentage points. In other words, variations across states and over time don't 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 FE and PSU FE instead of state FE, and results remain unchanged (see Appendix Table A3).

As far as other variables are concerned, 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 C-section. Problems during pregnancy, even if statistically significant, have relatively less impact on probability of C-section. The variable indicating complications during delivery is not even statistically significant. Estimated coefficients on all explanatory variables are shown in Table A1 in Appendix, while Table A2 shows 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 4 shows results from household FE, i.e. specification (2). The estimated coefficient, at 20.3 percentage points, is not very different from what we obtained through baseline specification.

Table 3: Delivery in a private medical facility and probability of C-section (State FE)

	1	2	3	4	5
Delivery in private institution	0.287***	0.224***	0.183***	0.194***	0.194***
	(0.022)	(0.021)	(0.017)	(0.015)	(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

Table 4: Delivery in a private medical facility and probability of C-section (Household FE)

	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

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.

Table 5: Coarsened Exact Matching (CEM): 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

Table 6: 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 CS	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

Tables 5 and 6 show the outcome of matching procedure. The original sample contains 66,318 untreated (i.e. births in public facilities) and 26,462 treated (i.e. births in private facilities) observations with an overall imbalance score (as measured by L1 statistic) of 0.629 (Table 5). 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 6). 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 7. We obtain an estimate of 18.6 percentage points which is marginally lower in magnitude than our earlier estimates.

To summarize, a woman who delivers in a private facility is 18.6-20.3 percentage points more likely to deliver through C-section.

Table 7: 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

Planned and Unplanned C-sections

Fourth round of NFHS added a question that was not asked in previous NFHS waves: *When was the decision made to have a C-section – before onset of labor or after onset of labor?* 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 sector.

Planned C-sections can be driven by medical reasons. For example, the American College of Obstetricians and Gynecologists (ACOG) recommends C-section before onset of labor 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 (ACOG, 2014 2018). Planned C-sections may also reflect demand for C-sections i.e. women who prefer C-sections due to say, fear of pain in natural births or preference for birth of the child on a specific day or time driven by cultural or religious belief 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 similar approach.

But dropping planned C-sections also implies loosing observations where the medical professional might have mis-led a woman to go for scheduled C-section when not justified due to say, financial incentives or convenience (Gans et al., 2007; Halla et al. 2016). In Indian context, private facilities that provide maternal care predominantly consist of small hospitals or nursing homes typically owned by a single doctor or a family. These are characterized by limited assistance from other doctors, difficulties in maintaining round the clock monitoring or obtaining second opinion, inadequate facilities, and lack of skilled man-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 sector.

Table 8 shows the results from state FE, household FE and CEM when we drop the planned C-sections. The results suggest that opting for private sector increases the probability of unplanned C-section by 13.5-14 percentage points.

Sub-sample analysis

Now we turn to sub-sample analysis and address some of the concerns with the estimates obtained above. Results from this analysis are shown in Table 9. Panel A presents results without excluding planned C-sections while panel B presents results after excluding planned C-sections.

Table 8: Delivery in a private medical facility and probability of C-section after excluding planned C-sections

	1	2	3
	State FE	Household FE	Matched Sample +State FE
Delivery in private institution	0.141***	0.139***	0.135***
	(0.012)	(0.018)	(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

What if private providers cater 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 analyzing two separate sub-samples. In the first case, we create a sub-sample of low-risk women, i.e. women who were between 20 to 24 years of age when they gave birth and who did not experience fetal 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 sub-sample. In the second case, we drop the deliveries in lower-level public facilities (dispensary, sub-centers, primary health centers, or community health centers 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 sub-samples are shown in columns 1 and 2 of Table 10. Though the magnitude of the estimate drops marginally, the effect of private sector on un-planned C-sections within these sub-samples is still considerably large, i.e. between 11.2 to 12.4 percentage points.

Is 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-section (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-section. Hence, to ensure that supply side constraints in the public sector are not driving our results, we estimate the model for two separate sub-samples where such constraints are less binding– a) births to women who reside in urban areas (Table 10 column 3), and b) 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 sub-samples.

First order births

Profile and pattern of risks in higher order pregnancies are likely to be governed by what happened during first pregnancy and child-birth. Hence, we also obtain estimates only for the first order births as indicated in column 3. Card et al. (2018), Johnson and Rehavi (2016) follow similar approach. We find that the estimates are even higher for primary births (column 4).

Table 9: Delivery in a private medical facility and probability of C-section: sub-sample analysis

Panel A: Without excluding planned C-sections

	(1)	(2)	(3)	(4)
	Low risk pregnancies	Include only those public sector births which were in govt/municipal hospital#	Urban	First Order Births
Delivery in private institution	0.179***	0.154***	0.166***	0.230***
	(0.0165)	(0.0136)	(0.0150)	(0.0158)
N	16503	35093	13670	34124
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

	(1)	(2)	(3)	(4)
	Low risk pregnancies	Include only those public sector births which were in govt/municipal hospital#	Urban	First Order Births
Delivery in private institution	0.124***	0.112***	0.116***	0.175***
	(0.0122)	(0.0112)	(0.0115)	(0.0133)
N	15502	30574	11659	30078
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 center/community health center/rural hospital/block primary health center/urban health center/urban health post/urban family welfare centre/govt dispensary

5. Discussion

The objective of this study was to investigate the role of private sector providers on the probability of C-section births in India. The paper uses household fixed effects and coarsened exact matching techniques to account for the selection of women into private facilities, and finds that probability of C-section is 18.6-20 percentage points higher in private facilities. Further, the paper distinguishes between planned and un-planned C-sections to ensure that demand for C-sections or pregnancies characterized by certain medical risks do not bias the estimates. After excluding planned C-sections, the paper finds that the likelihood of an un-planned 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 7 million births (of the 26 million 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 0.9 million 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 probability of C-section in private medical facilities remains significantly higher than public sector after controlling for various background characteristics, risk factors and demand factors. What could explain higher C-sections in private sector when characteristics of pregnancies are not very different? Medical provider's concern about malpractice liability or fear of legal consequences is unlikely to be an important factor in Indian context (Pai, 2000; Fuglenes et al., 2009; Litorp et al., 2015). The supplier-induced demand driven by financial incentives especially when patient has limited information is probably an important explanation. As per NFHS IV, a natural birth in private facility costs on an average Rs. 10,814, while a C-section costs Rs. 23,978, more than twice the cost of a natural birth. In addition to economic incentives, convenience can be another important factor as the duration of labor 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 Indian context, perform un-planned C-sections in the absence of medical indications to avoid attending to lengthy labor at night. Prior studies in different contexts have presented evidence on 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's the way forward? Before we discuss how to deal with rising (medically unjustified) C-sections, it might be pertinent to point out paucity of relevant data in India. There has been a gap of almost a decade between two rounds of 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, absence of facility-level data in the public domain on type of delivery and background characteristics of the patients prevents robust analysis of facility-level determinants of type of delivery. Thus, need to augment data from multiple sources can't be overemphasized.

Coming back to the ways to counter rising C-section rates in private sector, one strategy advocated is to reduce the difference in fees between vaginal and cesarean deliveries. However, if the time costs of waiting for labor 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 cesarean surgery can be taken. As of now, no such guideline exists 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. 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. 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 private sector and help bringing down C-sections that are not needed (Banerjee et al., 2004; Besley and Malcomson, 2018). Thus, a lot more thought, context-specific understanding of reasons for increase in C-sections, 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 GDP in India in 2015-16) and the private sector plays an important and ever-expanding role in health-care provision (NSS, 2016; GoI, 2016).

References

American College of Obstetricians and Gynecologists, 2014. Safe prevention of the primary cesarean delivery. Obstetric Care Consensus 1, American College of Obstetricians and Gynecologists, Obstet Gynecol, 123:693–711. Available at https://www.acog.org/Clinical-Guidance-and-Publications/Obstetric-Care-Consensus-Series/Safe-Prevention-of-the-Primary-Cesarean-Delivery

American College of Obstetricians and Gynecologists, 2018. Frequently asked questions – Cesarean birth. Available at https://www.acog.org/Patients/FAQs/Cesarean-Birth-C-Section#what

Arrieta, A., 2011. Health reform and cesarean sections in the private sector: the experience of Peru. Health Policy 99(2),124-130.

Arrieta, A. and García Prado, A., 2016. Non-elective C-sections in public hospitals: capacity constraints and doctor incentives. Applied Economics 48(49), 4719-4731.

Banerjee, A., Deaton, A., Duflo, E., 2004. Wealth, Health, and Health Services in Rural Rajasthan. American Economic Review 94, 326–330. https://doi.org/10.1257/0002828041301902

Barber, E.L., Lundsberg, L., Belanger, K., Pettker, C.M., Funai, E.F., Illuzzi, J.L., 2011. Contributing Indications to the Rising Cesarean Delivery Rate. Obstetrics and Gynecology 118, 29–38. https://doi.org/10.1097/AOG.0b013e31821e5f65

Besley, T., Malcomson, J.M., 2018. Competition in public service provision: The role of not-for-profit providers. Journal of Public Economics 162, 158–172. https://doi.org/10.1016/j.jpubeco.2018.04.004

Betrán, A.P., Ye, J., Moller, A.-B., Zhang, J., Gülmezoglu, A.M., Torloni, M.R., 2016. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990-2014. PLOS ONE 11, e0148343. https://doi.org/10.1371/journal.pone.0148343

Brown, H.S., 1996. Physician demand for leisure: implications for cesarean section rates. Journal of Health Economics 15, 233–242. https://doi.org/10.1016/0167-6296(95)00039-9

Card, D., Fenizia, A., Silver, D., 2018. The Health Effects of Cesarean Delivery for Low-Risk First Births. Working paper 24493, National Bureau of Economic Research, Cambridge, MA. Available at http://www.nber.org/papers/w24493.pdf

Chalkley, M. and Listl, S., 2018. First do no harm - the impact of financial incentives on dental X-rays. Journal of Health Economics 58, 1-9.

Clark, E.A.S., Silver, R.M., 2011. Long-term maternal morbidity associated with repeat cesarean delivery. American Journal of Obstetrics and Gynecology 205, S2–S10. https://doi.org/10.1016/j.ajog.2011.09.028

Costa-Ramón, A.M., Rodríguez-González, A., Serra-Burriel, M., Campillo-Artero, C., 2018. It's about time: Cesarean sections and neonatal health. Journal of Health Economics 59, 46–59. https://doi.org/10.1016/j.jhealeco.2018.03.004

Das, J., Hammer, J., 2007. Money for nothing: The dire straits of medical practice in Delhi, India. Journal of Development Economics 83, 1-36.

Das, J., Hammer, J., Leonard, K., 2008. The quality of medical advice in low-income countries. Journal of Economic Perspectives 22 (2), 93-114.

Fraser, W., Usher, R.H., McLean, F.H., Bossenberry, C., Thomson, M.E., Kramer, M.S., Smith, L.P., Power, H., 1987. Temporal variation in rates of cesarean section for dystocia: Does "convenience" play a role? American Journal of Obstetrics & Gynecology 156, 300–304. https://doi.org/10.5555/uri:pii:0002937887902729

Fuglenes, D., Øian, P., Kristiansen, I.S., 2009. Obstetricians' choice of cesarean delivery in ambiguous cases: is it influenced by risk attitude or fear of complaints and litigation? American Journal of Obstetrics and Gynecology 200, 48.e1-48.e8. https://doi.org/10.1016/j.ajog.2008.07.021

Gans, J.S., Leigh, A., 2009. Born on the first of July: An (un)natural experiment in birth timing. Journal of Public Economics 93, 246–263. https://doi.org/10.1016/j.jpubeco.2008.07.004

Gans, J.S., Leigh, A., Varganova, E., 2007. Minding the shop: The case of obstetrics conferences. Social Science & Medicine 65, 1458–1465. https://doi.org/10.1016/j.socscimed.2007.05.034

Gill, Kaveri, 2009. A primary evaluation of service delivery under the National Rural Health Mission: findings from a study in Andhra Pradesh, Uttar Pradesh, Bihar and Rajasthan. Working Paper 1/2009, Planning Commission of India, New Delhi.

GoI, 2011. High level expert group report on Universal Health Coverage for India. Planning Commission of India, Government of India, New Delhi.

GoI, 2015. Rural Health Statistics 2014-15. Ministry of Health and Family Welfare, Government of India. Available at http://wcd.nic.in/sites/default/files/RHS_1.pdf

GoI, 2016. Public Health Expenditure in India. Press Information Bureau, Ministry of Health and Family Welfare, Government of India. Available at http://pib.nic.in/newsite/PrintRelease.aspx?relid=153797

GoI, (2017). National Health Policy, 2017. Ministry of Health and Family Welfare, Government of India, New Delhi. Available at https://mohfw.gov.in/sites/default/files/9147562941489753121.pdf

Gregory, K., Jackson, S., Korst, L., Friedman, M., 2012. Cesarean versus Vaginal Delivery: Whose Risks? Whose Benefits? American Journal of Perinatology 29, 07–18. https://doi.org/10.1055/s-0031-1285829

Halla, M., Mayr, H., Pruckner, G., Garcia-Gomez, P., 2016. Cutting Fertility? The Effect of Cesarean Deliveries on Subsequent Fertility and Maternal Labour Supply. Discussion Paper No. 9905, IZA, Bonn, Germany. Available at http://ftp.iza.org/dp9905.pdf

Health in India: NSS 71st Round (January-June 2014). Report No. 574 (71/25.0)), 2016. National Sample Survey Office, Ministry of Statistics and Programme Implementation, Government of India. Available at http://mospi.nic.in/sites/default/files/publication_reports/nss_rep574.pdf

Hyde Matthew J., Mostyn Alison, Modi Neena, Kemp Paul R., 2011. The health implications of birth by Caesarean section. Biological Reviews 87, 229–243. https://doi.org/10.1111/j.1469-185X.2011.00195.x

Iacus, S.M., King, G., Porro, G., 2011. Multivariate Matching Methods That Are Monotonic Imbalance Bounding. Journal of the American Statistical Association 106, 345–361. https://doi.org/10.1198/jasa.2011.tm09599

Jachetta, C., 2015. Cesarean Sections and Later Child Health Outcomes. Job market paper. Available at http://www.christinejachetta.com/upload/jachetta_job_market_paper_2015.pdf

Jensen, V.M., Wüst, M., 2015. Can Caesarean section improve child and maternal health? The case of breech babies. Journal of Health Economics 39, 289–302.

https://doi.org/10.1016/j.jhealeco.2014.07.004

Johnson, E.M., Rehavi, M.M., 2016. Physicians Treating Physicians: Information and Incentives in Childbirth. American Economic Journal: Economic Policy 8, 115–41. https://doi.org/10.1257/pol.20140160

Joshi, S., Sivaram, A., 2014. Does it Pay to Deliver? An Evaluation of India's Safe Motherhood Program. World Development 64, 434–447. https://doi.org/10.1016/j.worlddev.2014.06.004

King, G, Nielsen, R., Coberley, C., Pope, J., Wells, A., 2011. Comparative effectiveness of matching methods for causal inference. Available at https://gking.harvard.edu/publications/comparative-Effectiveness-Matching-Methods-Causal-Inference

King, G., Nielsen, R., 2016. Why Propensity Scores should not be used for Matching. Available at https://gking.harvard.edu/files/gking/files/psnot.pdf

Kozhimannil, K.B., Arcaya, M.C., Subramanian, S.V., 2014. Maternal Clinical Diagnoses and Hospital Variation in the Risk of Cesarean Delivery: Analyses of a National US Hospital Discharge Database. PLOS Medicine 11, e1001745. https://doi.org/10.1371/journal.pmed.1001745

Leone, T., 2014. Demand and supply factors affecting the rising over-medicalization of birth in India. International Journal of Gynecology & Obstetrics 127, 157–162. https://doi.org/10.1016/j.ijgo.2014.05.018

Litorp, H., Mgaya, A., Mbekenga, C.K., Kidanto, H.L., Johnsdotter, S., Essén, B., 2015. Fear, blame and transparency: Obstetric caregivers' rationales for high caesarean section rates in a low-resource setting. Social Science & Medicine 143, 232–240. https://doi.org/10.1016/j.socscimed.2015.09.003

Lo, J.C., 2003. Patients' attitudes vs. physicians' determination: implications for cesarean sections. Social Science & Medicine 57, 91–96. https://doi.org/10.1016/S0277-9536(02)00301-5

Lobel, M., DeLuca, R.S., 2007. Psychosocial sequelae of cesarean delivery: Review and analysis of their causes and implications. Social Science & Medicine 64, 2272–2284. https://doi.org/10.1016/j.socscimed.2007.02.028

Mishra, U., Ramanathan, M., 2002. Delivery-related complications and determinants of caesarean section rates in India. Health Policy and Planning 17, 90–98. https://doi.org/10.1093/heapol/17.1.90

National Family Health Survey (NFHS-4), 2015-16, 2017. International Institute for Population Sciences (IIPS) and ICF.

Neuman, M., Alcock, G., Azad, K., Kuddus, A., Osrin, D., More, N.S., Nair, N., Tripathy, P., Sikorski, C., Saville, N., Sen, A., Colbourn, T., Houweling, T.A.J., Seward, N., Manandhar, D.S., Shrestha, B.P., Costello, A., Prost, A., 2014. Prevalence and determinants of caesarean section in private and public health facilities in underserved South Asian communities: cross-sectional analysis of data from Bangladesh, India and Nepal. BMJ Open 4. https://doi.org/10.1136/bmjopen-2014-005982

Padmadas, S.S., Kumar S., S., Nair, S.B., Kumari K.R., A., 2000. Caesarean section delivery in Kerala, India: evidence from a National Family Health Survey. Social Science & Medicine 51, 511–521. https://doi.org/10.1016/S0277-9536 (99)00491-8

Pai, M., 2000. Unnecessary Medical Interventions: Caesarean Sections as a Case Study. Economic & Political Weekly 35, 2755–2761.

Papanicolas, I. and McGuire, A., 2015. Do financial incentives trump clinical guidance? Hip Replacement in England and Scotland. Journal of Health Economics 44, 25-36.

Schulkind, L., Shapiro, T.M., 2014. What a difference a day makes: Quantifying the effects of birth timing manipulation on infant health. Journal of Health Economics 33, 139–158. https://doi.org/10.1016/j.jhealeco.2013.11.003

Vora, K.S., Mavalankar, D.V., Ramani, K., Upadhyaya, M., Sharma, B., Iyengar, S., Gupta, V., Iyengar, K., 2009. Maternal Health Situation in India: A Case Study. Journal of Health, Population, and Nutrition 27, 184–201.

Walker Ruth, Turnbull Deborah, Wilkinson Chris, 2002. Strategies to Address Global Cesarean Section Rates: A Review of the Evidence. Birth 29, 28–39. https://doi.org/10.1046/j.1523-536X.2002.00153.x

Wang, E., 2017. Requests for cesarean deliveries: The politics of labor pain and pain relief in Shanghai, China. Social Science & Medicine 173, 1–8. https://doi.org/10.1016/j.socscimed.2016.11.032

World Health Organization, 2015. WHO Statement on Caesarean Section Rates. World Health Organization, Geneva, Switzerland. Available at http://apps.who.int/iris/bitstream/10665/161442/1/WHO_RHR_15.02_eng.pdf?ua=1

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 - OBC	-0.023***	(0.004)
Social Group - SC	-0.014*	(0.006)
Social Group - ST	-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

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***	3.681***	3.504***	4.037***	4.047***
	(0.726)	(0.465)	(0.378)	(0.407)	(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

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***	0.144***	0.199***	0.147***
	(0.014)	(0.012)	(0.015)	(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