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Physician induced demand for C-sections: does the convenience incentive matter?*

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Abstract

This paper investigates whether physicians induce demand for C-sections in the days preceding leisure periods. I reject that doctors are meaningfully increasing the number of primary cesareans to accommodate their own preferences for control of deliveries around holiday Mondays. Using a sample of more than 1,300,000 deliveries, I can estimate that the induced demand due to convenience is close to zero. A small significant effect is found for women having had a previous C-section. While I replicate previous results of lower C-section rates on leisure periods, I show that they are due to the way doctors schedule planned cesareans rather than to an induced demand for reason of physicians' convenience. If induced demand occurs, the decision takes place in the labor room and is not planned in advance.

Keywords: C-section, convenience incentive, physician induced demand
JEL codes: I10, I12

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1 Introduction

The C-section rate in the United States has risen by more than 50 percent between 1996 and 2009, reaching 32.3 percent of all births in 2009 (Martin et al. (2011)). Improvement of medical techniques unquestionably explains part of this increase. But controversies regarding physicians' economic incentives also appear. Physicians are able to influence the choice of delivery mode, because they have better information than the patients. Physician induced demand theory predicts that they can shift the decision toward the one they prefer.

Four main incentives have been advanced. First, physicians may respond to the financial incentive provided by the higher fee for a C-section. Second, vaginal deliveries last for longer than C-sections, implying a higher time cost for doctors. Third, physicians may practice C-sections as a defensive response to the fear of malpractice. Fourth, by practicing C-sections, doctors have a greater opportunity to influence the timing of deliveries for reason of convenience. The present paper focuses on this last incentive. It investigates whether physicians tend to induce demand for C-sections in order to advance the moment of delivery for their own convenience.

Previous studies (Burns et al. (1995); Brown (1996); Gomes et al. (1999); Mossialos et al. (2005b); Gans and Leigh (2012); etc.) have shown that C-sections are more performed during non-leisure periods, especially during weekdays and during office hours, controlling for the relevant medical risk factors. However, it is unclear if it is an evidence of induced demand. Indeed, two main reasons explain why C-sections rate may be higher in non-leisure than in leisure periods. On the one hand, when scheduling a clinically justified C-section, physicians can choose the most suitable moment for practicing such a surgery. It is likely to be on a weekday during office hours when the largest capacity of hospital staff is available. It is also likely that physician themselves have some preference for working at these periods rather than on leisure periods. This behavior, however, does not induce demand for C-sections. It is simply a 'scheduling' effect. On the other hand, we have the induced demand for reason of convenience: the action of performing a C-section that is not fully medically justified in order to advance the date of delivery. The fact that C-sections are less likely on leisure than on non-leisure periods is necessary but not sufficient to assert that physicians induce demand for a convenience motive.

Identifying the induced demand without contamination of the scheduling effect can be challenging. The strategy I adopt is to test if the probability of C-section increases in a given period of time around (and including) a leisure period. If only the scheduling effect plays a role, the likelihood of C-section should not be affected, the C-sections not performed in the leisure period being simply displaced at the non-leisure one. However, if the rate of C-sections was higher during this entire period than during any other non-leisure period, this would indicate that doctors do induce more demand for C-section when a leisure period is approaching.

In this study, I test for the increase of the probability of C-section in a period including a holiday Monday, such as Memorial Day or Labor Day. In the US, states decide most public holidays. For instance only Maine and Massachusetts observe Patriots' Day. I take advantage of this variability across states to identify the effect that is due to the observance of the holiday and not to the particular date of the year.

While I can easily replicate previous results of lower C-section rates on leisure periods, I reject that doctors are substantially increasing the number of C-sections they practice before the leisure period in order to shift the day of delivery. Using a sample of more than 1,300,000 deliveries, I estimate that the induced demand due to convenience is close to zero and is unlikely to be of interest for public policies. Indeed, controlling for relevant medical factors, the probability of having a C-section during the period including a holiday Monday is, if anything, increased by less than 0.5 points of percentage.

2 Choice of the mode of delivery

Several clinical and non-clinical factors may influence the choice of C-section as a method of delivery. While the mother's preference certainly plays a role (Lo (2003)), survey evidence suggests that maternal requests for C-sections are rare in the US (Declercq et al. (2007)). Roth and Henley (2012) argue that when women have the ability to choose, they prefer avoiding C-section. Rather, it is generally assumed that the physician makes the decision, because he is supposed to have more information.

When the C-section is clearly indicated, it can be scheduled before the beginning of labor. Clinical situations in which a scheduled C-section may be recommended include fetus malposition, placenta previa, triplets and higher order multiples, prior C-section, etc. When the C-section is scheduled and performed without a trial of labor, the mother's recovery is easier and the uterine scar due to the C-section is expected to be less important.

If no C-section is scheduled, then an attempt of vaginal delivery begins with the natural onset of labor or with a medical induction of labor. In most cases, the labor attempt results in a vaginal delivery. However, the physician can recommend a C-section during labor. These surgeries are known as unscheduled C-sections. For instance, they are indicated when the fetus does not tolerate labor well, when the labor is too long, when the fetus is tangled by the umbilical cord, etc.

While a C-section is incontestably indicated in some clinical situations, in most cases the physician has to assess the potential benefits against the risks associated with the procedure. Those include a longer recovery time for the mother, possible surgical complications, a higher mortality rate at delivery, accidental fetal lacerations and potential transient respiratory disorder for the newborn.

The medical risks of a C-section should be weighed against the medical risks of labor and vaginal delivery, given the clinical situation of the mother and the infant. However, non-medical factors have also been advanced to explain the physician's choice of delivery mode. Firstly, the higher physician's fee for a C-section with respect to vaginal delivery may incite doctors to practice more C-sections (Gruber et al. (1999); Mossialos et al. (2005a); Lo (2008); Grant (2009); Hong and Linn (2012); etc.). Secondly, vaginal deliveries typically last for a longer time than C-sections, implying a higher time cost for the physician. Thirdly, physicians' defensive response to the fear of malpractice may incite them to perform more C-sections (Localio et al. (1993); Baldwin et al. (1995); Sloan et al. (1997); Dubay et al. (1999); Brown (2007); Shurtz (2013); etc.). Fourthly, the physician can influence the timing of deliveries by practicing C-sections. In particular, the physician may use C-section to advance the timing of birth, shifting deliveries off periods that are related to his leisure. The present paper focuses on this last hypothesis.

3 Literature

Brown (1996) uses data on a sample of births in US military hospitals to test the impact of time-dependent variables related to leisure on the rate of C-sections. Military doctors have no financial incentive to perform a C-section rather than a vaginal delivery and are supposed to be less subject to lawsuits than other physicians. Hence the only non-medical incentive for C-section is the convenience. Brown (1996) shows that C-sections are less likely on weekends than on weekdays. He also finds a higher probability of C-section at the end of the day (from 6 PM to midnight). Using birth certificates and hospital data in California, Spetz et al. (2001) also show an increase in C-section probabilities between 4 PM and midnight, except for Kaiser HMO hospitals. In Greece, Mossialos et al. (2005a) and Mossialos et al. (2005b) find that C-sections are more likely to occur between 8 AM and 4 PM and less likely to occur on Sundays. In Brazil, Gomes et al. (1999) show that the likelihood of C-section is higher between 7 PM and midnight and lower on Sundays. Similar results are reported by Burns et al. (1995) in

Arizona, Fang (2008) in China and Hanvoravongchai et al. (2000) in Thailand.

While the exact timing differs across studies, the consistent result is that C-sections are more likely on daylight hours and on weekdays than during nights and weekends. Nevertheless, these results do not provide sufficient evidence for the presence of an induced demand motivated by physicians' convenience. Indeed, these results could be attributed to a scheduling effect, as clinically justified planned C-sections are more likely to be scheduled on weekdays during office hours or after doctors' appointment hours.

To exclude the scheduling effect, most of the studies related to the convenience incentive place an emphasis on unplanned C-sections. The decision regarding unplanned C-section, by definition, is made in the labor room, not in advance. Hence, controlling for medical factors, an increased rate of C-sections at some periods can be fully attributed to the induced demand for reason of convenience. Planned C-sections, however, are scheduled in advance such that both induced demand and scheduling effect can play a role.

Brown (1996) finds that the probability of unplanned C-section (opposed to any other mode of delivery including planned C-section) is still higher from 6 PM to midnight but the effect is less significant. Interestingly, he finds a strong positive effect of the period 4-6 PM that did not appear for C-sections in general. Spetz et al. (2001) define the unscheduled C-sections as the ones indicated because of fetal distress or prolonged/dysfunctional labor. They find that theses types of C-sections are more likely to occur in the evening. Burns et al. (1995) are not able to distinguish scheduled and unscheduled C-sections, but state that the probability of C-section is higher between 6 AM and 6 PM and during weekdays regardless the admission being in emergency room or not.

Still, by focusing only on unplanned C-sections, one may fail to identify the induced demand that is planned in advance by the physician. Even if previous studies seem to assess that such a behavior exists, little has been done to study the induced demand that aims to shift the date of birth by several days. Nevertheless, by mentioning that C-sections are less likely on leisure days, lots of studies implicitly make reference to this effect.

While Gans et al. (2007) are not able to distinguish the delivery modes, they find that the number of births drops by 2 to 4 percent during the days on which the annual obstetricians and gynecologists' conferences are held in both Australia and the US. Since the date of natural vaginal delivery cannot easily be shifted, most of this result must come from medical inductions of labor and from C-sections. However, whether these procedures are simply advanced (scheduling effect) or are induced due to the conference (for physicians' convenience) is not investigated. With the aim of evaluating parents vs doctors' bargaining power, Gans and Leigh

(2012) show that fewer children are born on the February 29 and April 1, but this effect is considerably reduced when theses dates abut a weekend. Again, this tells us nothing about the potential induced demand for C-section before weekend, as the effect can come from a shift in the scheduling of medically justified C-sections.

Even if no reliable evidence has been provided, the idea seems commonly admitted that physicians induce demand for C-sections in the days preceding leisure periods (see for instance Margulis (2013)). Several civil society organizations have take position against this behavior. For instance, the president of Lamaze International said *"Few doctors want to be pacing the halls on Thanksgiving or Christmas, waiting for a mother to deliver. So it's not uncommon to see a surge of women with normal pregnancies being told that there might be an issue and that they should consider scheduling the delivery, coincidentally, right before a holiday"*.[1] These considerations are not limited to C-sections but also apply to medical induction of labor. Unfortunately, labor induction cannot be distinguished in the data.[2] Nevertheless, as the likelihood of C-section is increased after an induction of labor, one can be confident that the analysis presented here partially accounts for the effect on medical inductions.

4 Data

To analyze delivery modes, I use the Thomson Reuters MarketScan® Commercial Claims and Encounters database for years 2008 to 2011. This annual claims database includes private sector health information submitted for reimbursement to approximately 100 payers (employers and health insurances). It consists of electronic records of the transactions that occur between patients and health care providers and the information that typically appear on bills. The database contains inpatient and outpatient claims of almost 40 million employees and their dependents covered under a variety of health plans.

I restrict the analysis to deliveries of live births. To select women with such a delivery in the MarketScan® database, I identify the records corresponding to vaginal and cesarean deliveries, from which I exclude the ones corresponding to stillborns.[3] For simplicity, I exclude patients

[1] Lamaze's Giving Birth with Confidence blog, November 17, 2010,
http://givingbirthwithconfidence.org/2010/11/is-your-baby-due-on-a-holiday-dont-be-pressured-into-an-early-delivery.

[2] While procedure codes for induction exist, they are not reimbursed separately from the delivery and hence are under-recorded.

[3] The CPT-4 codes used to identify deliveries are respectively 59400, 59409, 59410, 59610, 59612 and 59614

having more than one delivery in the considered period. This selection, summarized in table A-1 in Appendix, provides a sample of 1,373,255 patients. After excluding inconsistent observations i.e patients having records for both cesarean and vaginal deliveries (2963 observations) and patients recorded as males (379 observations), this leaves a sample size of 1,369,914 women. As pregnancies at very young and old ages are expected to provide outliers results, I have restricted the sample to patients aged 15 to 45 years old. This excludes 3395 women. Since most public holidays are observed at the state level, knowing the patient's state of residence is crucial for the analysis. Therefore, I exclude the 23,882 observations (less than 2% of the sample) for which this information is missing. The final sample has 1,342,637 observations.

Summary statistics are reported in table 1. Among all the births in the sample, 494,821 were cesareans while 847,816 were vaginal deliveries. The proportion of C-sections (36.85%) is slightly above the national level. Indeed, the US Department of Health and and Human Services reported a rate of 32.9% in 2009 (Martin et al. (2011)). The MarketScan® database only concerns patients covered by private insurance and these patients are on average older and have more generous insurance than the national average, which may reasonably explain this difference.

Table 1 displays summary statistics. The average age at delivery is 30.6 years old, also slightly above the national average of 27.5. This reflects the fact that MarketScan® data do not include women who are covered by public insurance or are uninsured, and are likely to give birth at a younger age. Women who deliver per cesarean are on average 1.5 years older than the ones who deliver vaginally. In the database, more deliveries have occurred in 2011 than in the previous years, reflecting the growth of the MarketScan® database. C-section rate is quite stable amongst the four years of the data. As expected, a lower percentage of deliveries occur on Saturdays and Sundays.

[Table 1 about here.]

I identify forty-two categories of clinical factors that are likely to affect the decision of practicing a cesarean rather than a vaginal delivery. These risk factors are selected in the MarketScan® database using the corresponding ICD-9 codes, as summarized in table A-2 in Appendix. I restrict the selection to the diagnosis codes appearing in the 9 months before the

(vaginal) and 59510, 59514, 59515, 59525, 59618, 59620 and 59622 (cesareans). I ensure that live births do not include stillborns by excluding records with any of the following ICD-9 codes: 630-632, 63300-63792, 6391-6399 and 6564.

delivery date or in the 6 weeks after. Summary statistics for these clinical factors are also given in table A-2 in Appendix.

In a attempt to separate C-sections into scheduled and unscheduled, I use the codes identified by Gregory et al. (2002) and define a subsample of women with medical indication for planned primary C-sections. This subsample has 480,143 observations. Using the algorithm proposed by Henry et al. (1995), I select the patients who had a vaginal delivery or a diagnosis related to problems occurring. These 1,022,607 women are categorized as having labored. If such a women has had a C-section, it must be unscheduled. Finally, as a delivery after a previous C-section is likely to be different from another delivery (93% of women who have had a previous cesarean give birth by C-section), I also build a separate subsample for these patients.

5 Empirical Strategy

If physicians want to shift deliveries off leisure periods, other things being equal, they should be more likely to perform a C-section during the period preceding the leisure one than at any other period. Hence we expect a higher probability of C-section on weekdays than on weekends. In the same way, we expect a lower rate of C-sections during public holidays.

The major identification challenge is that the lower probability of C-section during leisure periods may be due to two effects. On the the one hand, physicians may want to schedule C-sections before the weekends and holidays in order to decrease the number of deliveries they will have to perform during the weekends and holidays. This behavior induces demand for C-sections. On the other hand, provided that a C-section is medically required, the physician is more likely to schedule it on a non-holiday weekday. As in any other firm, less workers are present in the hospital during weekends and only emergency surgeries are performed on these days. To test for the induced demand hypothesis, one needs to estimate the first effect without contamination by the second.

Most of the public holidays in the US are observed on a Monday. These Mondays have two interesting characteristics. First, by definition, they occur just after a weekend. The 3-day periods they form with the preceding Saturday and Sunday (hereafter called 'long week-ends') are related to leisure. Indeed, long weekends are often chosen by families for city trips, skiing weekends, etc., as schools also observe the public holiday. Second, some of these holidays are federal while others are only observed in some states. This brings a useful variation across states in the analysis. Indeed, due to potential seasonality effects, days of the year are not directly comparable to each others. However, in this study, I am able to compare a given day in a state where a holiday is observed to the same day in a state where the holiday is not observed. I identify eight Mondays that have been considered as public holidays in at least one state in 2008. There were also eight such Mondays in 2009, nine in 2010 and ten in 2011 (see table A-3 in Appendix).

As C-sections can be scheduled while spontaneous vaginal births cannot, we expect C-sections rate to decrease on these long weekends and to increase on the previous and following days, as a compensation. If there is no induced demand for reason of convenience, the probability of having a C-section over a given period around the holiday Monday should not be affected. Indeed, the C-sections that are not performed on the long weekend should simply be displaced to another day in this period. However, if the probability of having a C-section in this period increases, then it is an indication of the convenience effect. On the days preceding the long week-end, not only the physician performs the C-sections that would have been scheduled on the Monday, but also performs additional C-sections in order to decrease the number of deliveries (both vaginal an cesarean) he will have to perform on the Monday.

Table 2 summarizes the identification strategy. Due to the scheduling effect, C-sections are displaced from the holiday Monday to other days. The decrease of the probability of C-section on the holiday Monday should be compensated by the increase of this probability on other days. The effect on the entire considered period should hence be zero. If we observe positive impact, it must indicate induced demand.

[Table 2 about here.]

To formally test for the presence of an induced demand before the long weekend, I estimate the following logit model:

$$Prob(cesa_{id}) = \Lambda(\alpha + \beta X_i + \delta M_i + \lambda D_d + \gamma T_{id}) \tag{1}$$

where $cesa_{id}$ is a dummy variable equal to 1 if the woman i who has given birth at date d has delivered by C-section and equal to zero if her delivery has been vaginal, X_i are woman i's demographic characteristics, M_i are her medical factors, D_d are the characteristics of the date of delivery such as day of the week, month, year, etc. and T_{id} is a dummy variable taking the value 1 if the delivery has occurred in a given period of time around a holiday Monday in a state where this holiday is observed. As the holiday Mondays differ by state, two deliveries occurring the same day but in different states can have different values for T_{id}. α, β, δ, λ and γ are vectors of parameters to be estimated and $\Lambda(.)$ denotes the logistic cumulative distribution function. A positive γ would indicate the presence of an induced demand motivated by physicians' convenience. Standard errors are two-way cluster-robust (at the month and state level) following the procedure suggested by Petersen (2009), Cameron et al. (2011) and Thompson (2011).

I consider various specifications for T_{id}. In a first specification, the considered period is staring 7 days before the holiday Monday and ending 7 days after. I also consider a period of 10 days, 4 days and 1 day before and after the holiday Monday. Summary statistics for the different specifications of this variable are given in table 3. 31% (resp. 23%, 10%, 4%) of the deliveries in the sample occurred within a period of 21 (resp. 15, 7, 3) days centered on a holiday Monday. With these specifications, I focus on the holiday Monday as leisure period. I also check that the results are not affected if I consider the long weekend as the leisure period. Hence I also consider periods starting 10 (resp. 7, 4) days before the holiday Monday and ending 7 (resp. 4, 1) days after the holiday Monday.

[Table 3 about here.]

6 Results

Table 4 provides evidence that the probability of C-section is reduced on holiday Mondays. The *Holiday Monday* variable is a dummy taking the value one if the delivery occurs on an holiday Monday in a state where it is observed. When considering the full sample of deliveries, the coefficient associated with this variable is negative and significant. As one may expect, the rate of C-sections is reduced when a public holiday is observed. As doctors anticipate these holidays, they schedule the (medically justified) C-sections on other days of the week.

The average marginal effect for the holiday Monday variable is reported at the bottom of Table 4. Controlling for relevant medical factors, the holiday Monday decreases the probability of C-section by 1.3 points of percentage. Given the baseline C-section rate of 36.85% it corresponds to a 3.5% decrease of the probability of C-section. This is comparable to the effect found in other studies. For instance, Gans et al. (2007) found that the number of births decreases by 2 to 4 % during the obstetricians and gynecologists' conference.

[Table 4 about here.]

The effect is similar when the sample is restricted to women with medical indications for planned primary C-section (column (3)) and even stronger for women having had a previous C-section (column (4)). This provides comforting evidence of a scheduling effect, as assessed by the previous literature. In the same way, it may be showed (results are not reported here) that the probability of C-section is lower on Sundays compared to any other day of the week. Saturdays present a lower rate of C-sections than the weekdays, but a higher rate than the Sundays. The weekend has a negative impact on the probability of C-section, compared to weekdays. Finally, the likelihood of C-section is lowered during long weekends compared to other comparable periods.

The signs of the estimated coefficients related to control variables are as expected. Age has a quadratic effect on the likelihood of C-section: for young women, the risk of C-section decreases with age, then it increases for older women. Healthy women (for whom none of the considered medical factor has be recorded) are considerably less likely to give birth by C-section. The medical risk factors I consider explain an important part of the variance.[4]

In column (2), I get rid of the scheduling effect by focusing only on women categorized as having labored. By definition, if a C-section occurs after a trial of labor, it is unscheduled. For these women, the probability of C-section is not affected by the holiday Monday. This is a first indication that the impact of the holiday Monday is due to a scheduling effect and is not induced demand.

To further analyze whether there is an induced demand for C-sections due to convenience, I estimate the logit models described in equation (1), using the specifications for T_{id} described in Table 3. Marginal effects are displayed in table 5. In the full sample, the marginal effect of $T(7)$ is small (while significantly positive), which indicate the absence of substantial induced demand for physicians' convenience. Using the upper bound of a 95% confidence interval, one can believe that the induced demand due to convenience increases the probability of C-section by less than 0.5 point of percentage. Using other specification for T_{id} reinforce this assertion.

[Table 5 about here.]

Primary scheduled C-sections (column (3)) do not suffer from the convenience effect neither. While doctors try to schedule these surgeries outside the holiday period, they do not seem to increase the number of such procedures for convenience purpose.

Patients having had a previous C-section (column (4)) however, seem to be affected by the induced demand due to convenience. While the effect is still small, the probability of C-section for these women is significantly increased in the period around and including the holiday Monday. One reason can be that doctors can easily justify performing a C-section for

[4] In the full sample case, the pseudo R^2 measure increases by more than 0.5 when these factors are included.

such a women, arguing that eligibility criteria for vaginal birth after C-section (VBAC) are not met.

Column (2) also provides meaningful results. It shows an induced demand for C-section for women having labored. This indicates that physicians tend to end the labor earlier when a holiday is approaching. The decision to induce demand for a convenience motive hence takes place in the labor room rather than being well planned in advance. Anyway, the induced demand effect is small: using the upper bound of a 95% confidence interval, the probability of C-section is increased by less than 0.25 point of percentage.

In the previous analysis, the state variable is defined as the state of residence of the insurance beneficiary in the MarketScan® database. One may wonder if this is a good proxy for the physician's state of residence, on which no information is provided in the database. A better proxy could be the state of the hospital where the delivery takes place. Due to a large number of missing observations, using this definition for the state variable considerably decreases the size of the sample. Nevertheless, results are consistent to the ones obtained before.

Finally, one concern could be that the physician, trying to justify a C-section he is performing for convenience, would be more likely to report some diagnosis, such as fetus malpresentation or disproportion. If this was the case, it could explain the absence of significant results in the above models, where I control for these medical factors. To assess the robustness regarding this issue, I checked that the likelihood of having none of the considered medical risk is not affected by the period $T(7)$, neither when I restrict the analysis to C-section deliveries. Further evidence is provided by the fact that the coefficient associated with $T(7)$ is not significantly positive if medical factors are omitted.

7 Conclusions

This paper analyses the physician induced demand for C-sections. In particular, it explores the induced demand that could be motivated by the physicians' convenience incentive. In periods related to leisure, physicians would be willing to decrease the amount of deliveries they have to perform. For that, they would increase the number of C-sections they practice in the period preceding, in order to shift deliveries off the leisure periods.

While I can easily show that fewer C-sections are performed on leisure periods, I find little evidence of induced demand due to convenience. Indeed, this paper provides evidence that the higher probability of C-section in non-leisure periods is due to rescheduling the C-sections that cannot occur during the leisure periods. Having a preference for working on weekdays and outside holidays, the doctors are able to advance (as well as postpone) medically justified C-sections. However, they do not increase the number of C-sections they perform (i.e. perform non clinically justified C-sections) in order to advance the date of delivery. Using very large samples, I estimate that the induced demand due to convenience is close to zero.

I take advantage of the fact that most public holidays in the US are decided at the state level. Hence I can compare the probability of C-section on the same day in states where a holiday is observed with states where no holiday is observed. I show that the probability of C-section is lower on holiday Mondays than on a regular Mondays. Nevertheless, the probability of C-section in a given period of time around (and including) a holiday Monday is not substantially different from the probability in regular periods. This means that the C-sections that are not performed on the holiday Monday are simply advanced or postponed to other periods. But doctors do not induce more demand for C-section when a holiday Monday is approaching, or if they do, the magnitude of the effect is very small.

The induced demand effect is stronger for women having had a previous C-section. Vaginal birth after a previous C-section being still controversial, physicians can easily justify the choice of C-section in that case. The effect is also significant for women having had a trial of labor, indicating that if induced demand plays a role, the decision is made in the labor room rather than planned in advance.

This paper provides the first piece of evidence against the commonly admitted statement that physicians substantially induce demand for C-sections in the days preceding leisure periods. Even if the claim that the rate of C-sections is higher in period preceding leisure is verified, it is mainly due to the way doctors schedule the surgery and is not much caused by a physician induced demand for C-sections.

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Tables

Table 1: Descriptive statistics (1,342,637 observations)

	Mean	**(Std. Dev.)**	**% of C-sections**
Demographics:			
Age (Years)	30.56	(5.44)	
Type of insurance plan (%):			
HMO	13.89	(34.59)	36.32
POS	7.79	(26.93)	38.70
PPO	65.64	(47.49)	36.97
CDHP	3.36	(18.02)	36.56
HDHP	1.88	(13.59)	34.04
Others/Unknown	7.35	(26.10)	35.67
Year of delivery (%):			
2008	22.46	(41.73)	37.28
2009	22.46	(41.73)	37.60
2010	24.94	(43.27)	36.76
2011	30.14	(45.89)	36.06
Delivery (%):			
Cesarean	36.85	(48.24)	
Vaginal	63.15	(48.24)	
Day of delivery (%):			
Sunday	8.36	(27.68)	26.35
Monday	15.82	(36.49)	39.41
Tuesday	17.12	(37.67)	39.12
Wednesday	16.72	(37.31)	37.97
Thursday	16.64	(37.24)	38.20
Friday	15.96	(36.63)	40.29
Saturday	9.38	(29.16)	27.57
Medical factors (%):			
No risk factor[a]	20.05	(40.04)	2.71
Previous C-section	18.09	(38.49)	92.82
Has labored[b]	76.16	(42.61)	17.09
Indication for primary planned CS[c]	35.76	(47.93)	37.56

[a] Risk factors are listed in table A-2 in Appendix

[b] Patients with vaginal delivery and/or at least one of the following diagnosis: disproportion, obstructed labor, labor abnormalities, long labor, fetal distress, cord prolapse.

[c] Patients without previous C-section but presenting at least one of the following diagnosis: unengaged fetal head, malpresentation, antepartum hemorrhage, excessive fetal growth, hypertension, central nervous system malformation in fetus, multiple gestation, preterm gestation, herpes, uterine scar (unrelated to previous c-section), soft tissues disorders.

Table 2: Expected effect on the probability of C-section

	Induced demand	Scheduling effect
Before Holiday	+	+
During Holiday	0	−
After Holiday	0	+
Entire period	+	0

Table 3: Definitions of T

Variable	Definition	% of the sample	(s.d., %)
$T_{id}(10)$	$= 1$ if the delivery of patient i on date d is such		
	that $d \in [D-10; D+10]$ where D is a holiday Monday		
	and this holiday is observed in the patient i's state	31.02	(46.26)
	$= 0$ otherwise	68.98	
$T_{id}(7)$	$= 1$ if the delivery of patient i on date d is such		
	that $d \in [D-7; D+7]$ where D is a holiday Monday		
	and this holiday is observed in the patient i's state	22.77	(41.94)
	$= 0$ otherwise	77.23	
$T_{id}(3)$	$= 1$ if the delivery of patient i on date d is such		
	that $d \in [D-3; D+3]$ where D is a holiday Monday		
	and this holiday is observed in the patient i's state	10.37	(30.48)
	$= 0$ otherwise	89.63	
$T_{id}(1)$	$= 1$ if the delivery of patient i on date d is such		
	that $d \in [D-1; D+1]$ where D is a holiday Monday		
	and this holiday is observed in the patient i's state	3.91	(19.40)
	$= 0$ otherwise	96.09	

Number of observations: 1,342,637.

$T_{id}(10)$ (resp. $T_{id}(7)$ $T_{id}(3)$, $T_{id}(1)$) includes a holiday Monday, as well as 10 (resp. 7, 3, 1) days before and after the Holiday Monday

Table 4: Impact of the holiday Monday on the probability of C-section: Logit model

	(1) Full sample		(2) Have labored[a]		(3) Planned[b]		(4) Previous CS	
Variable	**Coeff.**	**(se)**	**Coeff.**	**(se)**	**Coeff.**	**(se)**	**Coeff.**	**(se)**
Holiday Monday	-0.139**	(0.061)	-0.055	(0.064)	-0.094**	(0.047)	-0.414*	(0.247)
Monday	0.450***	(0.018)	0.181***	(0.028)	0.339***	(0.031)	1.249***	(0.037)
Tuesday	0.431***	(0.013)	0.235***	(0.026)	0.317***	(0.022)	1.166***	(0.026)
Wednesday	0.404***	(0.013)	0.198***	(0.038)	0.309***	(0.021)	1.081***	(0.036)
Thursday	0.408***	(0.019)	0.216***	(0.026)	0.326***	(0.030)	1.054***	(0.039)
Friday	0.469***	(0.017)	0.259***	(0.029)	0.367***	(0.026)	1.193***	(0.048)
Saturday	0.037*	(0.020)	0.006	(0.031)	0.044*	(0.024)	0.048	(0.032)
Age	-0.121***	(0.008)	-0.096***	(0.010)	-0.135***	(0.008)	-0.035	(0.023)
Age^2	0.002***	(0.000)	0.002***	(0.000)	0.003***	(0.000)	0.001*	(0.000)
PPO	0.056	(0.039)	0.055	(0.057)	0.046	(0.045)	0.054	(0.048)
POS	0.152***	(0.046)	0.177***	(0.068)	0.163***	(0.052)	0.065	(0.066)
HMO	0.105**	(0.043)	0.148***	(0.054)	0.123***	(0.046)	-0.071	(0.064)
CDHP	0.132***	(0.045)	0.119	(0.073)	0.133***	(0.049)	0.030	(0.041)
HDHP	-0.027	(0.041)	-0.001	(0.070)	0.002	(0.050)	-0.175***	(0.040)
No risk factor -0.842***	(0.031)							
Intercept	-1.923***	(0.133)	-5.674***	(0.172)	-1.497***	(0.130)	1.188***	(0.277)
Holiday Monday ME	-0.013**	(0.005)	-0.002	(0.002)	-0.013**	(0.006)	-0.026*	(0.016)
Observations	1342637		1022607		480143		242883	
Pseudo-R^2	0.5384		0.7459		0.3663		0.0665	

***, ** and * indicate significance at 1%, 5% and 10% level.

Two-way cluster robust standard errors at the state and month levels.

Additional control variables: risk factors listed in table A-2 in Appendix, 53 dummy variables capturing the effect of the patient's state of residence, 4 year dummies, 12 dummy variables capturing the effect of the month of the year, 209 dummy variables capturing the effect of each week of the study period.

A week is defined as the 7-day period from Tues through Mon.

[a] Patients with vaginal delivery and/or at least one of the following diagnosis: disproportion, obstructed labor, labor abnormalities, long labor, fetal distress, cord prolapse.

[b] Patients without previous C-section but presenting at least one of the following diagnosis: unengaged fetal head, malpresentation, antepartum hemorrhage, excessive fetal growth, hypertension, central nervous system malformation in fetus, multiple gestation, preterm gestation,herpes, uterine scar (unrelated to previous c-section), soft tissues disorders.

Table 5: Average marginal effects from the Logit models

	(1) Full sample	(2) Have labored	(3) Planned	(4) Previous CS
		Effect of $T(10)$		
Marginal effect	0.0011	0.0013*	0.0008	0.0042***
Standard error	(0.0009)	(0.0007)	(0.0014)	(0.0015)
Lower bound	-0.0006	-0.0001	-0.0020	0.0013
Upper bound	0.0028	0.0027	0.0036	0.0072
		Effect of $T(7)$		
Marginal effect	0.0023*	0.0015***	0.0032	0.0036**
Standard error	(0.0013)	(0.0004)	(0.0030)	(0.0018)
Lower bound	-0.0001	0.0007	-0.0026	0.0001
Upper bound	0.0048	0.0024	0.0090	0.0071
		Effect of $T(3)$		
Marginal effect	-0.0003	-0.0001	-0.0001	-0.0030
Standard error	(0.0014)	(0.0007)	(0.0029)	(0.0021)
Lower bound	-0.0030	-0.0015	-0.0058	-0.0072
Upper bound	0.0024	0.0014	0.0055	0.0012
		Effect of $T(1)$		
Marginal effect	-0.0030	0.0002	-0.0026	-0.0075
Standard error	(0.0022)	(0.0019)	(0.0035)	(0.0046)
Lower bound	-0.0073	-0.0035	-0.0095	-0.0165
Upper bound	0.0012	0.0039	0.0044	0.0016
Predicted probability	0.3685	0.1717	0.3756	0.9282
Observations	1342637	1022607	480143	242883

***, ** and * indicate significance at 1%, 5% and 10% level.

Same control variables and sample definitions as in Table 4.

Lower bound and upper bound represent the bounds of a 95% confidence interval calculated using Z critical values.