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Exploring the Nexus between Certainty in Injury Compensation and Treatment Selection*

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Abstract

We study how legal and financial incentives affect medical decisions. Using patient-level data, we identify the effect of a change in medical liability pressure exploiting the geographical distribution of hospitals across court districts, where some districts improve the certainty of expected damages per injury while others do not. As certainty increases, unnecessary c-sections increase by 20%. This increase is higher for hospitals with lower quality, farther from consumers associations, facing lower expected damages, and paid more per c-section. Combining the difference-in-difference with a regression discontinuity design, we show that the effect is already detectable in the short-run. .

JEL Classification: K13; K32; I13
Keywords: Scheduled Damages, Cesarean Sections, Difference in Difference

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1 Introduction

Modern health care systems struggle to reduce the burden of inappropriate health care, services, which increase expenditures without improving the medical condition of patients. Their main cause is a misalignment between the best interest of physicians/hospitals, and that of patients and stakeholders. This misalignment can be exacerbated by at least two elements: reimbursement methods for health care services (i.e., fee-for-service vs. per capita payments), and medical liability regimes (e.g., medical malpractice pressure and fear of litigation).

Although the role played by financial incentives may be intuitive, the assessment of the consequences of medical liability on the selection of treatments is not always clear cut (*e.g.*, Danzon 2000): to avoid the risk of being sued, providers would resort to excessive care and/or refuse to accept the most risky patients and procedures. Tort reforms that reduce medical liability are the traditional response of scholars and policy makers to this issue. However, the evidence on both the direction and magnitude of this policy approach is mixed. For example, a decrease in medical liability has been associated with fewer unnecessary procedures (Yang *et al.*, 2009; Esposto, 2012; Shurtz, 2013), more unnecessary procedures (Dubay *et al.*, 1999; Currie and MacLeod, 2008), and no impact on the selection of medical procedures (Sloan *et al.*, 1997; Frakes, 2012).

We study whether and how a tort reform that reduced medical liability affected the use of birth delivery methods; namely whether and when a cesarean section is preferred to a natural delivery. In doing so, we also investigate some elements of the environment in which providers operate that can interact with tort reforms and reinforce or attenuate their effect. Therefore, our work improves on the existing literature in at least three ways. First, we identify the reduction in medical liability through the introduction of schedules of non-economic damage, and we demonstrate that this method of anchoring the expected damages provides a sharper effect on compensation than any other tort reform. Second, we offer insights into the channels driving the reaction of providers and suggest important implications for the design of healthcare policies other than tort reforms. Finally, we analyze the timing of this response to understand the extent of providers' sensitivity to liability changes.

Schedules of non-economic damage are tables with entries for the injury severity level and victim's age (see Table A1): different combinations of age and injury severity lead to different and clear-cut compensation amounts.[1] They reduce the variance of compensation, and increase the predictability of payouts, thereby mitigating the medical liability pressure faced by healthcare providers. Previous studies on the link between liability pressure and treatment selection rely on policies with a less straightforward final effect, such as

[1] *Damage schedules*, *scheduled damage tables* or *schedules* are other terms for the same tables. For further information on scheduling damages, see, among others, Avraham (2006).

the introduction of caps on damages. Caps are expected to eliminate the right tail of the payout distribution, thus shifting down the mean (Avraham, 2007), but they do not increase the certainty of compensation (Shurtz 2014, Frakes and Jena 2016). Moreover, the mean of the distribution of malpractice damages is not a good predictor of the actual risk faced by providers, due to the very high variance of this distribution as shown in Section 2.2. In contrast, schedules directly affect the variance of the distribution by narrowing it. This directly and indirectly benefits healthcare providers: directly because it relaxes their general concerns about legal claims, as the possible monetary outcome becomes easily predictable, and indirectly because it facilitates obtaining malpractice insurance.

Based on a unique dataset of inpatient discharge records from the Italian Ministry of Health, our identification strategy exploits the country's institutional context, in which schedule adoption depends on the discretionary decisions of courts, which have implemented them in a staggered manner. The adoption of schedules did not interfere with other malpractice or tort reforms, and, once introduced, schedules have never been repealed. We focus on the period 2001-2003 because 18 courts switched to schedules in 2002. Since hospital location determines the court in which malpractice claims must be filed, we consider hospitals located under the jurisdiction of courts switching to schedules as the treated group. These hospitals experience an increase in certainty over expected damages relative to the control group (*i.e.*, hospitals placed in court districts that did not switch). Having geolocated hospitals, we can minimize the unobserved heterogeneity by confining our analysis to those hospitals managed by a single local health authority, but overseen by two courts, only one of which switched to schedules. Ultimately, we have 22 treated and 19 control hospitals, and we use a difference-in-difference (DD) approach to identify the effect of schedules. The adoption of schedules leads to a 20% increase in c-sections at the mean of c-sections, which can be classified as unnecessary since there is no improvement in the health outcomes of either mothers or newborns.

Our findings are consistent with the idea that when there is a systematic mismatch between the chosen procedure and the medical needs, as in the use of c-sections in Italy,[2] reduced medical liability decreases the cost of errors and providers have no incentive to reduce the incidence of the mismatch; rather, the opposite effect might be observed (Currie and MacLeod, 2008).

The results are robust to the inclusion of hospital fixed effects that capture time-invariant characteristics at the hospital level. We also exclude any anticipatory behaviors and the possibility of a change in the composition of patients (*i.e.*, the incidence of low-risk mothers or of low-weight newborns) across treated and control hospitals. Finally, we show that the observed effects cannot be attributed to other policies by testing the

[2]Over the last three decades, the use of cesarean sections in Italy has constantly increased, making Italy the main user of cesarean procedures in Europe (Ministero della Salute, 2011) and one of the highest among OECD countries (OECD, 2013).

adoption of schedules in 2002 on hospitals that either consistently or never employed schedules between 2001 and 2003, both nationwide and only in those regions included in the main analysis.

Examining the factors that mitigate or reinforce the use of care due to a decrease in liability reveals that low-quality hospitals are more prone to overuse c-sections, where low quality is proxied by low volumes of deliveries (*i.e.*, fewer than 500 per year). The greater the difference in the reimbursement rate between cesarean and vaginal delivery, and the lower the level of schedules, the greater the number of unnecessary c-sections performed by hospitals. Under high reimbursement rates, hospitals exploit the decreased malpractice risk to further pursue the more profitable procedure, as suggested by Shurtz (2014). Under low schedules, hospitals benefit from a higher certainty of payouts combined with lower payouts; thus they perceive a lower overall liability than hospitals facing a higher level of schedules (*i.e.*, greater compensations to be paid). In addition, we find that the closer a hospital is to a Tribunal of Patient Rights— a nonprofit organization supporting patients' awareness of their rights— the lower the increase in unnecessary c-sections.

Finally, we provide an in-depth analysis of the timing of healthcare providers' response. According to the existing literature, this should be nil in the short run as providers need time to react to changes in medical liability. Combining the DD approach with a regression discontinuity (RD) design, we provide strong evidence to the contrary. This result, which is robust to falsifications as in Della Vigna and La Ferrara (2012) and to the use of different optimal bandwidths, casts doubt on the practice of considering liability reforms that have been in place for a few years to be irrelevant to explaining the selection of treatments for patients.

The paper is organized as follows: Section 2 presents the institutional setting and the theoretical expectations, while Section 3 defines the data and the empirical strategy. Section 4 presents the main results and describes the validity and robustness checks, together with the analysis of the channels and the response times. Finally, Section 5 concludes.

2 Institutional Background and Theoretical Expectations

2.1 The Italian Healthcare System and Its Liability pressure

In Italy, the central and regional governments share the responsibility for healthcare. The national government establishes the minimum level of care to be provided to the population, while regions are responsible for the actual delivery of health services. In particular, regional governments manage the local provision of healthcare using a network of Local Healthcare Authorities (LHAs), which are geographically based organizations.

Public hospitals are distributed within each LHA district.[3] Patients are, by default, assigned to a public hospital (*i.e.*, their home hospital) on the basis of their municipality of residence, but they can decide to be treated at their preferred hospital. During 2001-2003, 87% of newborns were delivered in public hospitals (Ministero della Salute, 2002 and 2003) and this trend has not weakened over time; since in 2013, more than 88% of mothers chose a public facility in which to give birth (Ministero della Salute, 2015). Moreover, 81% of mothers gave birth in their own LHA, and 64% of them used the nearest hospital, traveling, on average, 10.25 km (6.4 miles).

Hospitals are legally required to provide insurance coverage to their employees. However, physicians typically feel the need to obtain additional coverage in the market. Descriptive statistics from a set of insurance companies show that in 2012, for instance, the premia paid by hospitals for coverage totaled 288 million euros, while individual physicians paid 255 million euros in premia (ANIA 2014). According to a report based on data from Lombardy (1999-2011) and Piedmont (2005-2011), the wards facing the most claims are the emergency room, orthopedics, surgery, and obstetrics and gynecology (*e.g.*, Lombardy 2012; Piedmont 2012).[4]

Physicians are seriously concerned about malpractice, and evidence from targeted surveys on the topic confirms the high pressure they face. According to a survey conducted in 2005 among the EU members (Eurobarometer, 2006), 97% of the Italian respondents rated medical errors as being of *high* importance in their country against the average 78% for the EU 25 countries. Furthermore, of Italians surveyed, 53% reported having *often* read about medical errors in their country, against the European average of 34%. However, Italy is perfectly in line with the European average regarding the incidence of medical errors: in only 18% of cases has the respondent or a member of her family experienced a serious medical error. More recently, only 15% of those interviewed report having experienced any form of adverse event when interacting with the healthcare system, against the European average of 27% (Eurobarometer 2009). Italians also appear to be more prone to legal action. Respondents would seek help from hospital management only 18% of the time, against a European average of 37%, while they would seek legal assistance in 53% of cases, against the 48% European average. In terms of redress, Italians expect action to be taken against both the hospital (51% vs. 36% EU 27) and the person responsible for the error (48% vs. 37% EU27).

[3]There are also private hospitals, which can act as completely private facilities or through special agreements with the public system (private accreditation).

[4]There are no national official statistics on medical errors in Italy. Instead, regions publish independent reports on the aggregated claims histories of their hospitals, depending on whether they have a monitoring system for malpractice claims (Amaral-Garcia and Grembi, 2014). During 2004-2010, hospitals in the Northern regions reported 9.22 claims per 100 beds: figures for the Central and Southern regions are larger, at 12.44 and 12.70, respectively (Ronzoni, 2012).

2.2 Scheduled Damages and Why They Matter

Italy has 165 courts of first instance, which, in the 1990s began to adopt scheduled damages to provide clear guidance in setting non-economic compensation for any case of personal injury (Comandé, 2005).[5] Scheduled damages quantify the award to be granted based on the severity of the injury and the victim's age, thereby minimizing judges' discretion in the assessment of compensation. For instance, the schedule applied by the court of Milan in 2002 sets the non-economic compensation to 19,704 euros for an 11% disability suffered by a 3-year-old child, whereas this figure would be increased to 34,935 euros if the same child suffered a 16% disability.[6] Shortly thereafter, insurance companies followed suit and began to use schedules as a reference when negotiating settlements.

In contrast to most tort reforms, schedules are associated with an unambiguous effect on the liability pressure faced by healthcare providers. Given their structure, schedules decrease the dispersion of the distribution of payouts, and thereby increase the certainty in compensation, ultimately leading to lower liability pressure. Clearly, the main problem related to malpractice compensations relates to the fact that the average compensation is often not a good approximation of the real financial burden entailed by a medical error. For instance, in Lombardy, the average compensation granted for a surgical error in the period 1999-2011 was 52,436 euros with a standard deviation of 160,726 euros. The standard deviation is 3 times the mean; thus, the distribution is highly dispersed. The same holds for diagnostic errors, which had a 3.3 ratio (mean 71,499; std. 236,669), and therapeutic errors, which had a 3.7 ratio (mean 70,987; std. 264,441), while a 2.9 ratio is registered when considering only ob-gyn. Reducing the dispersion of the distribution is crucial for increasing the predictability of expected damages.

To support the argument that schedules are important precisely because they are able to reduce the dispersion of compensation distribution, we provide some descriptive evidence on the correlation between schedules and the standard deviation of payouts for personal injuries, using a dataset on insurance claims filed with commercial insurers between 2000 and 2010 (Bertoli and Grembi, 2017).[7] We calculate the standard deviation of damages granted and a t-test of the differences in the standard deviation between claims filed in court districts both with schedules and without schedules. Table 1 makes clear that the claims filed in courts without schedules show a higher standard deviation than those in courts with schedules. Overall, this evidence captures the greater uncertainty in

[5]Schedules are adopted at the court level, as judges vote for their introduction, and, once in place, they are is very unlikely to be waived (see Bertoli 2014, and Bertoli and Grembi 2017). If schedules are waived, judges must provide proper justification and adapt their decisions to the greatest extent possible to the average compensation granted in previous cases.

[6]An example of scheduled damages is provided in Table A.1 of Appendix A. In the Italian case, scheduled damages are traditionally defined in consultation with past decisions to avoid undermining the consistency of courts judgments (Sella, 2005); thus, current rulings should also not reduce deterrence relative to past levels.

[7]Overall, these claims refer to 257 public hospitals and 55 courts.

predicting the possible payout of a lawsuit where schedules are not in place.

Table 1: **Schedules and Variance of Compensation**

Outcome	**St. dev.** Courts without Schedules	Courts with Schedules	**T-test**
Granted Damages	1.78	1.66	0.116***
Obs.	540	3,886	4,426
Reserves	1.47	1.41	0.063***
Obs.	1,227	7,130	8,357

Notes: Based on a dataset of insurance claims filed with commercial insurers between 2000 and 2010 (Bertoli and Grembi, 2016), the table reports the t-test of the standard deviations of *Granted Damages* and *Reserves* between hospitals located in court districts that adopted schedules and hospitals located in court districts that did not adopt schedules. The values are in natural logarithms. *Granted Damages*= The average payout that the insurance company paid to the victim ; *Reserves*= the average reserve amount per malpractice claim. The number of observations refers to the closed cases *Granted Damages* and the pending cases per *Reserves*.

2.3 Theoretical Expectations

Ex ante, it is difficult to theoretically predict the effect of decreases in medical liability on the selection of the type of delivery. The main assumption is that healthcare practitioners are concerned about facing a legal claim. Even when providers can obtain medical liability insurance that reduces their financial risk, they neverthless perceive malpractice claims as a serious threat because they entail non-insurable costs, including serious reputational damages (Sage, 2004) and significant psychic and time costs.[8] However, the risk of facing a claim cannot be eliminated, since it is correlated with the probability of committing an error, which cannot be nullified even when taking precautions (Arlen and MacLeod 2005). As a result, healthcare providers are commonly expected to make medical decisions while considering both patients' conditions and the risk of being sued in the event of mistakenly performing a treatment. Within this framework, the conventional wisdom is to associate a switch with lower medical liability to a decrease in the need for providers to protect themselves against the risk of litigation. Since c-sections are traditionally viewed as a potential defensive against the risk of being sued,[9] this approach predicts a reduction of c-sections whenever there is a decrease in medical liability. However, the existing evidence is mixed and challenges this interpretation.

[8]Seabury *et al.* (2013) show that doctors, on average, spend over 4 years of a 40-year career with an open malpractice claim. However, there is no clear evidence on the magnitude of reputational costs.

[9]By performing c-sections, doctors reduce the risk to babies (*i.e.*, the most expensive potential victim) and can better control what actually happens in the delivery room.

To explain the conflicting evidence, more recent contributions attempt to adopt a broader perspective. Two models best identify this attempt, ans are found in Currie and MacLeod (2008) and Shurtz (2014). Currie and MacLeod (2008) contains the first model to consider the probability of facing a claim related to a medical error, when both performing a treatment and when denying it. Doctors may harm a patient not only by selecting a medically unnecessary treatment but also by withholding a medically necessary treatment. The starting point of the model is that physicians weigh the benefits of their choices according to the expected liability that they will incur by committing an error. A variation in liability changes a doctor's decisions with respect to the marginal patient, that is, one with respect to whom the physician is indifferent between denying or providing the treatment. As a consequence, the effect of a change in medical liability on the use of a treatment depends on the risk-risk trade-off between providing and withholding the treatment on the margin. The final effect on the utilization rate of a procedure depends on the current use of the treatment when the change in medical liability occurs. If – as in the case of Italy – the treatment is overused before the liability change, which means that it is often medically unnecessary, then the probability of an error or a poor outcome is higher with the use of that treatment than without it. This means that a reduction in liability decreases the costs of medically unnecessary treatments, making them more likely.

A further possible explanation of this dynamic is provided by Shurtz (2014) which stresses the role of the financial incentives faced by practitioners. A doctor will perform a treatment at the margin up to the point at which the monetary gains are offset by the risk of being sued in the event of an error. When c-sections are profitable and overused, a reduction in medical liability will not affect the financial incentive for performing a c-section on the marginal patient, but it decreases the malpractice risk associated with this decision. As a result, lower medical liability provides doctors with greater discretion to follow financial considerations, and thus, medically unnecessary treatments increase.

3 Empirical Analysis

3.1 Data

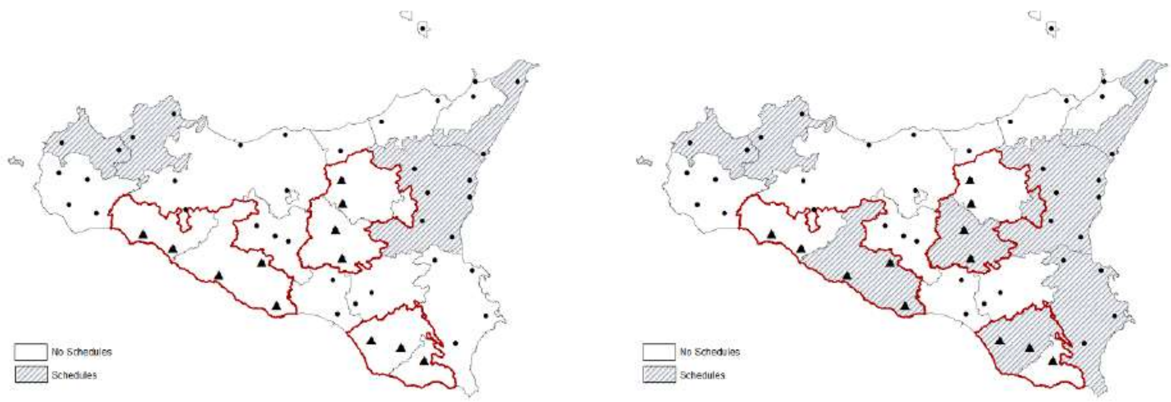
We use two unique datasets from the National Hospital Discharge Records (*Schede di Dimissione Ospedaliera - SDO*). The first dataset contains information on all deliveries that took place in Italian public hospitals between 2001 and 2003, whereas the second provides information on newborns.[10]

According to national legislation, a malpractice claim against a hospital or its employee

[10]Patient-level data on deliveries are not available before 2001. The two datasets come separately for privacy reasons.

must be filed in the court district where the hospital is located. This institutional feature allows us to exploit the geographical distribution of hospitals to identify the treated and control groups. Schedule implementation relaxes medical liability only for those hospitals located in a court district switching to schedules: the treated hospitals. In contrast, those hospitals subject to courts that did not switch to schedules represent the control group. We identify our sample of interest in two ways. First, to reduce unobservable heterogeneities between the treated and control groups, we focus on those deliveries that occurred in hospitals managed by the same LHA, but overseen by two different courts, of which only one switched to schedules in 2002.[11] This means that our sample includes only those treated and control hospitals located in the same LHA, as depicted by Figure 1 for the representative region of Sicily. This is a unique design in which hospitals treating very similar patients and managed by the same administrative unit face different levels of liability pressure due solely to their location. Second, the available data do not allow us to distinguish between emergency and planned c-sections.

Figure 1: **Example of Schedule Adoption and Hospital Distribution (2001-2003)**



Notes: The figure presents the region of Sicily as a representative example. Court districts' borders are in black. White areas identify court districts that do not apply schedules of non-economic damages. Grey striped areas identify court districts that apply schedules of non-economic damages. Black dots and triangles represent public hospitals. Thicker borders identify the borders of the LHAs governed by two different courts, one with and one without scheduled damages. On the left, we plot the picture with 2001 data, and on the right, we plot the picture with 2002 data.

However, there is a clear trend in the use of cesarean deliveries during the week. In Table A.2, we plot the results of a linear probability model in which the decision to perform a c-section is regressed on the days of a week. The results confirm that c-sections are performed mostly during working days—as expected; thus, cesarean deliveries occurring on weekends are most likely to be performed for emergency reasons (Amaral Garcia *et*

[11] We do not extend the period of observation after 2003 because doing so would allow us to include only one more treated hospital and one more control hospital. In fact, after 2003, there is only one LHA covered by different courts, of which at least one switched to schedules. As a robustness check employing a longer observational period, we apply a regression discontinuity approach that exploits the fact that hospitals are distributed across court district boundaries. Therefore, we use the distance to the border of a court district that adopted schedules as a running variable to identify treated and control hospitals and to test the effect of schedule introduction. The results obtained confirm both the sign and magnitude of our main findings and are available upon request.

al., 2015). To cope with this bias, we drop all weekend deliveries.[12]

Our final sample includes 41 hospitals for a total of 53,266 deliveries and 54,058 newborns.[13] We count 22 treated and 19 control hospitals. Table A.4 reports the descriptive statistics. On average, 37% of women gave birth by c-section between 2001 and 2003. Since 1985, the World Health Organization has established a range of 10%-15% as an acceptable incidence of c-sections, and more recently *Health People 2010* confirmed this view by establishing a new target at 15% for the performance of c-sections in the US (WHO). Hence, this evidence indicates a very high use of cesarean deliveries that cannot be explained by the risk profile of mothers.[14] Only 11 women out of 100 present health conditions that would require the use of a c-section. Overall, the majority of women were Italian, married, and on average 30 years old, and approximately 8% reported complications. Of newborns, 2.6% suffered from a congenital anomaly, and 4.5% of them were negatively affected by maternal conditions; moreover, 5.5% of newborns exhibited complications due to the performance of a c-section, while 22.6% were harmed during a vaginal delivery.

Figure 2 depicts the trends in treated and control hospitals for the number of weekly deliveries and the weekly incidence of cesarean sections. Treated and control hospitals report parallel delivery trends, while the trends in weekly cesarean sections begin to diverge after the implementation of schedules (*i.e.*, in week 0). Finally, we perform some t-tests on the main observable characteristics of the treated and control hospitals to check whether there is any major structural change that could confound the effect of our policy. We focus on hospitals' operational characteristics in the form of the number and composition of medical staff or the number of wards and beds.[15] As shown by Table 2, none of the t-test values for the differences between treated and control hospitals are statistically significant.

[12]The inclusion of weekend deliveries does not affect our results, as is apparent from Table A.3 in the Appendix.

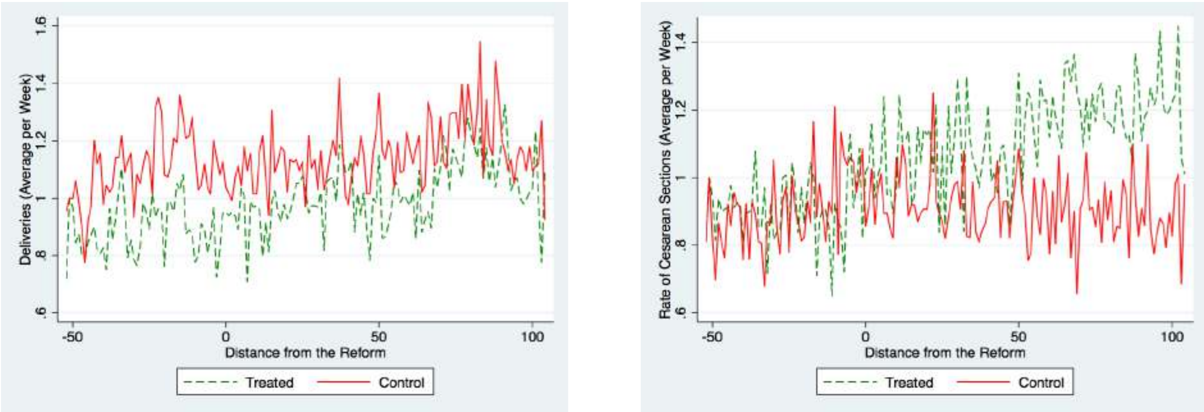
[13]Data on mothers and newborns differ in the number of observations, due to multiple pregnancies and stillbirths.

[14]These figures are in line with Italy's performance in international rankings: it has the highest number of births by c-section in Europe and one of the highest among the OECD countries (OECD, 2013; Meloni *et al.*, 2012; Ministero della Salute, 2011).

[15]This information is available only on an annual basis.

Figure 2: **Weekly Trends**

(a) Deliveries (b) Csections (Ratio)



Notes: The figures plot the average number of deliveries and the average cesarean section rate per week for treated and control hospitals. Week 0 represents the week in which schedules were adopted.

Table 2: **Balance of the Observables: Hospitals**

	Control			**Treated**				
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Diff.	T-test
Nurse	57	281	36	66	275	28	6	0.131
Doctors	57	131	17	66	123	14	8	0.381
Personnel	57	656	92	66	622	75	33	0.285
Beds	57	243	232	66	252	24	-9	-0.243
Used Beds	57	232	29	66	243	23	-11	-0.291
Wards	57	17	2	66	15	2	1	0.391
Used Wards	57	15	2	66	14	2	1	0.197
Discharges	57	9,757	1,070	66	10,553	852	-796	-0.588

Notes: Here we perform t-tests because data at the hospital level are available only annually (2001-2003). For variable definitions, see Table 3.

3.2 Main Outcomes

The decision to perform a c-section represents our main outcome of interest; thus, we use a dummy $C - section$, which is equal to 1 if a woman gave birth by c-section and 0 otherwise. In line with the model of Currie and MacLeod (2008), we expect an increase in the use of cesarean sections, since the decrease in liability pressure triggered by schedules occurs in a context of c-section overuse. However, it is possible that the patient population benefits from that increase. If a higher cesarean rate is associated with better outcomes for mothers and/or newborns, then we cannot speak of an overuse of c-sections, since the increase could be explained by a change in medical needs. This is detectable by checking the incidence of preventable complications. If preventable complications do not decrease, then there are no health benefits for the patients.

To capture the possible effects on maternal health, we use the variable *Preventable*, which indicates whether the mother suffered any preventable delivery or post-delivery problems as listed in Table 3.[16] In a similar vein, we also include three outcomes that proxy for adverse consequences for newborn health: *C-section complications*, *Vaginal complications*, and *Breathing interventions*.[17] The first two indicate whether the newborn suffered any harms specific to the choice of a cesarean or natural delivery. *Breathing interventions* captures whether any attempts were made to improve newborn respiratory function (*e.g.*, intubation, ventilation, respiratory manoeuvre).

[16] We also use an alternative definition of delivery problems, *Traumas*, which captures whether the mother reported any preventable traumas usually associated with the type of delivery performed. In essence, we derived *Traumas* by focusing on the preventable *Patient Safety Indicators* (PSI) developed by the Agency for Healthcare Research and Quality (AHRQ). Using this alternative measure does not produce any significant effect. The results are available upon request.

[17] *C-section complications* for newborns captures whether there was a premature birth due to miscalculation of gestational age, whether there was any infant respiratory distress syndrome, and whether there were any complications due to anesthesia, among other issues. Data on the APGAR score of newborns are not publicly available nationwide.

Table 3: **Outcomes and Controls**

Outcomes			**Controls**			
Delivery	**Mother Complications**	**Newborn Complications**	**X1**^{a}	**X2**^{a}	**X3**^{b}	**X4**
	Preventable^{a}		Mother Level	Mother Level	Municipality Level	Newborn Level
C-section	Maternal fever	Cesarean Complications	Cervix	Age	Average Income	Congenital Anomalies
	Perineal laceration	Vag Complications	Multiple babies	Nationality	Sea level	Maternal Conditions
	Perineal Infection	Breathing interventions	Diabetes	Marital status	Level of urbanization	
	Uterus laceration		Placenta		Education	
	Infection		Eclampsia			
	Prolonged labor		Breech			
	Anemia		Cord prolapse			
	Anaesthetic compl		Cancer			
	Haemorrhage		Use of alcohol			
	Embolism		Early-onset delivery			
	Cardiac compl		Use of drugs			
	Fever		Hypertension			
	Hysterectomy		Lung conditions			
	Maternal seizure		Cardiac conditions			
	Obstructed labor		Obesity			
	Other		Anemia			
			Renal failure			
			RH Problems			
			Sexually transmitted diseases			
			Previous Csec			

Note: (a) Both complications and controls for clinical risk factors are consistent with those used in Dubay *et al.* (1999), Dubay *et al.* (2001), Currie and MacLeod (2008 and 2013), Dranove and Watanabe (2009), Dranove *et al.* (2011), and Shurtz (2013 and 2014). Among the preventable complications, *Other* includes possible complications that differ from those explicitly mentioned, such as retained placenta and perineal haematomas among others. (b) The controls at the mothers' municipality level are consistent with those used at the county level by Baicker *et al.* (2006). We also include *Sea level* due to the territorial characteristics of the country.

3.3 Econometric Strategy

We identify the effect of a decrease in medical liability driven by the adoption of schedules on $Outcome_{iht}$, for mother i delivering in hospital h at time t, using a difference-in-difference (DD) approach. $Treated_h$ is a dummy that identifies the treated hospitals, $Post02_t$ is a dummy that captures the post-treatment period, and their interaction identifies the effect of schedules using the DD estimator (δ) as defined by the model in Equation 1.

$$Outcome_{iht} = \delta(Treated_h * Post02_t) + \tau Treated_h + \gamma_t + \pi_{wd} + \omega_d + X1^{'}_{iht}\sigma + X2^{'}_{iht}\beta + X3^{'}_{mht}\tau + \epsilon_{iht} \quad (1)$$

where γ_t are year fixed effects to control for common shocks; π_{wd} are weekday fixed effects to control for patterns in the distribution of deliveries across days of the weeks; and ω_l represents LHA fixed effects to control for time-invariant unobservable characteristics at the LHA level, as these could arise from healthcare planning and policy given the brief observational period. Standard errors are clustered at the hospital level to address possible serial correlations problems (Bertrand *et al.*, 2004). We include three sets of covariates, which can predict the probability of having a cesarean section as listed in Table 3. $X1^{'}_{iht}$ groups control variables for the risk profile of the mother, $X2^{'}_{iht}$ considers the characteristics of the mother other than her health conditions, such as her age, that might affect the type of delivery or the incidence of complications, and $X3^{'}_{iht}$ controls for the socio-economic characteristics of the municipality of residence of the mother, which are potentially correlated with her health status, such as her income level.

When we perform the analysis on the newborns, the model in Equation 1 is modified as follows:

$$Outcome_{iht} \quad = \delta(Treated_h * Post02_t) + \tau Treated_h + \alpha_h + \gamma_t + \pi_{wd} + \omega_d + X3^{'}_{mht}\tau + X4^{'}_{iht}\beta + \epsilon_{iht} (2)$$

where $X4^{'}_{iht}$ controls for any congenital anomaly suffered by the baby and for any maternal conditions complicating the risk profile of the newborn.

Our DD identification relies on two assumptions: 1) a common trend in the outcomes of interest between the treated and control groups in the absence of the policy and 2) the exogeneity of the year of schedule introduction with respect to the trend of medical malpractice claims. The descriptive evidence in Figure 2 offers a first approximation of the common trend in $C - section$, but we provide validity tests in Section 5.2. The exogeneity of the year of schedule implementation is a plausible assumption for several reasons. First, schedules apply to every case of personal injury, from car accidents to workplace compensation, and the need to introduce them stemmed from the necessity to help judges in assessing damage awards in road traffic accidents rather than in medical malpractice cases. Hence, it is very unlikely that a court's decision to implement scheduled damages depends on hospitals operating in the same court district and, more generally, on malpractice claims. Second, there is no possibility of public hospitals engaging in forum shopping. Hospitals always respond to any malpractice cases before the court in which district they are located. Finally, since these are public hospitals, there is no room for strategic location. Hospital location is not determined according to court district performance or policies but according to the resident population's needs and their accessibility. In addition, since 1968, the creation of a new hospital is subject to a population requirement of a minimum of 25,000 inhabitants (Bertoli and Grembi 2016a).

4 Results

4.1 Effects of Increasing Certainty

Table 4 reports our main results: Panel A shows the estimated coefficients of schedules without covariates and fixed effects, while Panel B includes all covariates and fixed effects. The results in Panel B are our preferred specifications for both mothers and newborns. Consistent with our theoretical expectations, a decrease in malpractice pressure due to the introduction of schedules produces a 7.4-percentage-points increase in the use of c-sections. This means that the probability of giving birth by c-section after the adoption of schedules increases by 20% at the sample mean of cesarean sections (*i.e.*, 0.370). However, there is no significant effect on either mothers or newborns' health status, as proxied by the different measures of complications: thus, the increase in cesarean deliveries can be classified as medically unnecessary.

We provide some back-of-the-envelope calculations of the first-order economic implications of cesarean section overuse.[18] For the sake of simplicity, we assume that the unnecessary c-sections observed would otherwise have been vaginal deliveries without complications, and thus, to quantify the additional expenditures due to cesarean overuse, we consider the Diagnosis Related Group (DRG) prices for both cesarean and vaginal delivery without complications . According to the national DRG list adopted in Italy during our period of interest, the weighted price of a c-section without complications was 2,371 euros, whereas the corresponding figure for a vaginal delivery without complications was 956 euros. If we consider the impact of our policy as estimated by the DD, a 20% increase in the use of c-sections corresponds to 3,941 additional cesarean deliveries (*i.e.*, 0.37*53,266=19,708 cesarean deliveries during the period 2001-2003). Overall, these ad-

[18]We focus solely on the monetary consequences of c-section overuse, as we cannot assess the health implications for women who undergo unnecessary cesarean sections, *e.g.*, complications for future pregnancies and deliveries.

Table 4: **DD - Main Results**

	Mothers		**Newborns**		
	Csection	**Preventable**	**Vag Compl**	**Csec Compl**	**Breathing Interv**
Panel A: With No Controls and No Fixed Effects					
δ	0.080***	0.007	0.009	0.016	-0.002
	(0.021)	(0.010)	(0.030)	(0.012)	(0.004)
Controls	No	No	No	No	No
Obs.	53,266	53,266	54,058	54,058	54,058
Mean	0.370	0.083	0.226	0.055	0.018
Panel B: With Controls and Fixed Effects					
δ	0.074***	0.004	0.004	0.018*	-0.001
	(0.020)	(0.010)	(0.022)	(0.010)	(0.004)
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	53,266	53,266	54,058	54,058	54,058
Mean	0.370	0.083	0.226	0.055	0.018

Notes: Controls include $X1$, $X2$ and $X3$ when outcomes refer to mothers, $X3$ and $X4$ when outcomes refer to newborns, as listed in Table 3. Fixed Effects are for years, week-days, and LHA. Linear probability model regressions. Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

ditional procedures cost 9,344,111 euros, while they would have cost 3,767,596 euros as vaginal deliveries. This is equal to an overall waste of 5,576,515 euros, which means 1,415 wasted euros per delivery.

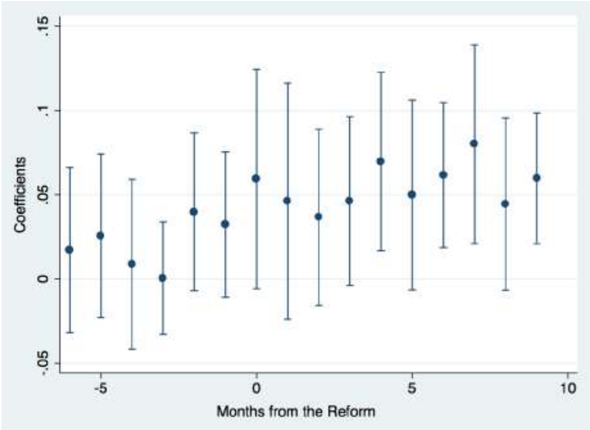
4.2 Validity and Robustness Checks

To defend the robustness of our results on cesarean deliveries, we perform several tests. First, we verify the validity of the common trends assumption for the DD identification and the lack of any anticipatory effect. Then, we test our preferred specification on different samples of hospitals and with additional covariates. Finally, we check whether our results could be driven by a change in the composition of the treated patients.

Figure 3 plots the coefficients of the monthly leads and lags of schedule adoption against the use of cesarean sections. The adoption of schedules begins to be statistically significant in the fourth month after the adoption of schedules.

We then estimate Equation 3, which considers only hospitals overseen by courts not switching to schedules in 2002. Our analysis relies on the assumption that schedules are the only relevant policy affecting medical liability in the period considered. If this is the case, we should not detect any changes in the trends of cesarean sections for hospitals

Figure 3: **Leads and Lags (Months)**



Notes: The figures plot the coefficients of the interaction between $Treated$ and $Months$ from schedule adoption. Month 0 represents the month in which schedules were adopted.

governed by courts that did not switch to schedules in 2002. We proceed by first considering a nationwide sample of hospitals, meaning that they are not necessarily located in the same regions as the treated and control observations of the main analysis. Then, we narrow the focus within the same regions from which the hospitals in our main specifications were extracted. In both cases, the results are now based on a sample of hospitals operating in a court district that *always* applied schedules, while the control hospitals operate in court districts that never used schedules.

The nationwide sample includes 89,381 deliveries with 27 "treated" hospitals that are always subject to schedules and 21 "control" hospitals with no schedules. However, one might be concerned that something is transpiring in those regions considered in our main analysis, rather than nationwide. For this reason, we perform the same test for the within-the-same-regions sample of 26 treated and 18 control hospitals, for a total of 81,447 deliveries. As is apparent from Table 5, when we assess the effect of a simulated adoption of schedules in 2002, no effect is observed, regardless of the geographical dimension considered.

Since the explanation of the effect triggered by schedules relies on the reaction by healthcare providers, we need to exclude any reactions on the patients' side. In fact, the latter would imply that the effect detected could be due to patient selection. The increase in the certainty of compensation could attract riskier patients, who decide to deliver in the treated hospitals rather than in the nearby control hospitals, meaning that in the event of an adverse outcome, these patients know what they can expect in terms of non-economic compensation. According to this explanation, we could detect more cesarean sections as a consequence of a change in the risk profile of the deliveries. To exclude any patient response, we estimate Equation 3 using as our outcome of interest two dummies: $Low - risk$ mothers and $Low - weight$ newborns. $Low - risk$ mothers is equal to one

Table 5: **Falsification Test - C-section Rates for Hospitals Always Covered by Schedules**

	Same regions	**All regions**
δ	0.023	0.012
	(0.015)	(0.020)
Obs.	81,447	89,381
Controls	Yes	Yes
Weekdays FE	Yes	Yes
Years FE	Yes	Yes
LHA FE	Yes	Yes

Notes: *Same Regions*= all hospitals belonging to the same regions as in the sample used for the main analysis, but the treated are those always covered by schedules and the controls are those hospitals never applying schedules between 2001 and 2003. *All Regions*= sample including all hospitals belonging to a given LHA that is covered by at least one court always applying schedules (treated) and one court never applying schedules (control) between 2001 and 2003. Controls include $X1$, $X2$, and $X3$ as listed in Table 3. Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

if the mother does not present any pre-delivery risk conditions,[19] while $Low - weight$ newborns is equal to one if the newborn is underweight for her gestational age. Table 6 shows that there is no change in the probability of treating a low-risk mother or facing a low-weight newborn for treated hospitals after the adoption of schedules. Hence, patient selection is not in place. Finally, the inclusion of hospital fixed effects does not affect our results, as shown in Table A.6 in the Appendix.

4.3 Who Performs More Cesarean Sections?

The assessment of the average effect of a decrease in medical liability pressure provides *per se* unclear policy implications. Tort reforms do not specifically target medical injuries but refer to all types of personal injuries, as in our case. The richness of our dataset allows us to identify the channels of hospital response and thus to provide more tailored policy implications. In particular, we focus on three dimensions that are expected to play a role: hospital quality, the reimbursement level, and other elements that can affect the liability pressure, such as the level of schedules and the presence of consumer associations.

Ex ante, other things being equal, the increase in medically unnecessary c-sections is

[19]According to the medical literature, a low-risk mother is any women who does not present any of the following pre-delivery risk conditions: fetus malposition, previous c-section, diabetes, prolonged pregnancy, early labor, poor or excessive fetal growth, multiple gestation, fetal abnormality, antepartum hemorrhage, placenta previa, pre-eclampsia, eclampsia, toxemia, hypertension, polyhydramnios, oligohydramnios, and infection of the amniotic cavity.

Table 6: **Low-Risk Mothers and Low-Weight Newborns**

	$Low - Risk$	$Low - Weight$
δ	-0.044	0.006
	(0.027)	(0.007)
Obs.	53,266	54,058
Controls	No	No
Weekdays FE	No	No
Years FE	No	No
LHA FE	No	No
δ	-0.035	0.006
	(0.023)	(0.007)
Obs.	53,266	54,058
Controls	Yes	Yes
Weekdays FE	Yes	Yes
Years FE	Yes	Yes
LHA FE	Yes	Yes

Notes: Controls include $X1$, $X2$ and $X3$ when the outcome is $Low - Risk$, while controls include $X3$ and $X4$ when the outcome is $Low - Weight$, as listed in Table 3. Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

expected to be lower in high-quality hospitals than in low-quality hospitals. High quality denotes appropriateness, effectiveness, and a critical mass of high-skilled doctors. In high-quality facilities, doctors should have less scope for strategic behaviors and medical decisions should be less affected by factors other than patients' medical conditions. We proxy for hospital quality with the number of yearly deliveries following the strand of literature that matches high volumes of a procedure to better quality due to a learning-by-doing process (Nueld Institute for Health, 1996; Sound, 2010; Kristensen *et al.*, 2014, Advic *et al.*, 2014; Guccio and Lisi, 2016). The higher the number of mothers giving birth in a hospital, the better the hospital should be at coping with both deliveries and their unexpected consequences, meaning that there is a better match between the type of delivery and the type of patient. We define high/low volumes following a 2006 Italian law, which established 500 deliveries per year as the minimum number of procedures that a birth center should manage to be authorized to operate by the National Health System.

Second, if we demonstrate that there is a change in the liability pressure, it is important to understand how this interacts with other factors affecting the degree of liability. We focus on the level of schedules and the presence of non-profit consumer organizations, which play the role of watchdogs for patients' rights within hospitals.

Courts construct their schedules; thus, in one court district the same percentage of disability for the same victim age might be paid less or more than in another court district.

Compared to high scheduled damages, the introduction of low schedules generates the same increase in certainty of compensation, but liability pressure is expected to be lower in the latter than in the former case. Healthcare providers enjoy the same higher certainty regarding what they have to pay, but overall they need to pay less than when subject to high-schedule courts.[20] We define high (low) schedules as those above (below) the median value of scheduled damages for a disability of 25%. As a consequence, we expect to observe a higher increase in c-sections in hospitals subject to low schedules.

We collect the information on the geographical distribution of Tribunals of Patient Rights (*i.e.*, *Tribunali dei Diritti del Malato*), which are operated by a non-profit consumer association named Active Citizenship (*i.e.*, *Cittadinanza Attiva*). These tribunals were created in the 1980s with the aim of promoting a good and accessible public healthcare system. They help patients to be aware of their rights and access the legal system in the event that they feel that they were mistreated at any time by the healthcare system. We expect that the nearer a hospital is to a Tribunal of Patient Rights (*i.e.*, a distance equal to zero when a Tribunal is located within the hospital), the greater the liability pressure, as the hospital operates in an environment in which consumer associations are more active; thus, the risk of being sued in the event of an error is higher. Consequently, being near a Tribunal should be associated with a lower increase in cesarean sections. We geolocate each Tribunal, as shown in Figure A.2 of the Online Appendix, and we generate the travel distance from each hospital to the nearest Tribunal.

Finally, financial incentives are also expected to interact with the adoption of schedules. Doctors and hospitals respond to monetary incentives (Gruber *et al.*, 1999; Grant, 2009; Cavalieri *et al.*, 2014; Johnson and Rehavi, 2016). Consistent with the literature, we expect that the greater the difference in the reimbursement between a cesarean and a vaginal delivery, the greater the incentive to perform a c-section. We define a high (low) difference in the reimbursement as a difference above (below) the median value of DRG prices. DRG tariffs in Italy differ across and within regions whenever regions decide to apply different reimbursements to adjust for differences across hospitals (Bertoli and Grembi 2016b).

We generate dummies, D, for each channel and interact them with $Treated_h * Post02_t$ using our DD approach to estimate the model. For each channel, we report the results for $Treated_h * Post02_t$ in each subsample defined on D and the significance of the difference between the two samples.[21] The results of this analysis are reported in Table 7.

[20] These differences have been considered unfair to potential victims. This is why a new regulation was implemented in 2016 to promote the adoption of a national schedule for personal injuries.

[21] The significance of the difference between the coefficients of $Treated_h * Post02_t$ in the two subsamples is the parameter λ in the following model:

$$Csection_{iht} = \delta(Treated_h * Post02_t) + \lambda(Treated_h * Post02_t * D) + \alpha D + \tau Treated_h + \gamma_t + \pi_{wd} + \omega_d + X1^{'}_{iht}\sigma + X2^{'}_{iht}\beta + X3^{'}_{mht}\tau + \epsilon_{iht}$$

Where D is the dummy for each channel. For instance, for the quality channel, D= 1 if the hospital

Table 7: **Drivers of C-section Overuse**

	Delivery Volumes	**Tribunals of Patient Right**	**Schedules**	**Reimbursement**
	Below 500	**Far**	**Low**	**Low**
δ	0.108***	0.099***	0.122***	0.004
	(0.029)	(0.026)	(0.039)	(0.023)
	Above 500	**Near**	**High**	**High**
δ	0.048**	0.041*	0.055**	0.085***
	(0.022)	(0.021)	(0.028)	(0.022)
Difference	-0.060**	-0.058*	-0.066**	0.080***
	(0.029)	(0.031)	(0.031)	(0.029)
Obs.	53,266	53,266	53,266	53,266

Notes: *Below 500* indicates that the annual number of deliveries that occurred in a hospital is smaller than 500; *Above 500* indicates that this number is higher than 500. *Tribunal of Patient Rights* is a dummy equal to one if the hospital is near (below the median) a tribunal of patient rights. *Low Level* stands for a below-median value, and *High Level* stands for an above-median value. Each model includes controls for weekdays, years, and LHA fixed effects. Controls include $X1$, $X2$, and $X3$ as listed in Table 3. Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

As expected, an increase in certainty over compensation triggers more medically unnecessary cesarean sections in hospitals with lower quality standards for being smaller, that are far from the pressure of consumers' association, that face lower levels of schedules, and those able to benefit from a higher level of reimbursements.

4.4 Response Times

Anecdotal evidence from Lombardy and Piedmont, shows that almost half of all claims are filed in the year in which the related error occurrs, and approximately 70% by the end of the year following the error.[22] The timing is an important component: healthcare providers are informed promptly if anything changes in their expected liability. If it is true that certain costs, such as insurance premia, can take time to be adjusted once a tort reform is implemented, the non-insurable costs might be more responsive in the short run.

A problem with tort reforms, especially in the most studied context, namely the US, is that they have been repealed on several occasions soon after their introduction. Under these circumstances, the common approach questions the ability of reforms to affect the selection of medical treatments based on the idea that it takes time for healthcare providers to internalize the incentives of a change in liability.[23] In this section, we challenge this

performs more than 500 deliveries per year.

[22]Generally, more time is required for claims related to infections.

[23]For example, the source of most papers studying the relationship between caps and treatment de-

interpretation by testing for a short-run response to a reduction in medical liability. The results for monthly leads and lags already revealed the existence of such a reaction by providers. Nevertheless, in the spirit of an event study, we provide further evidence based on a model that combines the DD setting with a RD framework (Casas-Arce and Saiz, 2015; and Grembi *et al.*, 2016). Having daily observations makes it possible to treat the time dimension as our running variable.

Following the suggestion of Gelmans and Imbens (2016), which cast doubts on the validity of RD estimators using higher degree polynomials, we borrow the local linear regression method from the RD setting and first restrict the sample to deliveries that occurred within an optimal interval (*i.e.*, bandwidth) h before and up to the date of schedule adoption P_{t0}, which for us is January 1, 2002. This means that we consider only mothers giving birth and newborns in the interval $P_i \in [P_{t0} - h, P_{t0} + h]$, and we estimate the following model:

$$Outcome_{iht} = \delta_0 + \delta_1 P_t^* + S_t(\gamma_0 + \gamma_1 P_t^*) + T_h[\alpha_0 + \alpha_1 P_t^* + S_t(\beta_0 + \beta_1 P_t^*)] + X1_{iht}^{'}\sigma + X2_{iht}^{'}\beta + X3_{mht}^{'}\tau + \xi_i ht \quad (3)$$

where P_t^* is the time normalized with respect to the reform date, that is P_t^*=P_t-P_{t0} where P_{t0} is January 1 and P_t are the dates before and after January 1; S_t is a dummy equal to 1 if P_t>P_{t0} and zero otherwise; and T_h indicates whether the hospital is located in a court district that adopted schedules (*i.e.*, $Treated_h$). The coefficient β_0 is the estimator identifying the treatment effect in the proximity of the reform date, as the treatment is $R_{th} = S_t * T_h$. Standard errors are clustered at the hospital level and we estimate the model with and without the same sets of control and fixed effects included in Equations 1 and 2. h is optimally computed following the algorithm developed by Calonico, Cattaneo, and Titiunik (2014a, 2014b).[24]

Finally, we present the results of a spline polynomial approximation and use all observations before and after P_{t0} using the model in Equation 4 for a quadratic and third-order polynomial:

$$Outcome_{iht} = \sum_{k=0}^{q}(\delta_k P_t^{*k}) + S_t \sum_{k=0}^{q}(\gamma_k P_t^{*k}) + T_h\big[\sum_{k=0}^{q}(\alpha_k P_t^{*k}) + S_t \sum_{k=0}^{q}(\beta_k P_t^{*k})\big] + \xi_{iht} \quad (4)$$

The direction of the effect detected by our DD estimator is confirmed when we combine the DD and RD approaches. As is apparent from Table 8, the increase in c-sections has

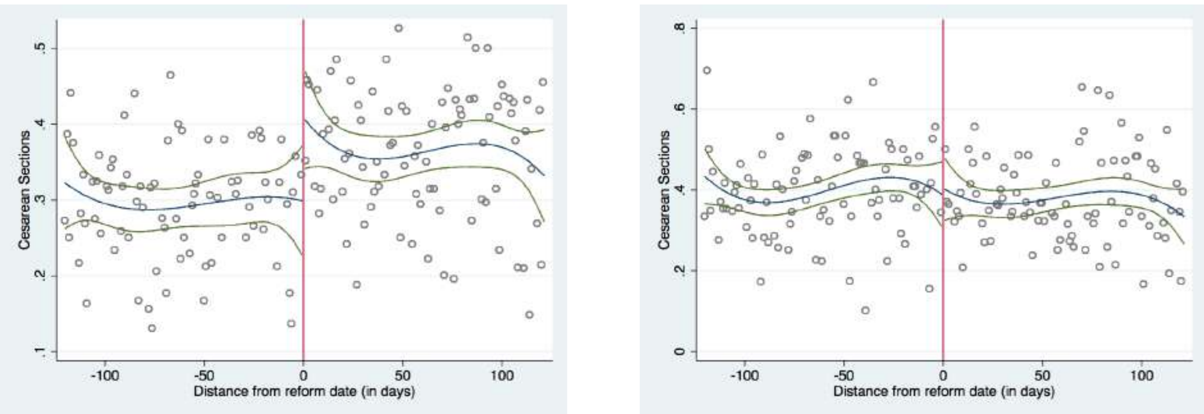
cisions is the Database of State Tort Law Reforms, DSTLR 5^{th} which includes US state laws from 1975 until 2012 (Avraham, 2015). Its *clever* version considers all reforms in place for 3 years or less to have never been implemented due to their supposed inability to affect liability pressure on physicians.

[24]We also adopted the cross-validation method proposed by Ludwig and Miller (2007). The results do not change and are available upon request.

already occurred around the date of schedule implementation, and its magnitude ranges between 24% (OB) and 22% (second-order polynomial) at the sample mean of c-sections in our preferred specifications, which include controls. These results are also confirmed by the RD graphical analysis. As is apparent from Figure 4, treated hospitals report a jump in the number of c-sections at the date of schedule implementation, while no discontinuity is observed in the behavior of control hospitals. This means that healthcare providers are sensitive to changes in medical liability pressure in the short run. They are aware of the malpractice environment they face, and they adjust their medical decisions within a relatively brief period. For instance, in the first column of Table 8, the optimal bandwidth corresponds to 142 working days. Hence, at approximately 7 months after schedule introduction, physicians increased the rate of c-sections by 8.9 percentage points. The results from this second identification strategy also confirm the lack of benefits for maternal and neonatal health status, as shown by Table 8.

Figure 4: **Discontinuity for C-section**

(a) Treated (b) Control



Notes: The central line is a spline third-order polynomial fit; above and below the central line are the lines representing the 95% confidence interval. Scatter points are the hospitals' average weekly c-sections.

We test the robustness of these results in two ways. First, we follow Della Vigna and La Ferrara (2012) and perform a set of placebo tests with a false reform date. To remain sufficiently far away from the true reform date, we set the treatment date used in Equation 3 at any day between 11 and 111 days before and after the actual reform date (*i.e.*, from September 12 until December 20, 2001 and from January 13 until April 23, 2002). Figure 5 shows the cumulative distribution function of the results obtained for these 200 placebo point estimates normalized with respect to our baseline point estimates from the third-order spline polynomial for $C-section$. Therefore, for example, a normalized coefficient of 60 means that the related placebo point estimate is equal to 60% of the true baseline estimate. At the false dates, we should not observe treatment effects systematically similar to our baseline results, and thus, the vast majority of the normalized coefficients should fall within the interval from -100 to +100.

Figure 5 shows that this is the case regardless of whether we include or exclude our

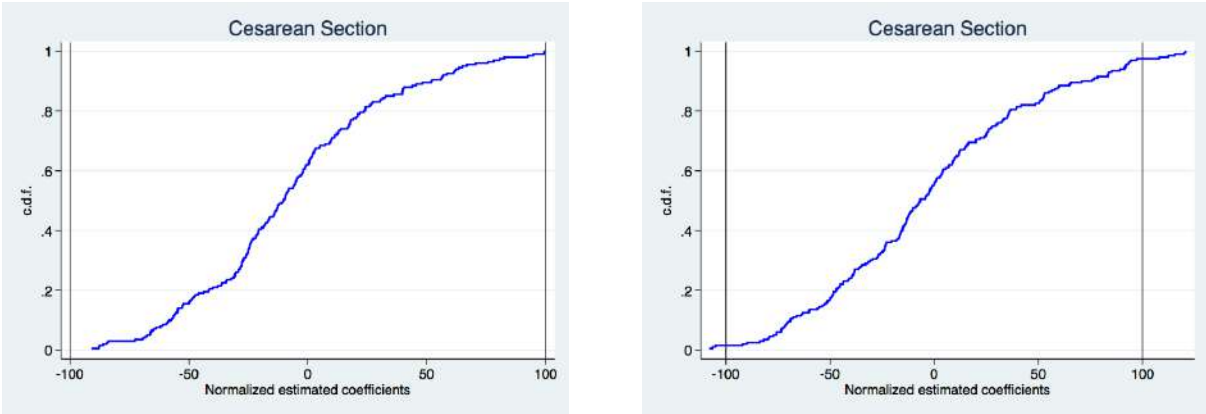
Table 8: **DD and RD**

	Mothers				Newborns		
	LLR CCT	Spline 2nd	Spline 3rd		LLR CCT	Spline 2nd	Spline 3rd
Panel A: With No Controls and No Fixed Effects							
Csection	0.096**	0.094***	0.112***	*Vag compl*	0.058	0.037	0.016
	(0.037)	(0.030)	(0.041)		(0.058)	(0.039)	(0.057)
Obs.	13,190	34,306	34,306		8,063	35,734	35,734
Preventable	-0.014	-0.002	-0.022	*Csec compl*	0.001	0.053	0.016
	(0.019)	(0.017)	(0.025)		(0.033)	(0.035)	(0.035)
Obs.	13,402	34,306	34,306		5,463	35,734	35,734
				Breathing int	-0.010	0.002	-0.010
					(0.011)	(0.011)	(0.010)
				Obs.	7,994	35,734	35,734
Panel B: With Controls and Fixed Effects							
Csection	0.089**	0.081**	0.098**	*Vag compl*	0.074	0.031	0.036
	(0.037)	(0.033)	(0.041)		(0.053)	(0.039)	(0.049)
Obs.	13,190	34,306	34,306		8,063	35,734	35,734
Preventable	-0.018	-0.012	-0.030	*Csec compl*	0.006	0.047	0.033
	(0.019)	(0.018)	(0.024)		(0.032)	(0.032)	(0.032)
Obs.	13,402	34,306	34,306		5,463	35,734	35,734
				Breathing int	-0.007	0.004	-0.006
					(0.011)	(0.010)	(0.010)
				Obs.	7,994	35,734	35,734

Notes: Controls include $X1$, $X2$, and $X3$ when outcomes refer to mothers and $X3$ and $X4$ when outcomes refer to newborns, as listed in Table 3. Fixed effects are for years, weekdays, and LHA. Estimation methods: Local Linear Regression (LLR) with 1 optimal bandwidth h, as in Equation 3, and spline polynomial approximation with second- and third-order polynomials, as in Equation 4. The optimal bandwidth in the first column – CCT – is estimated following Calonico *et al.* (2014a, 2014b). h=142 working days for cesarean section and 145 for preventable complications. We include robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

Figure 5: **Placebo Tests**

(a) Without Covariates (b) With Covariates



Notes: Placebo tests based on permutation methods for c-sections. The figure shows the cumulative distribution function of the normalized point estimates obtained by estimating Equation 3 at false reform dates between 11 and 111 before and after the actual reform date. Estimation method: spline polynomial approximation with third-order polynomial. The vertical lines represent our benchmark estimate for c-section from Table 8 and its negative value.

controls. All placebo coefficients are below our baseline estimates when no covariate is included, while fewer than 0.5% of the normalized placebo coefficients exceed the true coefficient in absolute value when covariates are included. Overall, our placebo tests exclude the presence of any anticipatory behaviors. In addition, they also allow us to exclude the possibility that the magnitude of our results is produced by random chance, rather than by a causal relationship. In addition, following the suggestion of Gelmans and Imbens (2016), we test our results by selecting alternative bandwidths, as shown in Tables A.8 and A.9 in the Online Appendix. Our results are robust to the use of several h values, as well as to the use of hospital fixed effects, as is apparent from Table A.7.

5 Concluding Remarks

By exploiting the implementation of schedules at the court district level in Italy, we study whether a reduction in medical liability affects the use of delivery methods in the context of childbirth. During our period of observation, 2001-2003, 18 courts implemented schedules in 2002. Since hospital location determines the court in which a claim must be filed, medical liability decreases only for those hospitals overseen by courts that switched to schedules. Applying a DD estimation, we show that hospitals react to a decrease in medical liability by increasing the use of the more intensive and less appropriate treatment. In particular, schedules incentivize the performance of c-sections, which increase by 20%. Neither maternal nor newborn health benefit from these additional c-sections, which can therefore be classified as unnecessary procedures.

Our results are consistent with the model of Currie and MacLeod (2008), as they confirm that in a context of c-section overuse, a further decrease in liability does not discourage the use of c-sections; instead, it may provide doctors with additional latitude to perform them. The analysis of the channels through which this reaction operates reveals that the opportunistic behavior of doctors also depends on the characteristics of hospitals and of the environment in which they operate. In particular, hospitals more prone to respond to lower liability by increasing the number of c-sections are low-quality hospitals, hospitals located far from the pressure of consumers' association (and the pressure they exert), those facing lower levels of schedules, and those able to benefit from a higher level of reimbursements. Finally, we offer interesting insights into the timing of the response of healthcare providers to variations in liability. Combining the DD approach with an RD design, we show that healthcare providers react even in the short run and are able to increase the use of c-sections within 7 months after the decrease in liability.

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Appendix A: Additional Figures and Tables

Table A.1: **Example of Schedules**

			Age						
			1	2	3	4	5	6	7
			Age Index						
		Point value	1.000	0.995	0.990	0.985	0.980	0.975	
	10%	1,729.83	17,298.34	17,211.84	17,125.32	17,038.86	16,952.37	16,865.88	16,779.39
	11%	1,809.41	19,903.47	19,803.95	19,704.43	19,604.91	19,505.40	19,405.88	19,306.36
	12%	1,888.40	22,660.82	22,547.52	22,434.21	22,320.91	22,207.60	22,904.30	21,981.00
	13%	1,967.97	25,583.66	25,455.74	25,327.83	25,199.91	25,071.99	24,944.07	24,816.15
	14%	2,046.97	28,657.58	28,514.29	28,371.00	28,227.71	28,084.43	27,941.14	27,797.85
	15%	2,216.54	31,898.13	31,738.64	31,579.15	31,419.66	31,260.17	31,100.68	30,941.19
Disability	16%	2,205.54	35,288.61	35,112.16	34.935.72	34,759.28	34,582.83	34,406.39	34,229.95
	17%	2,285.11	38,846.87	38,652.64	38,458.41	38,264.17	38,069.94	37,875.70	37,681.47
	18%	2,364.11	42,553.91	42,341.14	42,128.37	41,915.60	41,702.83	41,490.06	41,277.29
	19%	2,443.68	46,429.89	46,197.74	45,965.59	45,733.44	45,501.29	45,269.14	45,036.99
	20%	2,522.67	50,452.48	50,201.21	49,948.95	49,696.68	49,444.41	49,192.14	48,939.88

Notes: Values are expressed in 2002 euros and taken from the reference table adopted by the Court of Milan in 2002. In the case of 10% disability suffered by a 3-year-old victim, the reference compensation amounts to 17,125.32 euros, which is obtained by multiplying the monetary percentage point value (1,729.83 euros) by ten by the age index (0.990). This mechanism foresees the simultaneous application of two criteria: (i) a progressive criterion for the determination of the monetary point values of the disability percentages; and (ii) a regressive criterion with respect to the age of the injured party. According to the first criterion the compensation varies unevenly and more rapidly as the severity of the injury increases. In contrast, the regressive criterion reflects the fact that, considering the average possible lifetime of a person, a victim who has been harmed at a younger age would bear the consequences of the physical impairment for a longer period than an older victim (De Paola and Avigliano 2009).

Table A.2: **Weekday Deliveries**

	Deliveries	**Cesarean Sections**
Tuesday	36.882***	26.040***
	(6.919)	(4.040)
Wednesday	6.182	6.619
	(6.919)	(4.040)
Thursday	15.169*	15.403***
	(6.919)	(4.040)
Friday	1.258	3.173
	(6.919)	(4.040)
Saturday	-88.064***	-70.365***
	(6.930)	(4.046)
Sunday	-184.436***	-134.362***
	(6.941)	(4.053)
Observations	1,095	1,095

Notes: The reference sample was obtained by collapsing the dataset for the main analysis by weekdays of each year. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

Table A.3: **DD - Main Results with Weekend Deliveries**

	Mothers		**Newborns**		
	Csection	**Preventable**	**Vag Compl**	**Csec Compl**	**Breathing Interv**
Panel A: With No Controls and No Fixed Effects					
δ	0.073***	0.006	0.005	0.017	-0.002
	(0.021)	(0.010)	(0.030)	(0.012)	(0.004)
Controls	No	No	No	No	No
Obs.	70,200	70,200	70,183	70,183	70,183
Mean	0.354	0.082	0.226	0.053	0.018
Panel B: With Controls and Fixed Effects					
δ	0.069***	0.002	-0.002	0.018*	-0.001
	(0.019)	(0.010)	(0.021)	(0.010)	(0.004)
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	70,200	70,200	70,183	70,183	70,183
Mean	0.354	0.082	0.226	0.053	0.018

Notes: Controls include $X1$, $X2$, and $X3$ when outcomes refer to mothers and $X3$ and $X4$ when outcomes refer to newborns, as listed in Table 3. Fixed effects are for years, weekdays, and LHA. Linear probability model regressions. Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

Table A.4: **Descriptive Statistics**

	Total	**Treated**	**Control**
Outcomes at the mother level			
C-section	0.370	0.373	0.367
	(0.483)	(0.4784)	(0.482)
Preventable	0.083	0.088	0.077
	(0.276)	(0.283)	(0.266)
Controls at the mother level			
Age	30.431	30.310	30.578
	(7.99)	(7.848)	(5.151)
Italy	0.937	0.939	0.934
	(0.244)	(0.239)	(0.249)
Married	0.778	0.801	0.749
	(0.416)	(0.399)	(0.434)
Risk Factors	0.110	0.105	0.116
	(0.313)	(0.306)	(0.320)
Controls at the mother municipality level			
Average Income (2015 euro)	16,578.280	16,378.180	16,824.060
	(2,903.539)	(2,934.600)	(2,845.797)
Altitude (m)	691.388	642.140	751.882
	(495.211)	(450.262)	(539.265)
Low Urbanization	0.270	0.300	0.232
	(0.444)	(0.458)	(0.422)
Medium Urbanization	0.633	0.649	0.613
	(0.482)	(0.477)	(0.487)
High Urbanization	0.097	0.051	0.154
	(0.296)	(0.219)	(0.361)
Education	0.060	0.060	0.061
	(0.029)	(0.028)	(0.031)
Observations	53,266	29,362	23,904

Notes: *Outcomes* are described in Table 3. *Risk Factors* captures the incidence of risk factors as described by dummies in *Cov*1 of Table 3. *Italy* is equal to 1 if the mother is Italian and 0 otherwise. *Income* is in 2015 euros. *Education* is the share of municipal residents with a college degree as measured in the 2001 Census data. *Urbanization* captures both population density per square kilometer and the municipality dimension. It is provided by the National Institute of Statistics as measured in the 2001 Census data. *Sea Level* is in meters. Variables at the mother level are available through the patient discharge records, while variables at the mothers' municipality level are available through the Italian National Institute of Statistics.

Table A.5: **Descriptive Statistics (Cont'd)**

	Total	**Treated**	**Control**
Outcomes at the newborn level			
Cesarean Complications	0.055	0.062	0.044
	(0.227)	(0.242)	(0.206)
Vaginal Complications	0.226	0.244	0.201
	(0.419)	(0.430)	(0.400)
Breathing Interventions	0.018	0.014	0.024
	(0.134)	(0.119)	(0.152)
Controls at the newborn level			
Congenital anomalies	0.026	0.024	0.028
	(0.159)	(0.154)	(0.165)
Maternal conditions	0.045	0.048	0.039
	(0.206)	(0.215)	(0.193)
Italian	0.978	0.981	0.975
	(0.145)	(0.137)	(0.155)
Observations	54,058	31,584	22,474

Notes: *Outcomes* is described in Table 3. *Income* is in 2015 euros. *Education* is the share of municipal residents with a college degree as measured in the 2001 Census data. *Urbanization* captures both population density per square kilometer and the municipality dimension. It is provided by the National Institute of Statistics as measured in the 2001 Census data. *Sea level* is in meters. Variables at the mother level are available through the patient discharge records, while variables at the mothers' municipality level are available through the Italian National Institute of Statistics.

Table A.6: **DD - Results with Hospital Fixed Effects**

	Mothers		**Newborns**		
	Csections	**Preventable**	**Vag Compl**	**Csec Compl**	**Breathing Int**
δ	0.066***	0.006	0.003	0.018*	-0.002
	(0.018)	(0.010)	(0.035)	(0.010)	(0.004)
Controls	Yes	Yes	Yes	Yes	Yes
Years FE	Yes	Yes	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes	Yes	Yes
Weekdays FE	Yes	Yes	Yes	Yes	Yes
Obs.	53,266	53,266	54,058	54,058	54,058
Mean	0.370	0.828	0.226	0.055	0.018

Notes: Controls include $X1$, $X2$, and $X3$ when outcomes refer to mothers and $X3$ and $X4$ when outcomes refer to newborns, as listed in Table 3. Linear probability model regressions. Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

Table A.7: **DD and RD - Results with Hospital Fixed Effects**

	LLR CCT	Spline 2nd	Spline 3rd
Panel A: Mothers			
Csection	0.071**	0.066**	0.080*
	(0.034)	(0.031)	(0.039)
Preventable	-0.014	-0.005	-0.023
	(0.019)	(0.018)	(0.025)
Controls	Yes	Yes	Yes
Weekdays FE	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes
Panel B: Newborns			
Vag compl	0.070	0.044	0.069
	(0.051)	(0.036)	(0.047)
Obs.	8,063	35,734	35,734
Csec compl	0.013	0.031	0.013
	(0.032)	(0.031)	(0.030)
Obs.	5,463	35,734	35,734
Breathing int	-0.006	0.003	-0.002
	(0.011)	(0.009)	(0.009)
Obs.	7,994	35,734	35,734
Controls	Yes	Yes	Yes
Weekdays FE	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes

Notes: Controls include $X1$, $X2$, and $X3$ as listed in Table 3. Estimation methods: Local Linear Regression (LLR) with 1 optimal bandwidth h, as in Equation 3, and spline polynomial approximation with second- and third-order polynomials, as in Equation 4. The optimal bandwidth in the first column – CCT – is estimated following Calonico *et al.* (2014a, 2014b). Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

Table A.8: **DD and RD - Main Results on Mothers with Alternative Bandwidths**

	100 days	200 days	300 days
Panel A			
Csection	0.118***	0.102***	0.077**
	(0.043)	(0.032)	(0.029)
Preventable	-0.019	-0.001	0.004
	(0.019)	(0.016)	(0.014)
Controls	No	No	No
Weekdays FE	No	No	No
LHA FE	No	No	No
Panel B			
Csection	0.103**	0.090***	0.075**
	(0.049)	(0.034)	(0.033)
Preventable	-0.025	-0.009	-0.002
	(0.019)	(0.017)	(0.016)
Obs.	9,116	18,758	28,215
Controls	Yes	Yes	Yes
Weekdays FE	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes

Notes: Controls include $X3$ and $X4$ as listed in Table 3. Estimation methods: Local Linear Regression (LLR) with 1 optimal bandwidth h, as in Equation 3, and spline polynomial approximation with second- and third-order polynomials, as in Equation 4. The optimal bandwidth in the first column – CCT – is estimated following Calonico *et al.* (2014a, 2014b). Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

Table A.9: **DD and RD - Main Results on Newborns with Alternative Bandwidths**

	100 days	200 days	300 days
Panel A			
Vag compl	0.034	0.007	0.036
	(0.052)	(0.038)	(0.037)
Csec compl	-0.025	0.049	0.014
	(0.035)	(0.032)	(0.023)
Breathing interv	-0.007	-0.004	-0.006
	(0.010)	(0.009)	(0.007)
Controls	No	No	No
Weekdays FE	No	No	No
LHA FE	No	No	No
Panel B			
Vag compl	0.051	0.010	0.027
	(0.049)	(0.034)	(0.033)
Csec compl	-0.007	0.037	0.006
	(0.030)	(0.026)	(0.021)
Breathing int	-0.003	-0.002	-0.005
	(0.009)	(0.008)	(0.007)
Obs.	9,129	20,779	29,728
Controls	Yes	Yes	Yes
Weekdays FE	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes

Notes: Controls include $X3$ and $X4$ as listed in Table 3. Estimation methods: Local Linear Regression (LLR) with 1 optimal bandwidth h, as in Equation 3, and spline polynomial approximation with second- and third-order polynomial, as in Equation 4. The optimal bandwidth in the first column – CCT – is estimated following Calonico *et al.* (2014a, 2014b). Robust standard errors clustered at the hospital level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

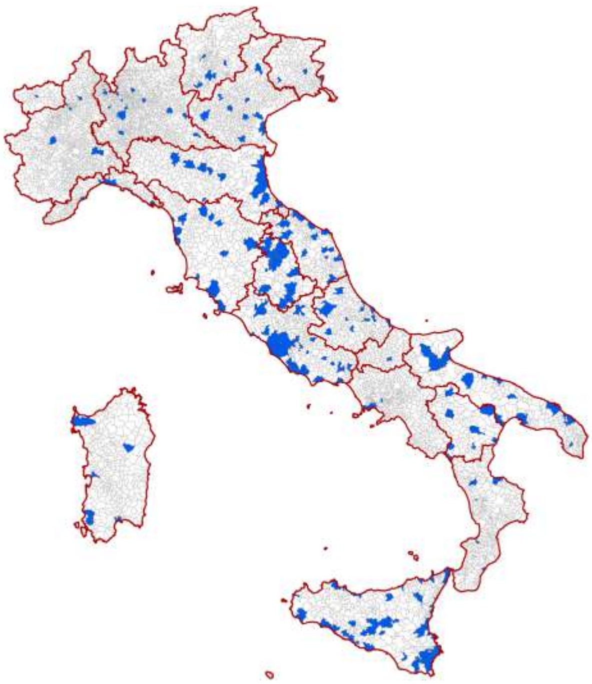
Figure A.1: **Tribunal of Patient Rights**

(a) Signs

(b) Location

Notes: These are pictures of the presence of a Tribunal of Patient Rights within an Italian Hospital. Patients can see signs indicating the presence of the Tribunal posted in the corridors of the hospitals. In practice a Tribunal is a room where employees of the non-profit organization are available to process any patient complaints.

Figure A.2: **Distribution of the Tribunals of Patient Rights**



Notes: We geo-located the Tribunals of Patient Rights using the address provided by the Active Citizenship Organization.

Abstrakt

Ve své práci studujeme, jak legální a finanční pobídky ovlivňují lékařská rozhodnutí. Za použití dat o pacientech, zjišťujeme statisticky významný efekt změny v lékařské odpovědnosti. Konkrétně ve své analýze využíváme zeměpisné rozložení nemocnic napříč soudními okrsky, kde některé okrsky podnikly kroky ke zlepšení odhadů očekávaných škod utrpěných zranění a jiné nikoliv. S vyšší jistotou odhadů očekávaných škod se zvyšuje míra zbytečných císařských řezů o 20%. K většímu zvýšení došlo u nemocnic nižší kvality, dále u nemocnic, které mají horší vztahy s pacienty, potom také u nemocnic čelící nižším očekávaným škodám a v neposlední řadě u nemocnic účtující si více za císařské řezy. Pomocí metod difference-in-differences a regression discontinuity designu ukazujeme, že je tento efekt patrný již v krátkém období.

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