HEDG

HEALTH, ECONOMETRICS AND DATA GROUP

WP 19/02

The strange case of appropriate C-sections: DRG-tariff regulation, hospital ownership, and market concentration

Paolo Berta; Gianmaria Martini;
Massimiliano Piacenza and Gilberto Turati

January 2019

http://www.york.ac.uk/economics/postgrad/herc/hedg/wps/

The strange case of appropriate C-sections: DRG-tariff regulation, hospital ownership, and market concentration

Paolo Berta[†], Gianmaria Martini[§], Massimiliano Piacenza[♯] and Gilberto Turati[♭*]

[†] *University of Milano-Bicocca, Department of Quantitative Methods - CRISP*

[§] *University of Bergamo, Department of Economics and Technology Management*

[♯] *University of Piemonte Orientale, Department of Economics and Business (DISEI), Novara*

[♭] *Catholic University, Department of Economics and Finance, Rome*

Abstract

The aim of this paper is to discuss how different types of hospitals respond to large financial incentives for vaginal deliveries and to financial disincentives for C-sections. We focus on a public health care system based on the quasi–market model. We theoretically and empirically evaluate a government policy equalizing the tariff for C-section and vaginal deliveries at a level such that hospitals face monetary disincentives for C-section and monetary incentives for vaginal deliveries. We first theoretically show that hospital ownership matters insofar different types of hospitals are characterized by different ethical preferences; but ownership interacts with market concentration. We then consider the case-study of Lombardy in Italy. We exploit spatial variation in the presence of for-profit, not-for-profit and public hospitals and in the market concentration at the local level to evaluate the relationship between ownership and the probability of C-section. Our empirical results strongly suggest that competitive pressures from alternative providers tend to homogenize behaviors. However, in local monopolies, we do observe less C-section from private for-profit hospitals than from public and private non-profit hospitals especially when they are medically appropriate.

JEL classification: I11, I18, L22, L33, D21, D22
Keywords: Public, for-profit and nonprofit hospitals, Market for birth deliveries, Tariff regulation, C-sections

*Corresponding author: G. Turati, Department of Economics and Finance, Faculty of Economics, Catholic University, Largo F. Vito 1, I-00168 ROMA, Italy, e-mail: gilberto.turati@unicatt.it.

Acknowledgements: We wish to thank Margaret Kyle, Paolo Di Caro, and all seminar participants at the 9th NERI Meeting (University of Genova), the 2nd Spatial Health Economics Workshop (University of York), and the 14th Annual IIOC (Drexel University, Philadelphia), for their insightful comments on preliminary drafts of this paper. We are grateful to Regione Lombardia (Assessorato alla Sanita) for kindly supplying the data. Usual disclaimers apply.

1 Introduction

The aim of this paper is to discuss how different types of hospitals respond to large financial incentives for vaginal deliveries and to financial disincentives for caesarean deliveries. There are worldwide concerns by both international organisations and national policymakers for the excessive use of C-sections, which have increased annually by 2.5% between 2000 and 2015, reaching an average of 28 per 100 live births among OECD countries (OECD Health at a Glance, 2017). Also in countries where C-sections are less common, the share is close or even slightly exceeds the 10-15% share needed to avoid mortality identified by the WHO (e.g., Ye et al., 2014). Nordic countries are those recording the lowest shares (from 15.5% in Finland to 21% in Denmark), while in Turkey, Mexico and Chile one out of two births are delivered by C-sections in latest years. The share is large also in the USA and in Italy, where one out of three birth deliveries are C-sections.

This rapid worldwide increase stimulated the attention of both economists and medical scholars towards understanding the potential factors behind this growth. The changes observed in the reproductive behavior of women (e.g., the increase in the age at first delivery) do certainly play a role. Nonetheless, many other nonclinical factors affect the choice of the delivery method like the availability of new technologies for monitoring the foetus health during pregnancy, the fear of malpractice liabilities, the scheduling convenience for both physicians and women, as well as the incentive role of the reimbursement mechanism (e.g., Ecker and Frigoletto, 2007; Francese et al., 2014).

The role of prices has drawn most of the economists' attention since C-sections are traditionally paid better than vaginal deliveries. The common finding across studies is an increase in the use of the procedure by hospitals triggered by the increase in the price differential between caesarean and vaginal deliveries. Estimates based on US Medicaid data suggest that C-sections would rise by a range between 2 to 7% following a $100 increase in the compensation received for a caesarean relative to a vaginal delivery, depending on the inclusion in the model of state-specific time trends and the sample period (Gruber et al., 1999; Grant, 2009; Alexander, 2013). Similar evidence of a positive impact of higher tariffs on the use of C-sections has been found also for other countries: for instance, Allin et al. (2015) find that doubling the compensation for a C-section relative to a vaginal delivery increases the likelihood that a physician opts for the former method by 5 percentage point in Canada; Bogg et al. (2010) provide descriptive evidence for China that

the increased level of fees for C-sections, following the introduction of a New Cooperative Medical Scheme, has induced a significant increase in the use of this delivery method. The main conclusions following this literature are that incentives matter, some C-sections are likely to be medically inappropriate and expenditure likely to be inefficiently inflated. Tackling the issue of unnecessary C-sections is unsurprisingly one of the most common examples to reduce inappropriateness and wasteful spending, a key challenge in recent decades for policy makers worldwide (e.g., OECD, 2017).

There are different policy options identified by international organizations to combat low-value care: the use of guidelines or campaigns promoting the dialogue between patient and clinician (like the Choosing Wisely project), the pre-authorization of certain procedures, but also the use of financial incentives and disincentives. The traditional approach to payment for birth deliveries is that a C-section is paid more since it is a surgical procedure as opposed to vaginal delivery which is a medical procedure; hence, tariffs reflect a cost differential for hospitals. However, in recent years, some countries have reviewed their payment policies. For instance, with the Maternity Pathway Payment introduced in April 2013 the UK government has defined a bundled payment which should remove the financial incentive for C-sections (e.g., OECD, 2017). At present, there are no studies evaluating the effectiveness of this policy. Another example is provided by the Taiwanese government, which introduced in 2005 a co-payment for patients requiring C-sections when unnecessary, but also increased the tariff for vaginal delivery up to the same level of C-sections. Evaluating the impact of this combined policy, Chen et al. (2014) find that while the overall trend of C-sections utilization did not stop, elective C-sections were reduced. However, it is hard to separate the effect attributable to copayment from the effect of tariffs.

In this paper we consider a similar policy introduced in 2005 by the regional government of Lombardy in Italy, which equalized the tariff for the two delivery methods creating a large rent for vaginal deliveries and penalizing C-sections, while leaving free-of-charge for patients the access to service. Our aim is to explore if and how the large incentive for vaginal delivery is related to the behavior of public, nonprofit, and for-profit hospitals; and whether this correlation changes in different local markets. The regional health care system in Lombardy comprises around 150 hospitals producing 2 million discharges annually for a total budget of about 18 billion euros, which are similar to numbers characterizing countries like Austria, Belgium, Greece, and about two times Finland. Our empirical analysis is guided by a

simple theoretical framework which we build from Brekke et al. (2011), and exploits individual level data on more than 80,000 birth deliveries per year between 2010 and 2012. Controlling for a large set of mother socio-economic characteristics, as well as information on pregnancy, labor, and the newborn, we find that private for-profit hospitals are more responsive to the large financial incentive for vaginal deliveries than the other types of hospitals when C-sections are likely to be more medically appropriate; and they do so more in local markets that are less competitive.

Our findings provides additional evidence to the large literature studying whether hospital ownership matters in health care, a literature which is mostly based on US data given the presence of different types of providers in the American medicine. Using California hospital-level data, Duggan (2000) finds that nonprofit hospitals are just as responsive to financial incentives and are no more altruistic than their for-profit counterparts. The crucial difference is between private and publicly owned hospitals, with the latter that are unresponsive to financial incentives because of their soft budget constraint. However, surveying the literature, Schlesinger and Gray (2006) suggest that studies involving a single-service or a single well-defined outcome find consistent differences across ownership types; in particular, for-profit hospitals are more aggressive and less trustworthy than their nonprofit counterparts. Horwitz and Nichols (2011) confirm this view investigating the role of different hospitals in rural areas; findings suggest that nonprofit hospitals are more likely than for-profit to supply unprofitable services and are less responsive to changes in profitability. Similarly, Bayindir (2012) finds that nonprofit hospitals significantly differ from for-profit providers in terms of treatment choices and patient selection, while the difference between nonprofit and government hospitals is found to be insignificant, which supports the view that they have similar objective functions. Silverman and Skinner (2004) and Dafny (2005) adds evidence to the literature showing that for-profit hospitals are more responsive in up-coding patients than nonprofit and public hospitals. Finally, Horwitz and Nichols (2009) consider how the behavior of different hospitals varies with the share of for-profit hospitals in local markets, showing that not-for-profits are more likely to behave as for-profits in markets with a high concentration of for-profit clinics; government hospitals follow the same behavior, although the effect is weaker. A similar behavior is detected by Silverman and Skinner (2004) with respect to up-coding. Our paper contributes to this literature by considering the market for birth deliveries and the policy issue of reducing inappropriate C-sections.

We show that using price incentives to curb inappropriateness in C-sections might deliver inappropriate vaginal deliveries, especially if for-profit clinics are active in this market as local monopolists.

The remainder of the paper is structured as follows: Section 2 presents essential background information, while Section 3 provides a theoretical framework for the empirical analysis. Section 4.2 shows our empirical strategy, Section 4.1 presents the data while our empirical evidence is reported in Section 5. Section 6 summarizes our findings.

2 Background

The Italian National Health Service (NHS) was created in 1978 to provide all citizens universal coverage for a large set of constitutionally defined essential healthcare services, which includes also antenatal, maternal and neonatal care. During the Nineties, two main reforms changed the originally defined NHS with the aim of improving efficiency in service delivery: on the one hand, a large process of legislative as well as fiscal decentralization moved the management and, partly, the funding of services from the central to the regional governments, leaving to the central government the definition of framework legislation and the role of equalizing resources across territories; on the other hand, a second reform introduced the quasi-market model to substitute the integrated public model which was producing large deficits and inefficiencies.

Among the Italian regions, Lombardy is one of the most important: it ranks among the most rich and competitive areas in Europe, with GDP per-capita between 25-50% above the EU-28 average (Eurostat, 2017). It is by far the most populated Italian region, hosting about 10 million citizens (16% of the whole population). The regional healthcare system is also one of the most important and efficient in Italy (e.g., Brenna, 2011), with spending reaching about 18 billion euros in recent years. As for hospital services, the regional system counts on approximately 150 hospitals producing 2 million discharges annually (including acute care, rehabilitation, day-hospitals), about 10% of which are patients living outside Lombardy.

In 1997, following the national framework legislation introducing the quasi-market model, a regional law radically transformed the regional healthcare system. Differently from other regional governments, Lombardy took seriously the new organizational model and created a public insurer separated

from public providers of services: Local Health Authorities (LHA) were then all separated from public hospitals, which compete since then with for-profit and nonprofit private hospitals to attract citizens that can freely choose their providers. Despite the region being one of those where the presence of private providers is most common, the role of private hospitals is different in Lombardy than in the USA: private beds represent only about 15% of the available total hospital beds at the regional level in the last twenty years (Health for All - Italy, 2017). However, as we show below in Section 4.1, there is a large heterogeneity across different provinces (which are somewhat characterized by the same administrative boundaries of LHAs), with respect to both the presence of private for-profit and nonprofit providers and their role in providing services to citizens.

The Italian quasi-market model was entirely defined from the original framework legislation identifying a prospective payment system based on Diagnosis Related Groups (DRGs) to remunerate providers. Like in the USA, under the DRG-based payment system hospitals receive a pre-determined tariff for each treatment they provide. Each patient is coded into a DRG according to the clinical information reported in the hospital discharge records. It is important to notice that the regional government of Lombardy was one of the few that decided to opt out from centrally determined tariffs, creating its own system of regional tariffs to tailor the payment to regional hospitals' costs (e.g., Fattore and Torbica, 2006). Following this approach, the regional government also characterizes itself for a pronounced attitude towards periodical DRG price changes. However, besides being an instrument to adjust prices to cost and to inflation, tariff regulation is also used as a tool to regulate the local healthcare system and to influence hospitals' behaviour (e.g., Cappellari et al., 2016).

Concerning birth deliveries, the regional government introduced a new and innovative payment scheme since 2005, when tariffs for vaginal birth and caesarean delivery were equalized, introducing a strong incentive for the former and a disincentive for the latter. The main goals behind this choice were to curb the number of C-sections (despite the share of caesarean was below the national average), and to avoid the charge of favouring private clinics for birth deliveries (which is a huge problem in some Italian regions like Campania or Sicily, where some private providers are characterized by C-sections rates above 80-90%). In particular, the new 2005 tariff for birth deliveries in Lombardy was fixed at 1,769 euro, up from 1,648 euro for vaginal deliveries and from 1,718 euro for C-sections back in 1999 (e.g., Cappellari et

al., 2016). In our sample period, the tariff was then raised to 2,095 in 2010 and 2,097 in 2011 and 2012.

To appreciate the incentives and disincentives implicit in the regional tariff, one can compare the unique tariff for birth deliveries in Lombardy with the national ones: 2,457 euro for a C-section, and 1,318 euro for a vaginal delivery. The regional tariff then implicitly defines a strong incentive for vaginal deliveries (allowing about a 60% mark-up on the national tariff) and a mild disincentive for C-sections (the mark-down is about 15%). How did different types of private hospitals respond to these implicit incentives and disincentives? More importantly, does this depend on the degree of concentration of local markets? These are the issues we aim at exploring in the remainder of the paper.

3 Theoretical framework

As a guide for the empirical analysis below, in this section we preliminarily define a theoretical framework describing hospitals' behavior in the decision between two mutually exclusive alternatives for delivery (a vaginal delivery V or a C-section C) building on Brekke et al. (2011). This decision is taken by the hospital's physicians and is based on three factors: (1) the *appropriateness* of the treatment; we assume that the physicians know — after observing the clinical conditions of the prospective mother — whether the appropriate treatment is V or C. Let $h(T|A)$ be the total health benefit to both the mother and the baby when treatment T is chosen given appropriate treatment A.[1] (2) The *monetary incentives*, given that the hospital receives a predetermined price defined by the regulator (either the national or the regional government) for each delivery. In particular, we define as $M_T = p_T - c_T$ the hospital's monetary profit when treatment $T = (V, C)$ is chosen, with p_T being the regulated pre-determined tariff and c_T the costs. (3) The *ethical preferences* of the hospital physicians, $\phi \in [0, 1]$, which weight the importance of appropriateness with respect to monetary incentives and measures the degree of altruism of the hospital.

[1] Notice that the decision regarding the treatment is then conditional on the appropriate treatment, and the physician has to choose among four alternatives: (1) to provide a vaginal delivery when it is appropriate $(V|V)$, (2) a vaginal delivery when a caesarean is appropriate $(V|C)$, (3) a caesarean when a vaginal is appropriate $(C|V)$, and (4) a caesarean when a caesarean is medically appropriate $(C|C)$.

The objective function for hospital i is then assumed to be defined as follows:

$$\pi_i(T_i|A_i;\mathbf{T}_{-i}|\mathbf{A}_{-i}) = X(T_i|A_i;\mathbf{T}_{-i}|\mathbf{A}_{-i})\left[\phi h(T|A) + (1-\phi)M_T\right] \quad (1)$$

where $X(T_i|A_i;\mathbf{T}_{-i}|\mathbf{A}_{-i})$ is the number of patients for hospital i given the choice of appropriate treatments by hospital i and rival hospitals $(\mathbf{T}_{-i}|\mathbf{A}_{-i})$. We assume, without any loss of generality, a mass of patients $X(.) = 1$ in each local market.

Local monopolies. Let us start by considering the most simple case of local monopolies. To understand the different incentives provided by the regulator in Lombardy, we compare two tariff regimes: (1) a national (n) regime where $p_V^n < p_C^n$, which prices C-sections more than vaginal deliveries ; and (2) a regional (r) regime with $p_V^n < p_V^r = p_C^r < p_C^n$. Under the national scheme the monetary profit is higher with a C-section when $M_C = p_C - c_C > p_V - c_V = M_V$, which implies $p_C - p_V > c_C - c_V$. Let us assume that this condition holds: notice that, since a C-section is a surgical treatment whereas a natural delivery is a medical treatment, hence c_C are higher than c_V, this implies that the difference in tariffs is larger than the difference in costs. The previous inequality immediately suggest that a purely opportunistic hospital $(\phi = 0)$ will provide C-sections even when they are not appropriate, simply because they are more profitable than vaginal deliveries. This points out the issue that has been raised by many authors in the empirical literature (e.g., for Italy, Francese et al., 2014; Cavalieri et al., 2014). However, accounting for ethical preferences can even counterbalance profit incentives. Inappropriate C-sections requires:

$$\pi_i(C|V) = \phi h(C|V) + (1-\phi)M_C > \pi_i(V|V) = \phi h(V|V) + (1-\phi)M_V \quad (2)$$

which — after some algebraic manipulations and considering $h(V|V) \gg h(C|V)$ — can be re-written as:

$$\phi^* < \frac{\underbrace{M_C - M_V}_{>0}}{\underbrace{[h(V|V) - h(C|V)]}_{>0} + \underbrace{[M_C - M_V]}_{>0}} \ll 1 \quad (3)$$

Intuitively, condition 3 suggests that inappropriate C-sections can be supplied whenever physicians' ethical preferences are sufficiently low, i.e. below the threshold ϕ^*. By the same argument, it is immediate to show that when a C-section is appropriate it will always be chosen as the preferred treatment. Hence, we can highlight the following remark:

Remark 1. *Under the national tariff regime, with $p_C > p_V$, a C-section is always chosen when appropriate by a local monopolist, but it is also chosen when it is inappropriate if $\phi < \phi^*$.*

We now turn to the regional case of Lombardy, with $p_V^n < p_V^r = p_C^r < p_C^n$. Since $c_V < c_C$, it immediately follows that $M_V \gg M_C$. This implies that — if we consider only the pure monetary incentives for hospitals – a vaginal delivery should always be provided. Notice that incentives for hospitals are then completely reversed in this case, and inappropriate C-sections are never an optimal strategy for hospitals since $\pi_i(V|V)$ is always greater than $\pi_i(C|V)$. This can be easily seen by inspecting condition (3) above. What becomes an issue in this case — somewhat surprisingly with respect to the literature — are inappropriate vaginal deliveries. As before, this requires $\pi_i(V|C) > \pi_i(C|C)$, which again boils down to:

$$\phi^* < \frac{M_V - M_C}{[h(C|C) - h(V|C)] + [M_V - M_C]} \ll 1 \tag{4}$$

We can then underline the following:

Remark 2. *Under the regional tariff regime with $p_V^n < p_V^r = p_C^r < p_C^n$ a vaginal delivery is always chosen when appropriate by a local monopolist, but it is also chosen when it is inappropriate if $\phi < \phi^*$.*

Combining the two remarks, it is clear that an increase in ϕ will always be accompanied by an increase in appropriateness. Unsurprisingly, when ethical preferences matter more, hospitals enjoying a local monopoly will choose more appropriate treatments for their patients. Notice also that both (3) and (4) will be more difficult to be satisfied either when the increase in monetary profits becomes smaller or the improvement in patients' health gets bigger. Intuitively, if choosing the inappropriate treatment will not make a large monetary gain, then only a hospital weighting profits relatively much more than patients' health can find preferable to supply the inappropriate delivery. On the contrary, if providing the appropriate treatment implies a

large benefit in patients' health, then also a profit-oriented hospital can find better to provide this appropriate treatment. This bring us to the following:

Remark 3. *Considering the incentives implicit in the tariff regime, an increase in ϕ will always result in an increase in appropriateness when hospitals enjoy local monopoly power. The critical threshold ϕ^* for providing inappropriate treatments becomes more stringent when $\Delta M = (M_V - M_C) \to 0$ or $\Delta h = [h(C|C) - h(V|C)] \to \infty$.*

Competition among hospitals. Let us now consider the case in which patients are free to choose among different hospitals. Following the literature on quality, we assume that hospitals increase their market share by choosing the most appropriate treatment given the clinical conditions of patients. Hence $\partial X(.)/\partial A > 0$, where A measures the degree of appropriateness of a treatment, which is assumed for simplicity to be observable also by patients[2]. We further assume that transportation costs are negligible in local markets.

Maximizing 1 with respect to A_i, and applying symmetry, the degree of appropriateness in equilibrium is implicitly defined by:

$$\frac{\partial X(.)}{\partial A_i}\left[\phi h\left(T|A\right) + (1-\phi)M^T\right] + X(.)\left[\phi\frac{\partial h\left(T|A\right)}{\partial A_i}\right] = X(.)(1-\phi)\frac{\partial M^T}{\partial A_i} \quad (5)$$

where $\partial h(T|A)/\partial A > 0$ and $\partial M^T/\partial A < 0$. Intuitively, if appropriateness increases, the health benefit for patients increases, while profits are likely to decrease. Interpretation of Eq. 5 is straightforward: the two terms on the LHS measures the marginal impact stemming on hospital's surplus from both the increase in demand and the marginal increase in benefits for patients; these are to be balanced with the marginal reduction in profits stemming from the switch to more appropriate treatments.

Applying the implicit function theorem to study how A^* varies with respect to ethical preferences ϕ, we obtain the following condition:

$$\frac{dA^*}{d\phi} = -\frac{\left[\frac{\partial X(.)}{\partial A_i}h + X\frac{\partial h(T|A)}{\partial A_i}\right] - \left[\frac{\partial X(.)}{\partial A_i}M^T + X\frac{\partial M^T}{\partial A_i}\right]}{\left[2\phi\frac{\partial X}{\partial A_i}\frac{\partial h}{\partial A_i} + X(1-\phi)\frac{\partial^2 M^T}{\partial A_i^2}\right] - \{\Sigma\}} \quad (6)$$

[2]Notice that the share of C-sections is a common indicator published by the Ministry of Health, which is usually taken as a measure of inappropriateness.

where:

$$\Sigma = \left\{ \frac{\partial^2 X}{\partial A_i^2} \left[\phi h + (1-\phi) M^T \right] + X\phi \frac{\partial^2 h}{\partial A_i^2} + \frac{\partial X(.)}{\partial A_i} (1-\phi) \frac{\partial M^T}{\partial A_i} \right\} \quad (7)$$

The sign of 6 is ambiguous without any further assumptions. Hence, in general, the presence of alternative hospitals will make the role of ethical preferences of less importance to understand appropriateness, a result already stressed by Brekke et al. (2011). The rationale behind this result is that increasing appropriateness would result in an inflow of patients, for whom health benefits increase (the first term in square brackets in the numerator), which makes less vital the marginal reduction in monetary profits stemming from the switch to a more appropriate set of treatments (the second term in the numerator). This brings us to the following:

Remark 4. *The impact of ethical preferences on appropriateness is not a priori clear in more competitive environments. Additionally, more competitors do not unambiguosly lead to a higher degree of appropriateness.*

To put it differently, the impact of competition on appropriateness and the behaviors of different hospitals becomes an empirical matter.

Testable prediction. Concentrating on the case of Lombardy allows variability along different dimensions. First, there are different types of providers supplying services in the regional health care system, which allows for variation in average ϕ across groups of hospitals. Second, there are local markets for birth deliveries characterized as local monopolies, but also urban markets characterized by the presence of a sufficiently large number of suppliers. As for providers' type, distinguishing public, private not-for-profit and private for-profit hospitals, we expect $\phi^{Pub} \geq \phi^{Npo} > \phi^{Fpo}$. Taking into account the peculiar set of tariffs favouring vaginal deliveries (which, in Lombardy, makes $\Delta M = (M_V - M_C)$ quite large), we should then observe a lower share of C-sections (when these are most appropriate, i.e., when $\Delta h = h(C|C) - h(V|C)$ is large) in private for-profit hospitals operating in local monopolies than in private not-for-profit and public ones. This brings us to the following testable hypothesis: *accounting for the clinical conditions of prospective mothers, in local monopolies the share of appropriate C-sections is lower in private for–profit hospitals than in public and private not–for–profit hospitals. This difference is expected to be larger when C-sections are more appropriate, i.e., when Δh is larger.*

From an empirical point of view, as long as incentives are the same for all providers in Lombardy, we need to explore how behaviors across different groups of hospitals change when Δh changes in more concentrated markets. As we do not have unambiguous results on the effect of competition we will then check also how behaviors vary for different degree of market concentration.

4 Data and Empirical Strategy

4.1 Data

We use administrative patient–level data from the Birth Assistance Certificates (CEDAP), which includes all the birth deliveries occurring in Lombardy in the period 2010-2012. Unfortunately, data related to the years before the introduction of the new payment scheme for birth deliveries in 2005 are not available. The CEDAP archive is important since it records – besides mother characteristics – a large set of information related to the delivery, including antenatal and maternal care, which has been already exploited in the literature for the richness of its information (e.g., Di Giacomo et al., 2017). As for mother characteristics, we have information on age, nationality, level of education, occupation and job position, number of voluntary abortions, number of miscarriages, and number of previous birth deliveries. With respect to the course and characteristics of pregnancy, CEDAP records information on its length and regularity, and on multiple pregnancy. Information on antenatal and maternal care includes invasive and non-invasive tests, like ecographies, amniocentesis, and chorionic villus sampling. As for labor, we are able to classify labor as normal or induced. Most important, we know whether the presentation is cephalic or in a breech position, one of the crucial information to define whether C-section is ex-ante medically appropriate. Finally, we also have information on the baby, like the exact birth date, gender, weight, head circumference and the presence of any malformations.

We complement individual data by considering also information related to hospitals characteristics collected from different official regional sources. Besides information on the ownership status (public, private for-profit and private nonprofit), we add information on hospitals characteristics (whether the hospital is a teaching hospital, whether it hosts a neonatology department, and whether it is mono-specialized in obstetrics and gynecology). We also

retrieve information on the total number of birth deliveries at each provider, to test whether volume increases brings about a reduction in the use of inappropriate C-sections.

Average birth deliveries per year are roughly 80,000 births (about one fifth of all births in Italy) during our sample period, involving 63 out of 150 hospitals.

Table 1: Descriptive statistics

Panel A. Hospital characteristics							
	Public		Private For Profit		Private Not-for-Profit		
	% hospitals	% birth del.	% hospitals	% birth del.	% hospitals	% birth del.	
Hospitals	77.78		14.29		7.94		
Birth Deliveries		81.14		9.17		9.70	
Monospecialized	2.39	5.22	11.12	30.63	0.00	0.00	
Teaching	14.28	18.58	22.32	17.43	0.00	0.00	
Neonatology Dept	51.02	68.75	11.21	11.83	59.80	54.03	
Large	55.10	77.91	11.21	30.63	60.01	74.18	
Medium	34.70	18.86	55.38	54.24	39,99	25.82	
Small	10.30	3.23	33.41	15.13	0.00	0.00	
Panel B. Birth delivery characteristics							
	Public		Private For Profit		Private Not-for-Profit		F-test
	mean	sd	mean	sd	mean	sd	
C-Section	0.2231	0.4164	0.2479	0.4318	0.2142	0.4103	***
Graduate mother	0.2645	0.4411	0.2309	0.4214	0.2071	0.4052	***
Italian mother	0.7924	0.4056	0.7747	0.4178	0.7177	0.4501	***
Mother Age	32.8173	5.0427	32.2861	5.3027	31.9412	5.3820	***
Num voluntary abortion	0.0546	0.2745	0.0601	0.3164	0.0710	0.3375	***
Num previous death birth	0.0072	0.1070	0.0081	0.0959	0.0065	0.0862	
Num previous birth deliveries	0.5996	0.7928	0.5926	0.8321	0.6003	0.8064	
Length of pregnancy	39.0892	1.6980	39.2242	1.7266	39.0833	1.7754	***
Amniocentesis	0.1042	0.3055	0.0948	0.2929	0.0952	0.2935	***
Chorionic villus sampling	0.0463	0.2102	0.0452	0.2078	0.0527	0.2235	***
Echography at week 22	0.9662	0.1806	0.9374	0.2423	0.9588	0.1988	***
Regular pregnancy	0.9335	0.2491	0.9420	0.2337	0.9548	0.2078	***
Difficult growing	0.0221	0.1471	0.0167	0.1282	0.0235	0.1515	***
Medically assisted procreation	0.0353	0.1847	0.0337	0.1806	0.0195	0.1381	***
Num of echographies	4.1955	1.8208	4.0923	1.8607	4.7764	2.0924	***
Total born in the delivery	0.0256	0.1581	0.0221	0.1471	0.0254	0.1575	
Natural labor	0.7471	0.4347	0.7452	0.4358	0.7591	0.4276	***
Vertex	0.9483	0.2215	0.9479	0.2223	0.9502	0.2174	
Birth sex ($male = 1$)	0.5096	0.4999	0.5089	0.4999	0.5146	0.4998	
Malformations	0.0035	0.0592	0.0032	0.0564	0.0048	0.0689	***
Head circumference (cm)	34.0978	1.7707	34.2470	1.8473	34.1405	1.7686	***
Birth weight (gr)	3277.6186	458.3016	3268.1538	452.5660	3265.8457	492.0572	**
Num hospitals	49		9		5		
Num birth deliveries	116,476		13,160		13,920		

Note: Summary statistics for the sample analyzed in this work. Panel A refers to hospital characteristics. Panel B refers to mother and birth deliveries characteristics from the CEDAP archive. Columns distinguish between public, private not-for-profit and private for-profit hospitals. Sub-columns provide statistics in terms of both the number of hospitals and the number of birth deliveries. Panel B also provides an F-test for equality in means: $\mu_{Public} = \mu_{PFP} = \mu_{NFP}$ (*** Sign at 0.01,** Sign at 0.05, *Sign at 0.1).

As for cross-sectional variations, the average number of birth deliveries

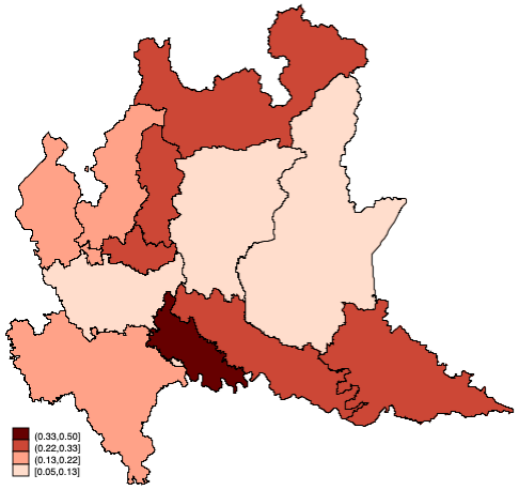
per hospital is 1,200, but the volumes treated in maternal departments range from a minimum of 150 to a maximum of 6,738 births. The large share of birth deliveries is provided by public hospitals; nonprofit and for-profit shares are about 8% for each type of hospital. Hospital descriptive statistics are provided in Table 1, Panel A. The lion's share of birth deliveries is provided by public hospitals, which represent about 4/5 of the number of hospitals supplying maternal care. There are very few mono-specialized hospitals, and relatively few teaching hospitals. A neonatology department is present in about half of public and not-for-profit hospitals, while just 11% of private for-profit hospitals have one. This largely reflects the size of hospitals: most public and nonprofit hospitals are large, while most private for-profit are medium sized. Delivery descriptive statistics across different hospitals are in Table 1, Panel B, which provides also a test of equality in means across ownership types. As largely expected, despite the means being substantially similar, they are statistically different among types of providers but for few of the variables listed. We will account for the differences by controlling for all these variables in our empirical model below.

As for spatial variations, we observe large territorial differences across provinces in the presence of the three types of providers, in local market concentration and in the use of C-sections. These spatial variations can clearly be seen in Figure 1, 2, 3 and 4, where we map the administrative boundaries of regional provinces.[3] Consider first Figure 2 and 3, where we map the share of birth deliveries in private for-profit and not-for-profit hospitals relative to the share of public hospitals. For-profit hospitals are totally absent in four provinces; in the provinces where we observe their presence, their relative share range between 11-68% of the public hospitals' share. Private not-for-profit hospitals are instead present only in three provinces, but their share range between 13-104% of the public hospitals' share. Figure 1 maps market concentration, representing the (average) share of birth deliveries per hospital in each province: the range of variation is between 5% in the less concentrated markets, and 50% in territories where we observe the presence of fewer hospitals (and only public hospitals are present). Finally, figure 4 shows geographical variations in C-section rates: the share of caesarean deliveries out of total birth deliveries ranges from 15% to 29%, below the national average of 36% in the same years. Interestingly, this descriptive

[3]Provinces are the level of government below the regions in the Italian vertical structure of governments. Provinces' boundaries somewhat overlap with LHAs' boundaries.

evidence suggest that the spatial variation in the use of C-sections follow different patterns depending on the presence of different types of hospitals and the concentration of the market: one of the provinces with the higher use of C-sections (Pavia, in the South-West) is one of the most competitive and with a high presence of for-profit-hospitals; on the contrary, one of the provinces where caesarean sections are less used (Como, in the North-West) share the same degree of competitiveness, but it is a mixed oligopoly where both private for-profit and nonprofit hospitals are active.

Figure 1: Market concentration



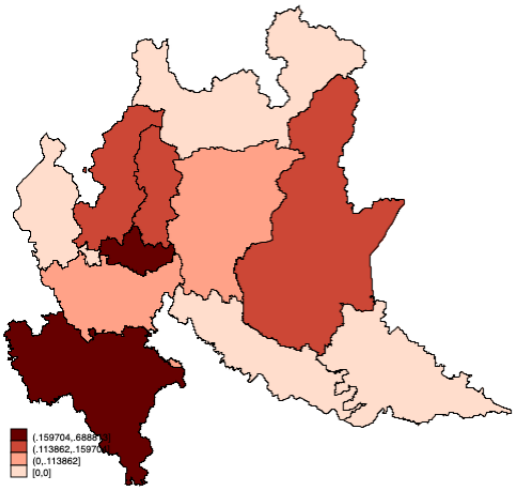
Note: This figure shows the average share of birth deliveries per hospital in the provinces of Lombardy. Data are taken from the Hospital Discharge Card (SDO) archive, years 2006-2008.

4.2 Empirical strategy

To understand whether different types of hospitals respond differently to the disincentive for C-sections, and how their behavior is influenced by differences in the presence of competitors offering the same treatment at the local level we consider the following baseline logit specification:

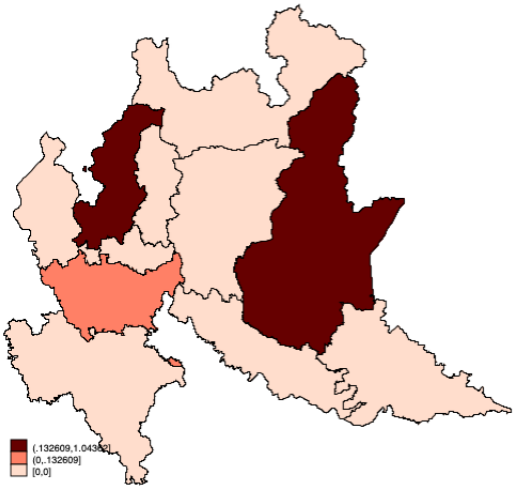
$$\Pr(C_{iht}) = \theta_1 NPO_{ih} + \theta_2 FP_{ih} + \eta \mathbf{H}_{ih} + \beta \mathbf{X}_{iht} + LHA_h + Y_t + M_t + D_t + \varepsilon_{iht} \quad (8)$$

Figure 2: Role of private for-profit hospitals



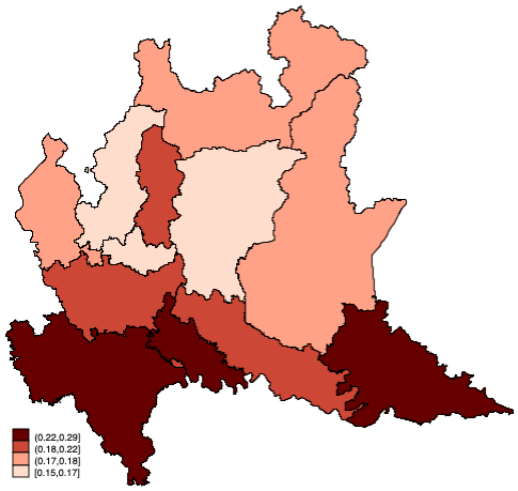
Note: This figure shows the share of birth deliveries in private for-profit hospitals relative to the share of public hospitals in the provinces of Lombardy. Data are taken from the CEDAP archive, years 2010-2012.

Figure 3: Role of private nonprofit hospitals



Note: This figure shows the share of birth deliveries in private nonprofit hospitals relative to the share of public hospitals in the provinces of Lombardy. Data are taken from the CEDAP archive, years 2010-2012.

Figure 4: C-section rate per province



Note: This figure shows the share of C-sections out of total birth deliveries in the provinces of Lombardy. Data are taken from the CEDAP archive, years 2010-2012.

where $\Pr(C_{iht})$ is the probability of a C-section for patient i in hospital h at time t; NPO and FP are two dummy variables picking up the ownership structure of hospital h (the reference category are public hospitals), which we read as proxies for the ethical preferences of hospitals according to discussion of parameter ϕ in the theoretical model above; $\mathbf{H}$ is a vector of hospitals characteristics; $\mathbf{X}$ is a vector of variables at the patient level allowing to control for a large bunch of mother as well as specific delivery characteristics, which allows to define the medical appropriateness of a specific treatment for a specific patient; LHA represents geographical fixed-effects at the Local Health Authority level, while Y, M, D are year, month and day of the week fixed effects respectively; finally, ε is a disturbance term which we cluster in all our specifications at the hospital, year and month level.

Model described in equation (8) is estimated first on the whole set of birth deliveries, and estimates of θ_1 and θ_2 give us evidence of differences in the behavior of nonprofit and for-profit hospitals with respect to public providers. However, in order to investigate the testable implication derived in Section 3, we need both to define different groups of birth deliveries according to the ex-ante medical appropriateness of C-sections, and to characterize different local markets with respect to market concentration. Definition of groups of

birth deliveries is based on the Robson score, which allows to classify different pregnancies considering parameters like nulliparous/multiparous women, the presentation of the baby, the number of gestational weeks, and the presence of several anomalies. The riskiness of birth decreases with the number of previous birth deliveries and the number of gestational weeks, and increases with the presence of anomalies, including presentations different from the cephalic one. We define in particular three different groups: Group 1 includes birth deliveries for which C-section is not medically appropriate (Robson categories 3 and 4, multiparous women with cephalic pregnancies); Group 2 includes birth deliveries for which C-section might be appropriate in some specific cases (Robson categories 1 and 2, nulliparous women with cephalic pregnancies); finally, Group 3 includes birth deliveries for which C-section has to be considered medically appropriate (Robson categories from 6 to 10, with breech pregnancies and other anomalies).[4] According to our theoretical framework above, we expect to see differences in behavior for birth deliveries in Group 3, for which C-sections are likely to be appropriate and the hospital faces a tradeoff between patients' health and monetary incentives; and the trade-off is stronger the lower is ϕ.

The degree of market concentration is based on a measure of market share computed for each hospital. In particular, we consider the hospital specific 2006-2008 average provincial share of birth deliveries ($Share$). There are at least two possible endogeneity concerns when considering this measure: first, with respect to the presence of a hospital in a specific local market; second, with respect to the role played by the hospital in the specific local market. As for the concern of entry in local markets, we do not have evidence of any substantial entry process in the market for birth deliveries in the years we are studying. After the new policy has been implemented in 2005, two hospitals left the market in 2006 and three hospitals entered in 2008. As expected, since entry is regulated by the regional government, we can then exclude that the new payment policy triggered entry to exploit the large profit allowed on vaginal deliveries. As for the second concern, we consider 4-years lagged data which should allow to safely exclude that the measure is biased by the reputation of the hospital in the choice of the delivery method.

To better understand the role of a measure of market concentration based on birth deliveries, we also computed the Herfindahl-Hirschman index on the

[4]Robson category 5 is excluded because it identifies previous C-sections, which makes highly likely to have another C-section.

shares of all inpatients services provided by each hospital (HHI). Interestingly, the correlation between $Share$ and HHI is positive and statistically significant only for not-for-profit (ρ=0.8028) and public (ρ=0.4624) hospitals, while it is negative and statistically significant for private clinics (ρ=-0.2057). Private for-profit hospitals are likely to increase their shares of birth deliveries in provincial markets where hospital activity is less concentrated, and competition is fiercer; on the contrary, public and private non-profit increase their activity in terms of birth deliveries where there are fewer hospitals and the whole hospital production is more concentrated. This tend to support the view in Horwitz and Nichols (2011) that nonprofit and public hospitals are historically located in less-profitable and less-densely populated areas.

To provide a test for the prediction in Section 3, we define interaction terms between our two dummy variables NPO and FP and the (lagged) hospital specific provincial share of birth deliveries ($Share$). We then augment our baseline specification by introducing also these measures of "competitive pressures" for each type of hospital, defining a model close to Horwitz and Nichols (2009):

$$\begin{gathered}\Pr(C_{iht}) = \theta_1 NPO_{ih} + \theta_2 FP_{ih} + \\ +\theta_3 NPO_{ih} \times Share_{ht-4} + \theta_4 FP_{ih} \times Share_{ht-4} + Share_{ht-4} + \\ +\eta \mathbf{H}_{ih} + \beta \mathbf{X}_{iht} + LHA_h + Y_t + M_t + D_t + \varepsilon_{iht}\end{gathered} \tag{9}$$

As before, the model is estimated first on the whole set of birth deliveries, and then on groups of birth deliveries differing according to the degree of appropriateness of C-sections.

5 Results

Ownership. Estimates of model in equation (8) are in Table 2, Panel A. Col. I consider the whole set of births, while col. II to IV present results for the three sub-groups of births defined according to the Robson score. Overall, results are consistent across the four models in which the reference category is represented by public hospitals. We record a different behavior between for-profit and nonprofit hospitals on the whole sample, which is confirmed across the different groups of birth deliveries. In particular, coefficient for NPO is positive and statistically significant in almost all specifications, but for birth deliveries in Group 1, which collects birth deliveries for which C-section

has to be considered medically inappropriate. On the contrary, coefficient for for-profit hospitals is almost always negative, and it is also statistically significant for birth deliveries in Group 3, those for which C-sections are to be considered as medically appropriate. According to these estimates, in line with our theory and with the available evidence, private for-profit clinics are those most affected by monetary incentives: they are those hospitals reducing the number of C-sections with respect to public hospitals when they are most appropriate. On the contrary, not-for-profit providers are behaving like public hospitals.

Table 2: Ownership and C-section

Model	**Overall**	**Robson 1**	**Robson 2**	**Robson 3**
Panel A. Baseline Model (excluding Market Share)				
$Not\text{-}for\text{-}profit$	0.124**	-0.0433	0.201***	0.228
$For\text{-}profit$	-0.00834	-0.147	0.100	-0.347*
Panel B. Model with Interaction Market Share and Ownership				
$Not\text{-}for\text{-}profit$	0.625***	0.289	0.676***	1.045***
$Not\text{-}for\text{-}profit \times Share$	-2.800***	-1.580	-2.811***	-4.295**
$For\text{-}profit$	0.593***	0.508***	0.532***	0.976***
$For\text{-}profit \times Share$	-4.413***	-4.950***	-3.064***	-9.284***
Share	-1.153***	-1.055**	-1.103***	-1.043
Observations	143556	59514	69839	14203

Note: OLS estimates. Dependent variable: Probability C-section. Reference category: Public hospitals. Not-for-profit is a dummy variable for nonprofit hospitals. For-profit is a dummy variable for for-profit clinics. Share is the (4 years lagged) hospital specific provincial share of birth deliveries. Columns identifies estimates based on different samples: estimates based on the full sample ('Overall'); estimates based only on birth deliveries classified as Robson categories 3 and 4, multiparous women with cephalic pregnancies ('Robson 1'); estimates based only on birth deliveries classified as Robson categories 1 and 2, nulliparous women with cephalic pregnancies ('Robson 2'); estimates based only on birth deliveries classified as Robson categories from 6 to 10, with breech pregnancies and other anomalies ('Robson 3'). Panel A reports estimates of Equation 8. Panel B reports estimates of Equation 9. All models include controls for hospital characteristics, mother and delivery characteristics, as well as LHA, year, month and day fixed-effects. SE are clustered at the hospital, year, month level.

Statistical significance: *** Sign at 0.01,** Sign at 0.05, *Sign at 0.1.

To better understand the behavior of for-profit and nonprofit hospitals, and if and how this changes with the presence of other hospitals in local

markets, we augment the baseline model introducing the lagged provincial share of birth deliveries of each hospital, and we interact this variable with the ownership dummies. Estimates of model 9 are in Table 2, Panel B. Now coefficients for both nonprofit and forprofit hospitals are always positive and significant, but the interaction terms between hospital ownership ans *Share* are negative and statistically significant. Hence, the relationship between the probability of having a C-section and the two types of hospitals depends on the concentration of local markets for birth deliveries.

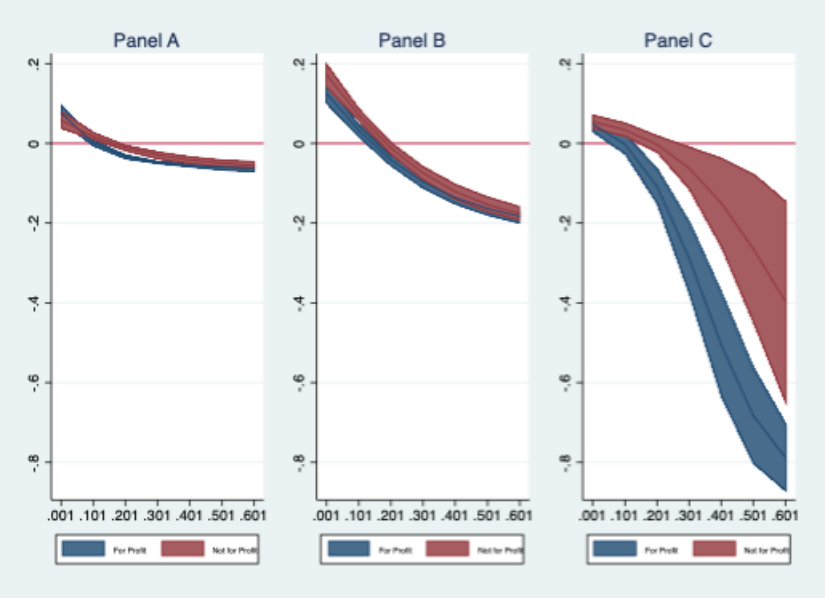
Figure 5 plots the marginal effects of hospital ownership on the probability of observing a C-section for the three different groups of birth deliveries according to the Robson score (from Robson group 1 in Panel A, to Robson group 3 in Panel C). Public hospitals are the reference category. Considering first Robson group 3, for which C-sections are likely to be medically appropriate, we observe a clear difference between public hospitals and the two types of private hospitals. Both types of private hospitals show a similar probability of observing a C-section with respect to public hospitals for highly competitive markets. But the effect turns rapidly negative in more concentrated markets. Hence, according to our theoretical model above, both nonprofit and for-profit hospitals appear to react to the trade-off between patients' health and financial incentives provided by the tariff regime in Lombardy. However, on the one hand, more competitive pressures make ownership less important in determining the choice of treatment. On the other hand, the reaction of for-profit hospitals is stronger, since the marginal reduction in the likelihood of a C-section is always larger than for nonprofits.

These differences are definitely less sharp in the case of Robson group 1 (Panel A) and group 2 (Panel B). Interestingly, for these two groups of birth deliveries, when competitive pressures are stronger private hospitals are correlated with a higher likelihood of C-sections with respect to public hospitals, which is likely a sign of specialization. Again, when the market becomes more concentrated, financial incentives become more important, and both types of private hospitals are related with a reduction of the probability to observe a C-section. Overall, however, the differences with respect to public hospitals are more contained than in the case of Robson group 3.

Taken together, our results offer a picture consistent with available results in the literature (e.g., Schlesinger and Gray, 2005; Horwitz and Nichols, 2009): the presence of alternative providers (proxied here by the share of birth deliveries at the provincial level) influence the behavior of different types of providers. Where patients have different alternatives available, hence hospi-

tals' share of birth deliveries is relatively low, the behavior of public, private nonprofit and private for-profit firms becomes somewhat similar (with private hospitals supplying more C-sections than their public counterparts, even if they are not really appropriate). However, when alternative providers are more difficult to find, private forprofit appear to use less C-section than both public and private nonprofit hospitals. This suggests that competition dilutes profit incentives, that matter more when hospitals enjoy market power and ethical preferences becomes the most important driver in shaping the choice of treatment.

Figure 5: Marginal effect of ownership on the probability of C-section according to market share.



Note: Marginal effects (with 95% confidence intervals) are computed using estimates of Equation 9 on the sub-samples of birth deliveries according to the Robson score. Reference category: public hospitals. Panel (A): Robson categories 3 and 4, multiparous women with cephalic pregnancies ('Robson 1'); Panel (B): Robson categories 1 and 2, nulliparous women with cephalic pregnancies ('Robson 2'); Panel (C): Robson categories from 6 to 10, with breech pregnancies and other anomalies ('Robson 3')

Control variables. As for control variables (see the full set of estimates in Tables A1-A2 in the Appendix), most of the coefficients are significant and take up the expected sign. Starting with variables in **H** picking up hospitals characteristics, coefficients for mono-specialized and teaching hospitals are consistently positive and statistically significant in all models. These hospitals are likely to attract more difficult pregnancies; hence, unsurprisingly, they supply – *ceteris paribus* – more C-sections even controlling for medical conditions of the mother and the foetus. Having a neonatology department allows the hospital to treat emergencies, hence the likelihood of a C-section decreases; but the coefficient is negative and significant in the whole sample, and for the Robson sub-sample identifying the intermediate level of appropriateness. In terms of size, we find that smaller hospitals are more likely to practice C-sections. This is confirmed also by the negative coefficient on the number of birth deliveries per day, albeit also in this case the coefficient is significant in the whole sample and in the intermediate Robson sub-sample.

Turning to variables in **X**, we consider a number of proxies for difficult pregnancies. Coefficient for the length of pregnancy (in weeks) is negative, suggesting that the longer the gestational period, the less difficult is the pregnancy, the lower the likelihood of a C-section. Coefficients for amniocentesis and chorionic villus sampling are both consistently positive and significant, but for the Robson sub-sample identifying more appropriate C-sections. Both procedures are more appropriate for older mothers, for whom the risks of developing malformations is higher. This story is confirmed by the coefficient for the dummy picking up malformation, which is positive and significant in almost all models, but not significant for the Robson group 3. It is confirmed also by the coefficient on mother's age, always positive and statistically significant. The number of ultrasound can be taken as a proxy for the difficulties in pregnancy too: the higher the number of exams, the higher the likelihood of a C-section. Notice that the larger the circumference of the child's head, and the higher (or lower) the weight of the baby with respect to normal weight, the higher the probability of having a C-section. Finally, presentation is clearly of utmost importance: all positions different from the cephalic presentation increase the medical appropriateness of C-sections. In terms of demographic variables, we do observe a clear gradient in the probability of a C-section in terms of mother's education: when moving from less educated to more educated women, the probability of a C-section drops. The same is true considering citizenship: Italian mothers are characterized by a lower probability of having a C-section than foreigners.

6 Concluding remarks

In this paper we exploit spatial variation in the presence of for-profit, not-for-profit and public hospitals, and in market concentration at the local level, to empirically assess the relationship between hospital ownership and the choice of C-section. We focus on Lombardy, an Italian region with a public health care system based on the quasi-market model, where the regional government decided to equalize the tariff for C-sections and vaginal deliveries at a level such that it creates a strong incentive for vaginal deliveries and a mild disincentive for caesarean deliveries. We build a theoretical model to rationalize the choice of providers in the presence of this incentive structure. We then propose a test on a rich archive of administrative data, which allows us to control for a large set of the mother and the fetus characteristics. Our results strongly suggest that - coherently with the literature - competitive pressures from alternative providers tend to homogenize behaviors. However, when alternative providers are more difficult to find, we do observe less C-section from private for-profit hospitals than from public and private non-profit hospitals, especially when C-section are medically appropriate. Overall, ethical preferences do make a difference in private hospitals, especially when competitive pressures are weaker and hospitals enjoy market power at the local level.

References

Alexander, D. 2013. Does Physician Compensation Impact Procedure Choice and Patient Health? Princeton University - Center for Health and Wellbeing Working Paper, No. 1475.

Allin, S., Baker, M., Isabelle, M., Stabile M. 2015. Physician Incentives and the Rise in C-sections: Evidence from Canada, NBER Working Paper, No. 21022, March 2015.

Bayindir, E. E. 2012. Hospital ownership type and treatment choices. Journal of Health Economics, 31, 359– 370.

Bogg, L., Huang, K., Long, Q., Shen, Y., Hemminki, E. 2010. Dramatic increase of caesarean deliveries in the midst of health reforms in rural China.

Social Science & Medicine, 70, 1544–1549.

Brenna E., 2011. Quasi-market and cost-containment in Beveridge systems: The Lombardy model of Italy. Health Policy, 103, 209–218.

Brekke K. R., L. Siciliani, O. R. Straume 2011. Hospital Competition and Quality with Regulated Prices. Scandinavian Journal of Economics, 113 (2), 444-469.

Cappellari L., A. De Paoli, G. Turati. 2016. Do market incentives for hospitals affect health and service utilization?: evidence from prospective pay system–diagnosis–related groups tariffs in Italian regions. Journal of the Royal Statistical Society (Series A), 179(4): 885-905.

Cavalieri, M., Guccio, C., Lisi, D. and Pignataro, G. 2014. Financial Incentives and Inappropriateness in Health Care: Evidence from Italian caesarean Sections. FinanzArchiv/Public Finance Analysis, vol. 70, no. 3, 430-457.

Chen, C.-S., Liu, T.-C., Chen, B., Lin C.-L. 2014. The failure of financial incentive? The seemingly inexorable rise of caesarean section. Social Science & Medicine, 101, 47-51.

Dafny, L.S., 2005. How Do Hospitals Respond to Price Changes? American Economic Review, 95:5, 1525-1547.

Di Giacomo, M., Piacenza M., Siciliani L., Turati G. 2017. Do public hospitals respond to changes in DRG price regulation? The case of birth deliveries in the Italian NHS. Health Economics, 26(S2): 23-37.

Duggan, Mark G., 2000. Hospital Ownership and Public Medical Spending. Quarterly Journal of Economics, 2000, 115(4), pp. 1343-73.

Ecker, J.L. and F.D. Frigoletto. 2007. caesarean Delivery and the Risk-Benefit Calculus. The New England Journal of Medicine; 356(9); 885-888.

Fattore, G. and A. Torbica 2006. Inpatient reimbursement system in Italy: how do tariffs relate to costs?, Health Care Management Science, 9(3): 251-258.

Francese M., Piacenza M., Romanelli M., Turati G. 2014. Understanding Inappropriateness in Health Spending: The Role of Regional Policies and Institutions in Caesarean Deliveries. Regional Science and Urban Economics, 49: 262–277.

Grant, D. 2009. Physician Financial Incentives and caesarean Delivery: New Conclusions from the Healthcare Cost and Utilization Project. Journal of Health Economics; 28; 244-250.

Gruber, J., J. Kim J. and D. Mayzil. 1999. Physician Fees and Procedure Intensity: the Case of caesarean Delivery. Journal of Health Economics; 18;

473-490.

Horwitz J. R., A. Nichols 2009. Hospital ownership and medical services: Market mix, spillover effects, and nonprofit objectives. Journal of Health Economics, 28(5): 924-937.

Horwitz J. R., A. Nichols 2011. Rural Hospital Ownership: Medical Service Provision, Market Mix, and Spillover Effects, Health Services Research, 46(5): 1452-1472.

OECD, 2017. Tackling Wasteful Spending on Health. OECD Publishing, Paris.

Schlesinger M. and B. H. Gray 2006. How Nonprofits Matter In American Medicine, And What To Do About It. Health Affairs, 25(4): 287-303.

Silverman E., J. Skinner 2004. Medicare upcoding and hospital ownership. Journal of Health Economics, 23(2): 369-389.

Ye J., Betrán A. P., Guerrero V. M., Souza J. P. and Zhang J. (2014), Searching for the Optimal Rate of Medically Necessary Cesarean Delivery, Birth, 41(3), 237-244.

Appendix Tables

Table A1: Probability C-section: baseline model.

	Model 1	**Robson 1**	**Robson 2**	**Robson 3**
Undergraduate	0.124**	0.278**	0.0784	0.219
1st Cycle of school completed	0.600***	0.636***	0.412***	0.573*
2st Cycle of school completed	0.364***	0.423***	0.376***	0.270**
High School	0.146***	0.238***	0.142***	0.134
Other	0.296	0.0338	0.514*	-0.427
Home worker	-0.0288	-0.126	0.0543	0.0514
Searching first job	-0.0358	0.866	-0.287	0.753
Worker	-0.170***	-0.263***	-0.141***	0.118
Student	-0.00495	0.289	-0.0404	0.339
Italian Mother	-0.173***	-0.230***	-0.118***	-0.127
Mother Age	0.0703***	0.0648***	0.0760***	0.0468***
Num of volountary abortion	0.114***	0.0828*	0.117***	0.159
Num previous death baby at birth	0.577***	0.399***	-0.242	0.0946
Num previous deliveries	-1.023***	-0.239***	0	-0.451***
Length of pregnancy	-0.176***	-0.493***	-0.147***	-0.00415
Amniocentesis	0.0815**	0.129*	0.104**	0.00727
Chorionic villus sampling	-0.0110	0.0149	0.0119	-0.0378
Echography at 22th week	-0.148***	-0.172*	-0.182***	0.189
Regular pregnancy	-0.379***	-0.0910	-0.348***	-0.641***
Difficutl growing	0.236***	-0.0713	0.143*	0.690***
Medically assisted procreation	0.395***	0.380	0.360***	0.321*
Num of echographies	0.0329***	0.0324***	0.0279***	0.0576***
Number of birth child	2.297***	0	0	1.718***
Parent present during delivery	-0.625**	-1.785**	0.757	-0.570*
Natural Labor	-1.425***	-1.587***	-1.395***	-1.009***
Other	3.026***	0	0	2.075***
Breech	5.263***	0	0	4.417***
Male	0.154***	0.121***	0.179***	-0.00664
Malformations	0.377**	0.622**	0.330*	-0.0176
Head circumference	0.0851***	0.0836***	0.102***	0.0575***
High weight	0.467***	0.272***	0.732***	0.455
Low weight	1.153***	1.220***	1.397***	1.217***
Monospecialized	0.371***	0.860***	0.147*	0.365*
Teaching	0.154***	0.0128	0.197***	0.249*
Neonatology	-0.0606	0.0568	-0.116**	0.134
Large	-0.566***	-0.443***	-0.549***	-1.031***
Medium	-0.369***	-0.195	-0.376***	-0.728***
Number delivery in a day	-0.00130	-0.000154	-0.00490	0.0125
Not for profit	0.124**	-0.0433	0.201***	0.228
Private	-0.00834	-0.147	0.100	-0.347*
Year = 2012	-0.187***	-0.124*	-0.193***	-0.301***
Year = 2011	-0.135***	-0.0704	-0.144***	-0.239**
Constant	2.518***	14.40***	-0.655	-2.020**
Observations	143556	59514	69839	14203
Pseudo R-squared	0.314	0.165	0.133	0.461
BIC	104202.0	26665.1	66724.9	9319.3

Note: OLS estimates. Dependent variable: Probability C-section. Reference category for ownership: Public hospitals. Std. Err. are clustered at the hospital, year, month level. Statistical significance: *** Sign at 0.01,** Sign at 0.05, *Sign at 0.1.

Table A2: Probability C-section: model including interactions ownership and market share.

	Model 3	**Robson 1**	**Robson 2**	**Robson 3**
Undergraduate	0.128**	0.282**	0.0806	0.228
1st Cycle of school completed	0.607***	0.640***	0.418***	0.593**
2st Cycle of school completed	0.362***	0.419***	0.373***	0.279**
High School	0.147***	0.237***	0.142***	0.147
Other	0.307	0.0799	0.505	-0.234
Home worker	0.000253	-0.0873	0.0716	0.129
Searching first job	-0.0450	0.867	-0.297	0.810
Worker	-0.150***	-0.231**	-0.132**	0.181
Student	0.0288	0.331	-0.0172	0.383
Italian Mother	-0.163***	-0.221***	-0.110***	-0.117
Mother Age	0.0704***	0.0649***	0.0762***	0.0475***
Num of volountary abortion	0.119***	0.0864*	0.122***	0.156
Num previous death baby at birth	0.598***	0.417***	-0.196	0.138
Num previous deliveries	-1.024***	-0.236***	0	-0.455***
Length of pregnancy	-0.171***	-0.485***	-0.142***	-0.00373
Amniocentesis	0.0793**	0.127*	0.101**	0.00193
Chorionic villus sampling	-0.0185	0.00836	0.00479	-0.0519
Echography at 22th week	-0.195***	-0.222**	-0.218***	0.110
Regular pregnancy	-0.426***	-0.154	-0.382***	-0.710***
Difficutl growing	0.220***	-0.0882	0.131	0.674***
Medically assisted procreation	0.390***	0.369	0.354***	0.307
Num of echographies	0.0328***	0.0339***	0.0273***	0.0603***
Number of birth child	2.307***	0	0	1.713***
Parent present during delivery	-0.639**	-1.860**	0.740	-0.592*
Natural Labor	-1.417***	-1.576***	-1.389***	-0.976***
Other	3.048***	0	0	2.102***
Breech	5.269***	0	0	4.424***
Male	0.154***	0.123***	0.179***	-0.00751
Malformations	0.387**	0.628**	0.334*	-0.00533
Head circumference	0.0861***	0.0849***	0.102***	0.0592***
High weight	0.465***	0.266***	0.730***	0.461
Low weight	1.197***	1.276***	1.408***	1.247***
Monospecialized	0.745***	1.170***	0.452***	1.141***
Teaching	0.283***	0.112	0.328***	0.378**
Neonatology	-0.0866*	0.0236	-0.119**	-0.00953
Large	-0.0885	-0.0106	-0.123	-0.326
Medium	-0.163**	-0.0340	-0.179*	-0.426
Number delivery in a day	0.00774*	0.00735	0.00393	0.0209
Market Share	-1.153***	-1.055**	-1.103***	-1.043
Not for profit	0.625***	0.289	0.676***	1.045***
Not for profit#Market Share	-2.800***	-1.580	-2.811***	-4.295**
Private	0.593***	0.508***	0.532***	0.976***
Private#Market	-4.413***	-4.950***	-3.064***	-9.284***
Year = 2012	-0.187***	-0.121*	-0.193***	-0.297***
Year = 2011	-0.132***	-0.0639	-0.142***	-0.238**
Constant	2.171***	14.01***	-1.023	-2.453**
Observations	143556	59514	69839	14203
Pseudo R-squared	0.315	0.167	0.134	0.465
BIC	104010.3	26643.3	66661.7	9287.4

Note: OLS estimates. Dependent variable: Probability C-section. Reference category for ownership: Public hospitals. Std. Err. are clustered at the hospital, year, month level. Statistical significance: *** Sign at 0.01,** Sign at 0.05, *Sign at 0.1.