Financial Incentives and Inappropriateness in Healthcare: Evidence from Italian Cesarean Sections[#]

Marina Cavalieri, Calogero Guccio, Domenico Lisi, Giacomo Pignataro

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The purpose of this paper is to examine the impact of financial incentives on the level of inappropriateness in healthcare. The case of the Italian NHS seems to be especially interesting when considering the effects of financial incentives on providers' behaviors, as decentralization processes have progressively increased the variability among Regional Health Authorities in both the financing and delivery of health care. In particular, we investigate the impact of DRG tariff differentials on hospital risk-adjusted cesarean rates for first-time mothers during the period 2009-11. Our main finding is that Italian hospitals respond to financial incentives in obstetrics and that the strategic behavioral response varies by hospital type.

Keywords: Inappropriateness, Cesarean section, Financial incentives, DRG differentials

JEL classification: I11, I18

[#] Cavalieri: Department of Economic and Business, University of Catania, Italy (mcavali@unict.it); Guccio: Department of Economics and Business, University of Catania, Italy (guccio@unict.it); Lisi: Department of Economics and Business, University of Catania, Italy (domenico.lisi@unict.it); Pignataro: Department of Economics and Business, University of Catania, Italy (giacomo.pignataro@unict.it). This study is part of the "International Research Project on Financing Quality in Healthcare" (InterQuality), whose main purpose is that of investigating the effect of different financing methods and incentives on the quality, effectiveness and equity of access to health care. The project is funded by the European Commission within the Seventh Framework Programme (FP7) for Research and Technological Development. More information on the Project can be found at *http://interqualityproject.eu/*.

1. Introduction

In the last decades, cesarean section rates have been rapidly increasing in most countries, though in a few of them this trend has recently started to reverse (OECD, 2011). The worldwide upward trend has drawn the attention of both scholars and policymakers, raising concern about the clinically appropriateness of some cesarean deliveries. Indeed, compared to the alternative vaginal delivery, cesarean section is a more invasive and risk-bearing surgical procedure. Therefore, in absence of specific therapeutic reasons, the former medical treatment is generally considered a more appropriate (and less risky) way of child delivery, which can clearly help in containing health care costs.

In 2011, 37.7% of all child deliveries in Italy were performed via cesarean section, a percentage well beyond the WHO recommended level of 15%[1]. Many attempts have been done by policy makers to investigate and monitor the phenomenon. Among the others[2], the Italian Ministry of Health regularly publishes child delivery indicators in its annual report on hospital activity. Moreover, evidence-based recommendations for the management of cesarean sections have been published in February 2010 by the National Institute of Health and periodically updated[3]. Notwithstanding this, a recent national report on the appropriateness of cesarean deliveries by the Ministry of Health has concluded that 43% of the cesarean sections executed in 2010 appeared unjustified, based on the information included in the patients' discharge records. This extremely high percentage of inappropriateness would

[1] In 1985 the World Health Organization stated: "There is no justification for any region to have cesarean section rates higher than 10-15%" (WHO, 1985). However, this threshold has been highly criticized for neglecting the effects of changing circumstances and country specificities on the cesarean rate trend (e.g., The Lancet, 1997). Indeed, the WHO has recently recognized that "both very low and very high rates of cesarean section can be dangerous, but the optimum rate is unknown" and that "there is no empirical evidence for an optimum percentage or range of percentages, despite a growing body of research that shows a negative effect of high rates" (WHO, 2009).

[2] See also Fortino et al. (2002).

[3] Available at *http://www.snlg-iss.it/lgn*.

imply for the Italian National Health Service (*SSN - Servizio Sanitario Nazionale*) an increase in expenditures equal to 80-85 million euros per year[4].

Although the "acceptable" level of cesarean sections in a country remains a matter of debate, evidence exists that in developed countries an excessive use of this surgical procedure does not result in discernible benefits for the mother or the child and could even give rise to negative consequences for their health (see e.g. Betrán et al., 2007; Althabe et al., 2006; Belizán et al., 2007). Medically unjustified cesarean deliveries have implications not only for patients but also for the overall society, as they impose a financial burden on the healthcare system, while diverting resources from other public interventions.

Reasons for increasing cesarean section rates are complex and often country-specific. Along with clinical risk factors (e.g. higher rates of obesity, diabetes, hypertension, multiple gestation, etc.), other explanations explored in the literature include increasing maternal age, technological innovation, physician's perception of the safety of the procedure, "defensive medicine", patient choice, previous cesarean section, social and cultural factors, health system features.

However, all together the above factors do not account for the majority of the observed variation in cesarean section rates. Indeed, beyond a given threshold exogenously defined by the clinical literature, hospital variability can be explained in terms of inappropriateness, whose level might be affected, *ceteris paribus*, by financial incentives related to DRG tariffs. In this regard, providers' response to financial incentives appears to be a further plausible explanation. Hence, some studies have

[4] Available at *http://www.salute.gov.it/portale/news/p3_2_1_1_1.jsp?lingua=italiano&menu=notizie&p=dalministero&id=914*

investigated the hypothesis that providers are motivated by financial and convenience incentives in their choice of the child delivery method.

The purpose of this paper is to contribute to the existing empirical literature on the role played by financial incentives in explaining the inappropriateness of health care services. The analysis focuses on the Italian case and employs, for the first time, micro data at the hospital level, which allow to account for the variability in the rates of caesarean sections both across regions and across different providers within each region. In particular, we test whether an increase in caesarean sections not justified by socio-demographic and clinical factors (thus, inappropriate from a clinical perspective) reflects a hospital preference for more profitable delivery modes.

Indeed, Italy is a particularly interesting case for several reasons. First of all, not only Italy exhibits one of the highest cesarean rates among the OECD countries but the use of the cesarean procedure is not uniform across the country, with some regions in the South experiencing rates that are more than twice those of the North. Furthermore, the way in which the Italian NHS is organized and regulated makes the country a natural laboratory for testing the effects of tariffs on hospitals' behavior. In fact, the Italian NHS was originally designed as a centralized system but decentralization processes have been progressively undertaken to increase the powers of Regional Health Authorities (RHAs) in both the financing and delivery of health care. Consequently, great variation exists across regions in the way tariffs are used and, more specifically, in the hospital reimbursements for the various methods of child delivery. Thus, the different payment choices are reflected in widely varying frequencies of cesarean deliveries both across regions and hospital providers.

The results show that in regions where higher DRG tariff differentials exist compared to the national standard, hospitals exhibit a greater (inappropriate) use of caesarean sections, thus confirming the positive reaction of healthcare providers to financial incentives. Moreover, we find that the response to financial incentives varies according to the type of hospital (i.e. higher impact for private hospitals) and that the degree of hospital specialization is important for explaining the differences in cesarean section rates (i.e. cesarean deliveries decrease in those hospitals more specialized in obstetrics, ceteris paribus, providing evidence of a learning by-doing effect).

The remainder of the paper is organized as follows. Section 2 provides the background for the study. Section 3 presents data and methods. The results are reported and discussed in section 4. Finally, section 5 provides the concluding remarks and some policy implications.

2. Background

2.1 Previous literature

In the last decade, there has been a proliferation of economic studies that have explored the possible causes of the worldwide increase in cesarean delivery rates. A primary factor accountable for this rise is certainly the increased maternal age and primiparity, which are associated with higher likelihoods of cesarean sections (e.g. Abdul-Rahim et al., 2009). Nonetheless, as emphasized by Ecker and Frigoletto (2007), many other non-clinical and non-demographic factors may influence the choice of cesarean delivery, thus requiring a complex risk-benefit calculus.

A relevant issue explored in the literature is patients' preferences for cesarean delivery, which indeed may reflect cultural factors deep-rooted in the particular story of

a given place. Hsu et al. (2008) find that cesarean rates in Taiwan, among the highest in the world, are significantly affected by the folk belief of Pe-Ji, which influences patients' preferences for delivery at a specific time. Similarly, Lo (2003) shows that cesarean sections in China are significantly higher on auspicious days than on inauspicious ones, owing to the general Chinese belief that choosing the right days for certain life events can change the fate for the better. Cultural factors seem to play a significant role also in Italy, where in southern regions risk-adjusted cesarean rates are higher than in the other regions (Rusticali and Di Virgilio, 2010). Therefore, relevant changes in the social and cultural context might help to explain the recent increase in the demand for cesarean sections.

Some papers in the literature tend to minimize the role of women in the choice of child delivery, ascribing a major role to obstetricians. Using data collected from a postpartum survey, Hopkins (2000) finds that the majority of first-time mothers in Brazil do not seek cesarean delivery, rather doctors appear to induce demand for surgical delivery, thus becoming active participants in building up this culture. Similarly, Kabakian-Khasholian et al. (2007) describe an environment in Lebanon characterized by the lack of women's involvement in the delivery decision-making process, due to the total trust accorded to their obstetricians, who make decisions with regard to their own convenience in relation to time and day of delivery.

Recently, a considerable number of studies has focused predominantly on physician and health system related factors, potentially affecting the decision of performing a cesarean delivery. Not surprisingly, most of the attention in the literature has been paid to financial incentives and, in particular, to fee differentials between vaginal birth and cesarean section. To this extent, the main hypothesis tested is whether

fee differentials between childbirth procedures have any influence on physician' decisions, inducing them to prefer the more profitable cesarean delivery. Indeed, this behavioral response would be consistent with a standard model of induced demand (e.g. McGuire and Pauly, 1991). One of the first papers on the topic by Burns et al. (1995) investigates the role of physician factors, including physician's training/experience, financial incentives and practice characteristics. Indeed, their estimates provide more support for the hypothesized effects of physician financial incentives than for background/training. In a seminal paper, Gruber et al. (1999) find that larger fee differentials between cesarean and normal childbirths for the Medicaid program lead to higher cesarean delivery rates. Replicating the previous analysis, Grant (2009) also finds a significant effect of fee differentials, even if smaller in magnitude. More recently, Bogg et al. (2010) find evidence that in China the increased level of cesarean fee, which followed the introduction of the New Cooperative Medical Scheme, has induced a significant increase in cesarean rates.

A relevant issue explored in the literature is the time scheduling of cesarean deliveries, which indeed seems to respond more to physicians' timetables than to clinical needs. For instance, Brown (1996) finds that in the US military hospitals, whose financing system negates the influence of economic incentives for cesarean sections, time-dependent dummy variables for deliveries on certain days (related to the consumption of leisure by physicians) turn out to be significant predictors of cesarean deliveries, after controlling for many relevant clinical factors. Similarly, in Italy there is a strong evidence that cesarean deliveries are concentrated more in working days and significantly less in weekends, with the peak on Monday (Fusco et al., 2010).

Another issue discussed in the literature is the increasing physicians' practice of choosing cesarean sections primarily not for clinical reasons, but as a safeguard against malpractice liability. In this regard, Dubay et al. (1999) provide evidence that physicians practice "defensive medicine" in obstetrics, but the impact of this behavior on total obstetric care costs is quite small.

More generally, different studies in the literature analyze the association of health care institutional characteristics with cesarean deliveries. Lin and Xirasarag (2004) find that obstetrics and gynecology clinics in Taiwan have a considerably higher likelihood of performing cesarean deliveries compared with all other categories of hospitals, after controlling for clinical and physician characteristics. Lee and Lee (2007) provide evidence that the health insurance program adopted in 1997 by the Korean government, introducing the DRG-based prospective payment system only for volunteering health care organizations, had no impact on cesarean section rates. In particular, they find that there are no significant differences in cesarean rates between providers in the DRG and fee-for-service systems. Similarly, Arrieta (2011) analyses the 1997 health reform enacted in the private sector in Peru and finds that the probability of cesarean deliveries increased by 19% in private hospitals after the reform. Again, Nigam (2012) develops and tests hypotheses predicting the impact of three features of institutional change (i.e. managed care insurance, changing professional controls and public attention to cost-control practices) on cesarean use. In particular, he finds that managed care insurance as well as clinical guidelines and cost-control practices contribute to diffuse cost-effective patient care practices, thus reducing cesarean use.

Looking at the Italian case, only few studies have tried to figure out the actual causes of both the extremely high national cesarean rate and the large regional variations. A first reason explored in the literature for such a large use of cesarean delivery is the assortative mating between patient and provider driven by practice style; that is, a non-random mating pattern in which patients with higher preference for a specific birth delivery mode mate more frequently with providers with the same preference. In particular, Fabbri and Monfardini (2008) consider both public and private Italian providers, with the latter actually being more inclined to executing cesarean sections. Nonetheless, they conclude that assortative mating is not especially relevant; on the opposite, the self-selection of patients between hospital types appears to be more based on risk factors. This self-selection mechanism allocates more risky cases to public (and high quality) hospitals where they are more likely to receive a scheduled cesarean section at any risk profile.

Indeed, the empirical evidence that the rate of cesarean delivery is higher in private hospitals, despite the fact that more risky patients give birth to public ones, raises the issue of the role of financial incentives in influencing providers' decisions on cesarean sections. Pizzo (2008) analyses the fee differences between vaginal and cesarean delivery. Nonetheless, the study does not provide any estimate of the impact of fee differentials and other non-clinical factors on cesarean rates. In this regard, a first analysis aiming at evaluating the relevance of financial incentives in explaining the large use of cesarean sections in Italy can be found in Francese et al. (2012). The paper exploits the significant variation in gross cesarean delivery rates among Italian regions to study the impact of pricing policies (i.e. choice between regional or national DRG fees) as well as political economy and structural supply indicators. Their results suggest

that differentiating the DRG tariffs from the national schedule can help regions to reduce inappropriateness in the use of cesarean deliveries, after controlling for socio-demographic factors and the characteristics of the health care system (i.e. public/private hospital mix). The characteristics of regional governments and the funding sources of regional health spending are also found to play an important role.

Despite the unquestionable role played by regional factors in explaining geographical variation of cesarean rates in Italy, Fusco et al., (2010) have correctly noticed that the heterogeneity in the use of cesarean delivery among hospitals and local health authorities (ASL – *Azienda Sanitaria Locale*) turns out to be much stronger than that among regions. Consequently, by using regional cesarean rates, we would leave out a considerable part of the story. In this paper, we intend to add to the existing literature by evaluating the relevance of fee differentials in explaining hospital variation in the use of cesarean sections, after controlling for socio-demographic and supply factors.

2.2 Financing hospital care in the Italian National Health Service

The Italian NHS was established in 1978 to grant universal access to a uniform level of care throughout the country, financed by general taxation. In early 90s, Italy deeply reformed the organization of its health care system, changing, among other things, the financing mechanism for health care providers, until then mainly based on actual expenditure. A wide devolution of responsibilities for the organization and financing of health care to regional governments was also undertaken.

As for the hospital sector, all physicians receive a fixed salary and two basic financing criteria are adopted for hospital care: i) lump sum transfers, related to the provision of specific health care services by hospitals, and ii) activity based payments.

The former is used to finance the provision of services, for which "tariffs are deemed inadequate or inappropriate" (Fattore and Torbica, 2006), such as integrated care, prevention activities, emergency services, experimental programs and transplants[5]. Regions have full autonomy in the identification of these services and, therefore, may alter the composition of hospital funding and reduce the role of activity based payments. Lump sum transfers should be determined on the basis of the efficient cost of their provision.

The rest of inpatient care is financed through a per case funding system, based on tariffs[6] related to the DRG classification of discharges (version 24) and on a differentiation of ordinary, day hospital and day surgery cases. Regions are free either to opt for the national DRG rates[7] or to establish their own DRG tariffs, in accordance with the specific criteria set at a national level.

Apart from the choice of the DRG fee schedule, the tariff-based system exhibits different features across regions too. First, in Northern and Central regions DRGs are consistently used to provide incentives to producers while in Southern regions such a role is weakened by the coexistence with other funding criteria such as past and current expenditure and deficits.

Secondly, the financing mechanism varies also according to the institutional nature of hospitals. In the Italian NHS, public provision of hospital care takes place through different types of providers, public as well as accredited private ones.

[5] Different are the reasons for the inappropriateness of tariff financing for these services. Services like transplants have a regional interest, require sophisticated technologies and need to be concentrated in one or a few hospitals. Other services, like the ones related to emergency, require an amount of resources independent of demand. Finally, there are peculiarities of some hospitals (like teaching hospitals) difficult to be dealt with in the tariff mechanism (see e.g. Morandi, 2009).

[6] Outpatient services are financed according to a fee-for-service mechanism.

[7] With the Decree December 14th, 1994, the Italian Ministry of Health laid down the first list of national tariffs, based on data collected from eight hospitals located in the Northern and Central Regions of the country. Since then, national tariffs have been updated many times, in 1997 (Ministry of Health Decree June 30th, 1997), in 2006 (Ministry of Health Decree September 12th, 2006) and, more recently, in 2012 (Ministry of Health Decree October 18th, 2012).

Moreover, there are two main types of public hospitals: the ones run by local health authorities (LHAs) and the independent hospitals (Hospital Trusts, HTs), which enjoy full managerial autonomy. The above criteria do not apply to public hospitals directly managed by LHAs (hereafter Hospital Units, HUs), whose activity is financed through the LHAs' budget[8].

Moreover, tariffs can play different roles depending on the type of hospital care provider. They represent the "real price" for the accredited private hospitals while for public ones they can be used just as a regional device to assess hospital activity and to determine the global hospital budget (Morandi et al., 2008). Furthermore, Regions can discriminate tariffs across providers to make them closer to their actual costs and local specificities.

Finally, in an attempt to limit the tendency of providers to increase the volume of services under activity based payments, some Regions (e.g. Lombardy) have set caps, ceilings or targets at either regional, local health authorities or hospital level, while others (e.g. Tuscany) control volumes of production by using bilateral contracts (between LHAs and hospitals).

The complexity of the regional regulatory frameworks, along with the impossibility of representing in quantitative terms all the above differences in the regional systems, makes even more difficult to disentangle the effects of single financing incentives on the activity of hospital providers operating in different regions.

3. Data and methods

3.1 Data description

[8] According to Morandi et al., (2008), public hospitals directly managed by LHAs are "… de facto financed on the basis of the consumption of production factors (personnel, goods and services, etc.)".

The main source of data for this analysis is the National Program for Outcome Assessment (PNE - *Programma Nazionale Valutazione Esiti*) run by the National Agency for Regional Health Services (AGENAS - *Agenzia Nazionale per i Servizi Sanitari Regionali*) together with the Italian Ministry of Health. Since its inception in 2009, the program has aimed at assessing the health care activity of all Italian hospitals, either public or private accredited. Overall, 45 performance indicators (32 related to hospital services and 13 to hospitalization) are computed, mostly using discharge data gathered through the Informative Hospital System (SIO - *Sistema Informativo Ospedaliero*). A more complete description of the program, the study population and the performance indicators is available elsewhere[9].

One of the outcome indicators provided by the PNE is the risk-adjusted cesarean rate for first-time mothers, aged 10-55 years, who reside in Italy. Compared to the overall rate of cesarean deliveries, this indicator is considered better suited to capture the phenomenon of clinical inappropriateness since it is not strongly influenced by the high risk of cesarean delivery for those women who already experienced a cesarean section (adherence to "once a cesarean section, always a cesarean section", which in Italy accounts for more than the 95% of cases) and by their distribution among hospitals. The cesarean rate for first-time mothers provided by the PNE is adjusted for maternal age and comorbidities (main and secondary diagnoses for admissions during the last two years) as well as for a-priori fetus risk factors[10]. Our final study sample consists of 1,441 observations from 492 hospitals[11], over the period 2009-11. Supply indicators for the structural characteristics of providers, published by the Italian

[9] For more information on PNE see *http://151.1.149.72/pne11_new*.
[10] The PNE risk-adjustment methodology uses multivariate regression models and direct standardization procedures to adjust variations in outcomes that stem from differences in patient characteristics (or risk factors).
[11] Risk adjusted cesarean rates for first time mothers are reported by the PNE only for those hospitals with at least 10 childbirths in the selected year. This fact explains the lack of 35 observations from the balanced panel.

Ministry of Health, are also considered. Summary statistics for this and other variables used in the analysis are reported in table 1.

[Table 1. Descriptive statistics for the selected variables]

A first glance at the data reveals great variability in birth delivery patterns among both regions and hospital providers. At the regional level, in 2011 the risk-adjusted cesarean rate for first-time mothers varies between a minimum of 15.3% in Friuli Venezia Giulia and a maximum of 52.3% in Campania, with an average national value of 31%. As a general trend, rates are higher in southern regions (43.8% on average) than in the rest of the country (26% on average). At the hospital level, during the same year, variation in cesarean rates for first-time mothers ranges from almost 4% in Lombardia to more than 90% in Campania. To better understand the great variability existing in the dataset, figure 1 shows the distribution of hospital risk-adjusted cesarean rates for first-time mothers by region. As already highlighted by Fusco et al. (2010), also in our dataset heterogeneity among hospitals is greater than that among regions, suggesting that, along with regional policies, organizational features of hospital providers play a strategic role in explaining data variability.

[Figure 1. Box plot of risk-adjusted cesarean rates for first-time mothers by region]

With regard to the typology of hospitals providers, as expected, University Hospitals (UHs), where both teaching and research activities are carried out, display a

lower median value of the adjusted cesarean rate for first-time mothers as well as a smaller variability of values among providers (figure 2). The opposite is true for private hospitals (PHs), particularly for those for profit (FP). Looking at the two main categories of public hospitals, that is independent (HTs) and directly managed (HUs) hospitals, the latter show both a higher median value and greater variability of rates.

[Figure 2. Box plot of risk-adjusted cesarean rates for first-time mothers by hospital type]

As for regional reimbursement policies for vaginal and cesarean childbirths, we match to the above data information coming from several sources, mainly from the AGENAS but also directly from RHAs. We consider tariffs for four specific DRGs (all included in the Medical Disease Classification 14), namely DRG 370 (cesarean section with complications and comorbidities), DRG 371 (cesarean section without complications and comorbidities), DRG 372 (vaginal delivery with complications) and DRG 373 (vaginal delivery without complications). Tariffs refer to the maximum allowed by each Region for ordinary admissions longer than one day in the years 2009-2011. As previously explained, Regions are free either to apply the national tariffs for vaginal and cesarean childbirths or to set their own fees. In general, tariffs for cesarean sections are higher than those for vaginal deliveries, due to the fact that the former is a surgical intervention, which should be performed in an operating room and by a surgeon. Even higher tariffs are, then, set in presence of complications and comorbidities. An exception to this rule are the Regions Lombardia and Sicily, which

have decided to apply a unique tariff schedule for cesarean and vaginal deliveries, allowing higher fees only in presence of complications.

The idea behind this paper is that hospital risk-adjusted cesarean rates are driven more by the regional DRG tariff differentials than by the amount of each regional DRG tariff. Under this hypothesis, the higher the regional tariff differential between cesarean and vaginal deliveries, the greater the incentive for regional hospital providers to behave strategically by opting for a cesarean section, *ceteris paribus*. By asserting this, we are implicitly assuming that costs are relatively homogeneous at the national level, at least among the same type of providers, which seems quite reasonable in the Italian context.

Therefore, to better account for the potentially different incentives for hospital between childbirth deliveries, we compute two separate tariff differential indicators, respectively for deliveries W/O CC and W CC, as follows:

$$FEEDIFF1 = \frac{(RegFEE_{DRG371}/RegFEE_{DRG373})}{(NatFEE_{DRG371}/NatFEE_{DRG373})}$$

$$FEEDIFF2 = \frac{(RegFEE_{DRG370}/RegFEE_{DRG372})}{(NatFEE_{DRG370}/NatFEE_{DRG372})}$$

Specifically, a value of 1 of FEEDIFF1 (FEEDIFF2) indicates that a Region has applied the same tariffs as the national ones for both cesarean and vaginal deliveries W/O CC (W CC). Differently, a value higher (lower) than 1 designates a Region where the ratio between the two DRG tariffs is higher (lower) than the corresponding national one, implying a relative financial convenience to execute a cesarean section. Figure 3 and 4 provide an overview of FEEDIFF1 and FEEDIFF2 by region for the year 2011.

[Figure 3. Tariff differentials between cesarean and vaginal deliveries W/O CC (FEEDIFF1) by region (year 2011)]

[Figure 4. Tariff differentials between cesarean and vaginal deliveries W CC (FEEDIFF2) by region (year 2011)]

To shed a first light on the relationship between hospital risk-adjusted cesarean rates for first-time mothers and each of the previous tariff differential indicators, data are plotted in figure 5. Fitted values reveal a positive relationship between our variable of interest and FEEDIFF2 (the indicator for deliveries W CC), while in the case of FEEDIFF1 (the indicator for deliveries W/O CC) the relationship appears quite weak.

[Figure 5. Scatter plots of risk-adjusted cesarean rates for first-time mothers against FEEDIFF1, FEEDIFF2 with fitted values and 95% confidence intervals]

To sum up, in absence of data on procedures' costs, we believe that our indicators represent the best available indices to capture the relative financial incentives related to regional DRG tariff differentials (i.e. the higher are the regional tariff differentials, the higher is the relative profitability between cesarean section and vaginal delivery, *ceteris paribus*). In the following section, employing the above indicators, we empirically test whether high rates of caesarean sections not explained by socio-demographic and clinical factors are, indeed, the result of providers' preferences for more profitable childbirth delivery modes.

3.2 Empirical strategy

To analyze the impact of DRG tariff differentials on the use of cesarean sections, we estimate the following model:

$$RACR_{ikjt} = \alpha + \beta * Bed_{ikjt} + \gamma * Birth_{ikjt} + \sum_{k=2}^{K} \theta_k + \delta * FEEDIFF_{jt} + \sum_{j=2}^{J} \varphi_j + \sum_{t=2}^{T} \mu_t + \varepsilon_{ikjt} \quad (1)$$

The dependent variable *RACR* is the risk-adjusted cesarean rate in hospital *i* of the type *k* in region *j* in year *t* (*t* = 2009,..., 2011). The risk-adjustment procedure described above ensures that we have already taken into account the socio-demographic and clinical factors driving differences in cesarean rates among hospitals. As long as exogeneity $E\left(\varepsilon_{ikjt} \middle| Bed_{ikjt}, Birth_{ikjt}, FEEDIFF_{jt}, \theta_k, \varphi_j, \mu_t\right) = 0$ holds in equation (1), we might interpret the estimated coefficients as consistent and, in particular, the coefficients of *FEEDIFF* as the effects of higher tariff differentials between deliveries in inducing higher cesarean rates[12]. However, a Linear Probability Model (*LPM*) could not be an appropriate underlying data generating process whenever data fall in the interval [0, 1], such as cesarean section rates. Therefore, as standard practice with this kind of data, we apply the *LOGIT* transformation to the data on cesarean sections[13];

[12] Among the others, one of the advantages of using a panel of hospital-level data is that it can be reasonably assumed that the single hospital's cesarean rate is not so relevant alone to affect the tariff policy for child deliveries in a region. Therefore, the above specification is less subject to the simultaneity problem between the variable of interest and the regional tariff policy (e.g., OECD, 2007; Lisi, 2013).

[13] For the sake of completeness, in the first version of this paper we had included also the estimates (available upon request) for the more simple, but certainly less consistent, LPM, with results fully in agreement to the LOGIT estimations.

thus, in our estimates *RACR* is the log of the odds ratio of the share of cesarean sections in hospital *i* of the type *k* in region *j* in year *t*.

The first group of explanatory variables aims at capturing differences in the supply factors among hospitals, which could potentially influence hospital cesarean rates. In particular, *Bed* is the total number of beds and *Birth* is the total number of childbirth deliveries in hospital *i* in year *t*, capturing the size and the level of specialization of hospital providers, respectively. Considering the previous evidence on the relevance of *learning-by-doing effects* in the provision of health care services (e.g., Birkmeyer et al., 2002; Chandra et al., 2012), these supply factors might be important in explaining the shares of cesarean sections. Moreover, we include a complete set of hospital type fixed effects (θ), aiming at capturing those unobservable differences among hospitals, which could affect cesarean section rates.

The explanatory variable *FEEDIFF* represents our main variable of interest. As we discussed above, we use two DRG tariff differentials: the tariff differential between cesarean and vaginal deliveries W/O CC and the same tariff differential but W CC. The two variables FEEDIFF only capture the variability of DRG tariffs among Italian regions. Unfortunately, data availability prevents us from considering also the variability of DRG tariffs among different hospitals within a same Region. The consequences of this potential drawback on our analysis will be better discussed when presenting the estimation results.

In the equation (1), we are particularly interested in estimating δ, from which $[exp(\delta) - 1]*100$ can be interpreted as the percentage change in the odds ratio of the share of cesarean sections due to a marginal increase in *FEEDIFF*, all other things

being equal. Moreover, for these explanatory variables we report also the marginal effects on the probability of executing a cesarean section.

Finally, we include in the estimation a large set of regional (φ) and time (μ) fixed effects, which should help us to alleviate omitted variables bias as well as model misspecification.

Since different hospital types (e.g., hospital units *vs.* accredited for-profit private hospitals) might be subject to different incentives, in the last part of the paper we wonder whether the impact of DRG tariff differentials differs according to hospital typology. To this extent, we augment equation (1) by including the interaction terms between *FEEDIFF* and all hospital types, using independent public hospitals (HTs) as the reference group:

$$RACR_{ikjt} = \alpha + \beta * Bed_{ikjt} + \gamma * Birth_{ikjt} + \sum_{k=2}^{K} \theta_k + \delta * FEEDIFF_{jt} + \sum_{k=2}^{K} \delta_k * FEEDIFF_{jt} + \sum_{j=2}^{J} \varphi_j + \sum_{t=2}^{T} \mu_t + \varepsilon_{ikjt} \quad (2)$$

Therefore, in equation (2) δ can be interpreted as the impact of the DRG tariff differential on risk-adjusted cesarean rates in HTs, whereas δ_k represents the differential effect (respect to δ) of *FEEDIFF* in hospitals *k*, implying a total effect of $\delta_k + \delta$ for each hospital type *k*.

As the number of cross-sectional observations is larger than the number of time-series ones, heteroscedasticity could be a potential problem in our estimates. In particular, the share of cesarean sections might exhibit a different variability according

to both hospital size and specialization, eventually implying heteroscedastic residuals. Furthermore, the variability of cesarean rates might not be constant among regions and hospital types. However, we can neither exclude the presence of serial correlation in our data, even though there are only three time periods in our sample. Therefore, for all our estimates, we provide standard errors that are robust to the presence of heteroscedasticity and serial correlation.

4. Results and discussion

In this section we discuss the results of the empirical analysis. First, we present a battery of estimates for the *LOGIT* model, which represents the primary source of our interpretation. Then, we move to the generalized linear models (*GLM*) proposed by Papke and Wooldridge (1996)[14], potentially an econometric specification even more appropriate for cesarean section rates. Subsequently, we conduct sensitivity analyses to check the robustness of our findings. Finally, we present the results concerning the differential effects.

4.1 Logit Model

In table 2 we report the different estimates from the *LOGIT* model, where the log of the odds ratio of the share of risk-adjusted cesarean sections is considered as dependent variable, including in all specifications the whole set of hospital types, regions and time fixed-effects. As discussed above, both heteroscedasticity and serial

[14] Indeed, Papke and Wooldridge (1996) proposed the so-called "fractional *logit*" in the cross-section context. However, there are no serious drawbacks in applying their *GLM* approach with panel data, provided that one "... can account for unobserved heterogeneity that is possibly correlated with the explanatory variables ..." (Papke and Wooldridge, 2008). In this regard, we are confident that in our study the large structure of fixed effects should be sufficiently able to account for the unobserved heterogeneity, without suffering from the incidental parameters problem. For a study applying the "fractional *logit*" with panel data see e.g. Hausman and Leonard (1997), where they use a similar strategy to account for the unobserved heterogeneity.

correlation may be present in our estimates; therefore, we use a Generalized Least Squares (GLS) estimator for panel data[15].

In column (1) we first estimate a *LOGIT* regression including only *FEEDIFF1* (that is, the DRG tariff differential between cesarean and vaginal deliveries W/O CC) as explanatory variable. The point estimate of *FEEDIFF1* is positive and significant at 1%, implying that higher DRG tariff differentials are associated with higher cesarean rates. In particular, the coefficient of 0.210 implies a marginal effect[16] of 0.045, meaning that a marginal increase of *FEEDIFF1* would imply an increase of about 4 – 5 percentage points in the probability of a cesarean deliveries. This might suggest that in those regions where the financial incentives to execute cesarean sections are relatively higher, providers respond in a strategic way, by shifting procedures towards more cesarean deliveries. As mentioned above, the variables FEEDIFF are able to capture only the regional differences in the DRG tariffs for childbirths. Therefore, there could be a part of the variability in the rate of caesarean sections among hospitals located in the same region due to differences in DRG tariffs which remains unexplained in our model. This implies that the magnitude of the impact of FEEDIFF variables on hospital caesarean rates could be in theory under-estimated.

Furthermore, while the hospital size (*Bed*) does not seem to play any role after controlling for hospital type, the coefficient of *Birth* is negative and significant. Interestingly, this would indicate that more specialized hospitals tend to exhibit lower cesarean rates, suggesting the presence of a *learning-by-doing effect* in the provision of

[15] We also tried to use a pooled OLS (*POLS*) estimator with robust standard errors, obtaining coefficients fairly close to the GLS ones but, not surprisingly, estimates were less precise.

[16] Specifically, we are considering the standard marginal effect at means (MEMs), that is

$$\frac{\partial RACR}{\partial FEEDIFF} = \delta\left(F(\overline{\boldsymbol{X}}\boldsymbol{\beta}) - F(\overline{\boldsymbol{X}}\boldsymbol{\beta})^2\right) = \delta \frac{e^{(\overline{\boldsymbol{X}}\boldsymbol{\beta})}}{\left(1 + e^{(\overline{\boldsymbol{X}}\boldsymbol{\beta})}\right)^2}$$

childbirth delivery services. Moreover, there seems to emerge some interesting regularities in the differences among hospital types. On the one hand, public hospitals without an autonomous budget (*Hospital Units*) tend to experience lower cesarean rates, *ceteris paribus*; on the other hand, accredited for-profit private hospitals (*Private Hospitals*, *FP*) tend to execute significantly more cesarean sections. Indeed, this evidence would support the hypothesis of providers behaving strategically, in accordance with financial incentives[17]. Finally, after controlling for all other factors, a significant variation among Italian regions still remains unexplained. This is partially captured by the inclusion of a large set of fixed effects in the estimation, with the aim, among others, of exploring the role played by cultural factors.

In column (2) we run the same *LOGIT* regression as previously, but including *FEEDIFF2* (that is, the DRG tariff differential between cesarean and vaginal deliveries W CC) as explanatory variables. As we can see, the point estimate of *FEEDIFF2* is positive and significant too, with a magnitude more than twice that of *FEEDIFF1*. In particular, the coefficient of 0.512 implies a marginal effect of 0.107, meaning that a marginal increase of *FEEDIFF2* would imply an increase of about 10 – 11 percentage points in the probability of a cesarean deliveries. Furthermore, also the other indications concerning the effects of hospital type and specialization, as well as the role played by regional cultural differences, do not show relevant changes. Therefore, we can still conclude that in those regions where cesarean sections are relatively better reimbursed

[17] Though in Italy hospital physicians are salaried, the agency theory literature makes the assumption that they act on behalf of their third party payer (the NHS for public hospitals or the owner/s for accredited private ones), by maximizing hospital's revenue/profit. Moreover, under a fixed physician's revenue, it is also reasonable that the physician's strategy becomes that of minimizing the effort, especially in terms of time. Hence, whenever the fee for performing cesarean sections are relatively more profitable, the physician's choice to perform this typology of child delivery becomes attractive in terms of both revenue/profit maximization and effort minimization. In fact, cesarean sections take in general less time and can be scheduled at a time that is convenient for physicians. Therefore, it is reasonable to assume that physicians' interest is fully in line with the hospital management's preference for more profitable delivery procedures.

compared to vaginal deliveries, hospital providers tend to exhibit higher cesarean rates, *ceteris paribus*.

As we discussed above, the two conditions (birth deliveries W/O CC and W CC) might imply potentially different incentives for hospitals. Therefore, in the following specification (3) we try to figure out what DRG tariff differential turns out to be more important in affecting hospitals' practice, including both *FEEDIFF1* and *FEEDIFF2*. Once we include both indicators, only the DRG differential for deliveries W CC is still positive and significant, whereas that for deliveries W/O CC turns out to be negative. However, we should notice that the two indicators are highly correlated ($\rho = 0.90$); indeed, standard tests (*Conditioning Number*, *VIF*) show that there seem to be a problem of multicollinearity, once both *FEEDIFF1* and *FEEDIFF2* are included. Therefore, we should be overcautious in interpreting their estimates in (3).

[Table 2. Risk-adjusted cesarean rates for first-time mothers (*LOGIT model*)]

From an econometric point of view, though the *LOGIT* transformation is certainly more appropriate than the simple *LPM*, it might not be the most appropriate for cesarean section rates. In this regard, Papke and Wooldridge (1996) noted that the log-odds type procedures implicitly assume a standard normal distribution for the error term, which indeed might not be appropriate for regression models with fractional dependent variables. In particular, since fractional variables are the result of a dichotomous process, they proposed a more attractive quasi-likelihood estimation method in the framework of generalized linear models (*GLM*), using the *LOGIT* transformation as link function but assuming a binomial distribution for the error term. To the extent that the

share of cesarean sections is the result of the dichotomous choice vaginal/cesarean childbirth deliveries, the use of a *GLM* with *LOGIT* link function and binomial distribution could result even more appropriate.

Therefore, in the last three right columns of table 2, we run the same battery of estimates as for the *LOGIT* model, but for the described *GLM* estimator (Papke and Wooldridge, 1996). Once again, we first estimate a *GLM* regression including *FEEDIFF1*; then, we insert only *FEEDIFF2* and, finally, both DRG tariff differentials. Indeed, performing the *GLM* does not seem to change the results markedly. Similarly to the *LOGIT* model, the point estimates of *FEEDIFF2* are still positive and significant, implying a marginal effect of 0.051 in (5) and 0.157 in (6), whereas the evidence on *FEEDIFF1* would appear to be less striking. Indeed, the coefficient of *FEEDIFF1* in column (4) turns out to be even non significantly associated with cesarean rates. Moreover, all other regularities concerning the effects of hospital type and specialization are confirmed too. In particular, the significant coefficients of *Birth* imply that hospitals with a higher yearly number of childbirths experience lower cesarean section rates, thus confirming the positive effect of specialization on the physician's ability to choose the most appropriate delivery method. Finally, we still find that providers' behavior differs according to hospital type, with non-financially autonomous public hospitals (*Hospital Units*) showing, *ceteris paribus*, lower cesarean rates and for-profit accredited private hospitals (*Private Hospitals, FP*) higher ones.

Overall, both the *LOGIT* and *GLM* results tend to suggest that in those regions where the financial incentives to execute cesarean sections are relatively higher, providers respond strategically by shifting procedures towards more cesarean deliveries. More specifically, our findings highlight the significance of the DRG tariff differential

between cesarean and vaginal deliveries W CC (*FEEDIFF2*) in driving providers' behavior, while evidence on the tariff differential between deliveries W/O CC (*FEEDIFF1*) appears to be rather scarce. Indeed, such diversity between these two conditions (W and W/O CC) could probably be due to the greater difficulty for providers to "induce" and justify a cesarean delivery in absence of complications and comorbidities.

4.2 Sensitivity Analysis

To test whether our results depend crucially on the inclusion of some specific Italian regions, we re-estimate the *LOGIT* model by excluding all regions one-by-one from the panel. Indeed, this further robustness check is especially required for the Italian case, given the already mentioned significant differences existing among the Italian regions. Moreover, the number of hospitals in our sample is not homogeneous among regions, reflecting the actual distribution of Italian providers; thus, in theory each regions could have a different relative weight in determining the results.

[Figure 6. Coefficients of FEEDIFF1 and FEEDIFF2 from the reduced sample]

In figure 6 we show the coefficients of *FEEDIFF1* and *FEEDIFF2*, arranged from the smallest to the greatest[18]. As the figure shows, the results from the reduced sample do not change our conclusions. Indeed, the coefficients of the DRG tariff differential for deliveries W CC (*FEEDIFF2*) are always positive and significant, while evidence on the tariff differential for deliveries W/O CC (*FEEDIFF1*) are rather scarce.

[18] Full regressions are available upon request from the authors.

All in all, our results appear to be fairly robust and rather stable to the sample used in the analysis. Provided that in our estimates we control for socio-demographic, clinical and supply factors, along with several unobserved fixed-effects, we interpret our estimates as fairly consistent.

4.3 Differential effects by hospital type

In this final section we report the results relative to the differential effect of DRG tariff differentials among hospital types. It is here worthwhile to remember that in the Italian NHS the financing mechanism varies according to the institutional nature of hospitals; therefore, the exploration of a differential effect of tariff differentials among hospitals would seem reasonable in our case. In particular, the DRG-based reimbursement system applies to all private hospitals (both FP and NFP) and only to the autonomous public ones (HTs), while it does not apply to public hospitals directly managed by LHAs (HUs), whose activity is financed through the LHAs' budget.

Under the hypothesis here explored of a strategic providers' behavior, one should expect that tariff differentials affect most private hospitals, especially FP ones. On the other hand, among public hospitals, HUs should be less affected by tariffs than HTs. Therefore, in our estimates we consider HTs as the reference group.

In table 3 we report the estimates including differential effects. Similarly to table 2, we estimate the *LOGIT* model with our two DRG tariff differentials and, then, we re-run the same specifications for the *GLM*. The first result clearly emerging from the table is that the effect of tariff differentials is higher in private hospitals, especially in those for FP, than in public ones. More specifically, for the second DRG tariff differential (*FEEDIFF2*) the *LOGIT* estimates imply a marginal effect of 0.058 in HTs, while

consistently higher marginal effects of 0.212 and 0.100 are shown in PHs, respectively (FP) and (NFP). Interestingly, once we control for tariff differential effects, fixed effects for private hospitals turn out to be insignificant. This would suggest that the diversity in the behavior between private and public hospitals are mostly driven by the different financial incentives. Indeed, this finding appears to be fully in line with the theory of rational providers behaving strategically. On the other hand, among public hospitals, the effect on HUs does not seem to be significantly different from that on HTs. Although unexpected, this result might be due to the fact that LHAs usually use DRG tariffs as a device to assess hospital activity and, consequently, to determine the global budget of HUs (Morandi et al., 2008). To this extent, even if tariffs do not represent the real reimbursement for the healthcare services provided, HUs might still be interested in shifting procedures towards those treatments with a higher DRG tariff. However, fixed effects for HUs are still negative and significant, implying that HUs tend to experience lower cesarean rates, *ceteris paribus*.

Moreover, these estimates also confirm the importance of the DRG tariff differential between cesarean and vaginal deliveries W CC (*FEEDIFF2*) in driving providers' behavior. On the contrary, evidence on the role of the tariff differential between deliveries W/O CC (*FEEDIFF1*) seems less marked, especially with regard to public hospitals. Finally, all other regularities concerning the effects of specialization and regional differences are, once again, confirmed.

[Table 3. Risk-adjusted cesarean rates for first-time mothers (*Differential effect*)]

5. Concluding remarks

This study provides evidence that Italian hospitals respond to financial incentives in obstetrics and that the strategic behavioral response varies by hospital type and level of specialization. Specifically, using panel data on risk-adjusted cesarean rates for first-time mothers at the hospital level, we investigate the impact of two different tariff differentials (between cesarean and vaginal deliveries W/O CC and W CC), after controlling for supply factors that could potentially play a role in explaining differences among providers. Our main finding is that higher regional tariff differentials result in an increased intensity of cesarean deliveries, *ceteris paribus*. In other words, whenever the regional reimbursement policy favors cesarean sections, regional providers have an incentive to shift deliveries away from natural childbirths to the more highly reimbursed (and often risky) surgical cesarean procedure. More specifically, our findings highlight the significance of the DRG tariff differential between cesarean and vaginal deliveries W CC, while evidence on the differential between deliveries W/O CC turns out to be less striking. Indeed, such diversity could probably be due to the greater difficulty for providers to "induce" and justify a cesarean delivery in absence of complications and comorbidities.

Interestingly, the intensity of this induced effect is not uniform across providers. As expected, the empirical analysis confirms that for-profit private hospitals not only exhibit, *ceteris paribus*, higher cesarean rates but also respond more strategically than public hospitals. Within the latter category, once we account for differences in hospital size and other confounding factors, those hospitals that are not financially autonomous, whose activity costs are directly covered by LHAs (i.e. Hospital Units), experience lower cesarean rates. Nonetheless, we do not find evidence of a significant differential effect between autonomous (HTs) and non autonomous hospitals (HUs), despite the

different financial system. Along with the profit motive, hospital specialization in obstetrics is also important. We find that higher annual volumes of child deliveries are associated with lower cesarean rates, suggesting that more skilled providers are better able to choose the most appropriate mode of child delivery (*learning-by-doing effect*). Overall, our findings are consistent with the standard theory and previous studies on providers' response to financial incentives and supplier-induced demand.

Although the present study is specially focused on child delivery modes, it can be viewed as the analysis of a more general problem than the excessive use of caesarean sections, since the results may provide insights about the inappropriateness of the whole set of healthcare services provided by hospitals.

This paper has some relevant implications for policy. It highlights the importance of tariff policies as an effective tool through which to influence hospital providers' choices and to control for their clinically inappropriate and costly behaviors. As for childbirth services, active policies to curb down health care costs should pay attention to design financial incentives so as to minimize the risk of providers strategically substituting cesarean procedures to natural deliveries. Attention should be even greater for those financial incentives addressed to private providers working on behalf of the Italian NHS, as they tend more than other providers to respond strategically in terms of profit maximization. In this regard, the freedom given to regions to discriminate tariffs across providers could contribute to mitigate the problem. An alternative strategy requires a redefinition of the public/private hospital mix within the NHS.

The problem analyzed in this paper is of particular importance for the Italian context, where an ongoing debate exists on the design of policies for improving the efficiency of healthcare services provided by the regions – through the definition of

standard costs and standard needs. In this regard, the study highlights the importance of a proper use of healthcare regulation (e.g. by discriminating tariffs between public and private producers or by redefining the public/private mix), in order to contain the inappropriateness of services and, eventually, the inefficiency of public health spending.

Finally, this study suggests some areas worthy of future research. Indeed, it focuses on clinical inappropriateness, a concept more directly related to the efficiency of health expenditure and only indirectly to the quality of health care. However, the increasing number of unnecessary cesarean sections not only pushes up health care costs but it also raises mortality and morbidity in mothers and newborns. Therefore, future research should question whether and, eventually, in which measure the unnecessary cesarean procedure induced by hospitals have a detrimental effect on patient outcomes.

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Table 1. Descriptive statistics for the selected variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Risk-adj. cesarean rate for first-time mothers	1,441	0.32	0.16	0.04	0.92
Vaginal birth fee (W/O CC) (in euro)	63	1,535.48	339.25	923	2,226
Vaginal birth fee (W CC) (in euro)	63	2,249.02	414.28	1,370	3,180
Cesarean section fee (W/O CC) (in euro)	63	2,496.48	456.79	1,806	3,941
Cesarean section fee (W CC) (in euro)	63	3,555.13	630.68	2,316	4,955
FEEDIFF1	1,441	0.96	0.21	0.63	1.42
FEEDIFF2	1,441	1.01	0.18	0.67	1.42
Number of beds	1,441	317.53	290.35	2	1,719
Number of births	1,441	823.62	652.04	150	6,295

Note: FEEDIFF1: first index of fee differential (differential between cesarean and vaginal DRG tariffs W/O CC); FEEDIFF2: second index of fee differential (differential between cesarean and vaginal DRG tariffs W CC).

Figure 1. Box plot of risk-adjusted cesarean rates by region.

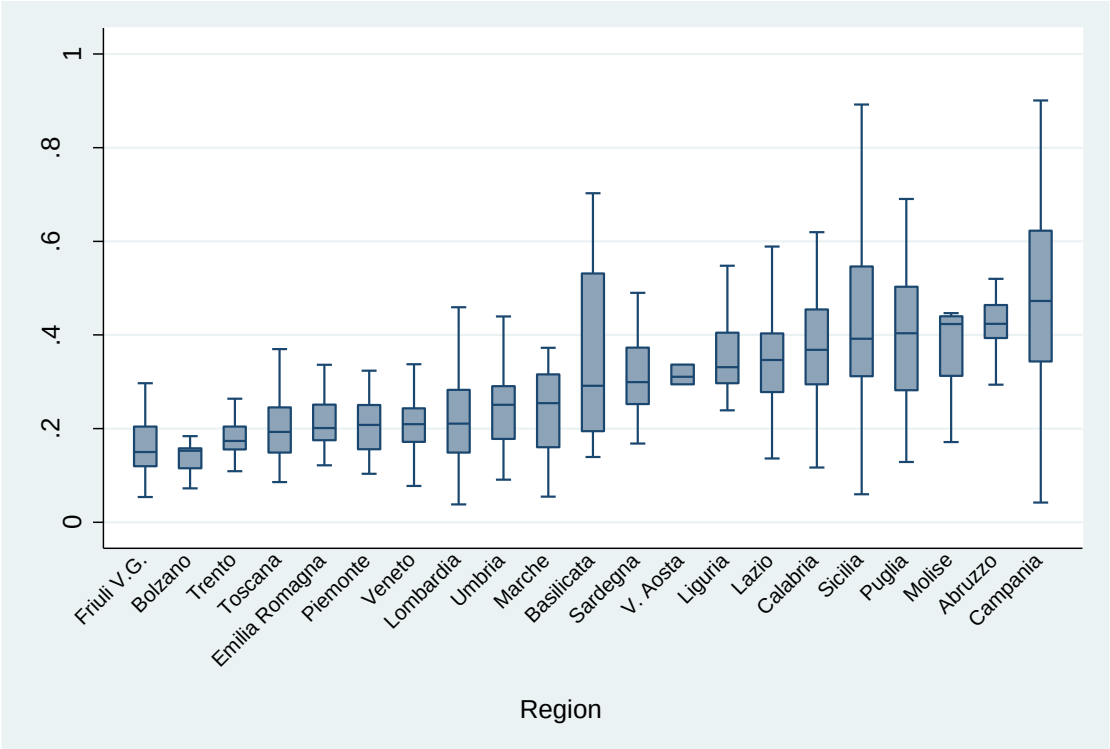

Figure 2. Box plot of risk-adjusted cesarean rates by hospital type.

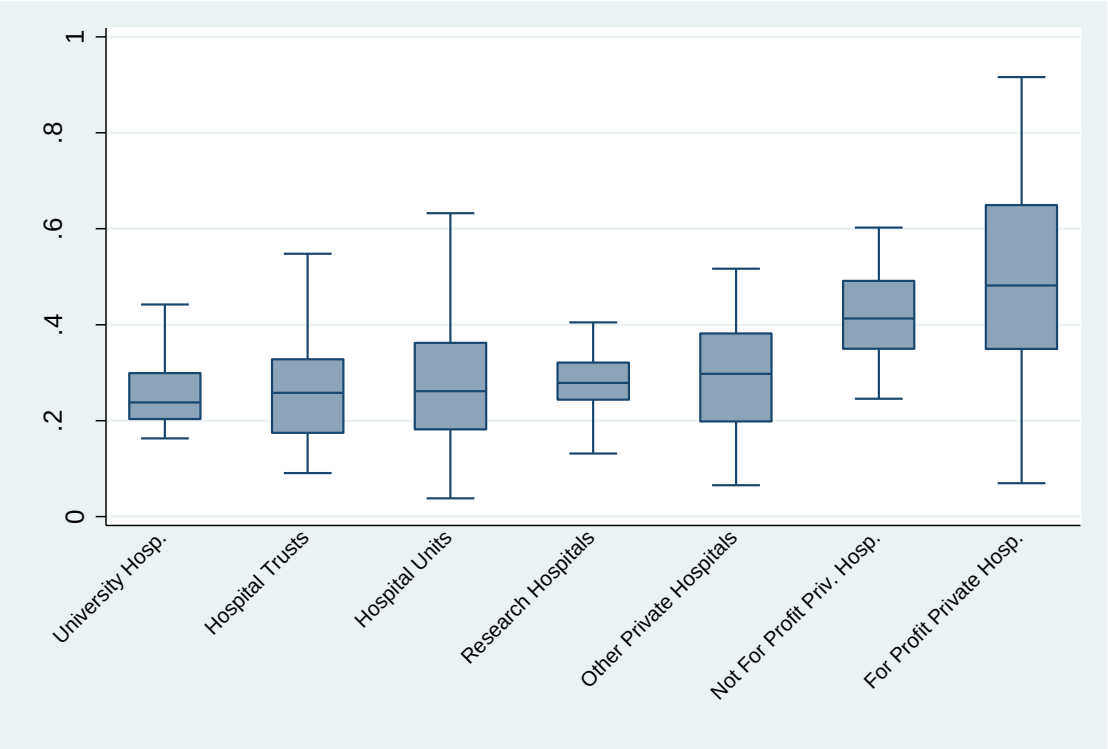

Figure 3. Tariff differentials between cesarean and vaginal deliveries W/O CC (FEEDIFF1) by region (year 2011).

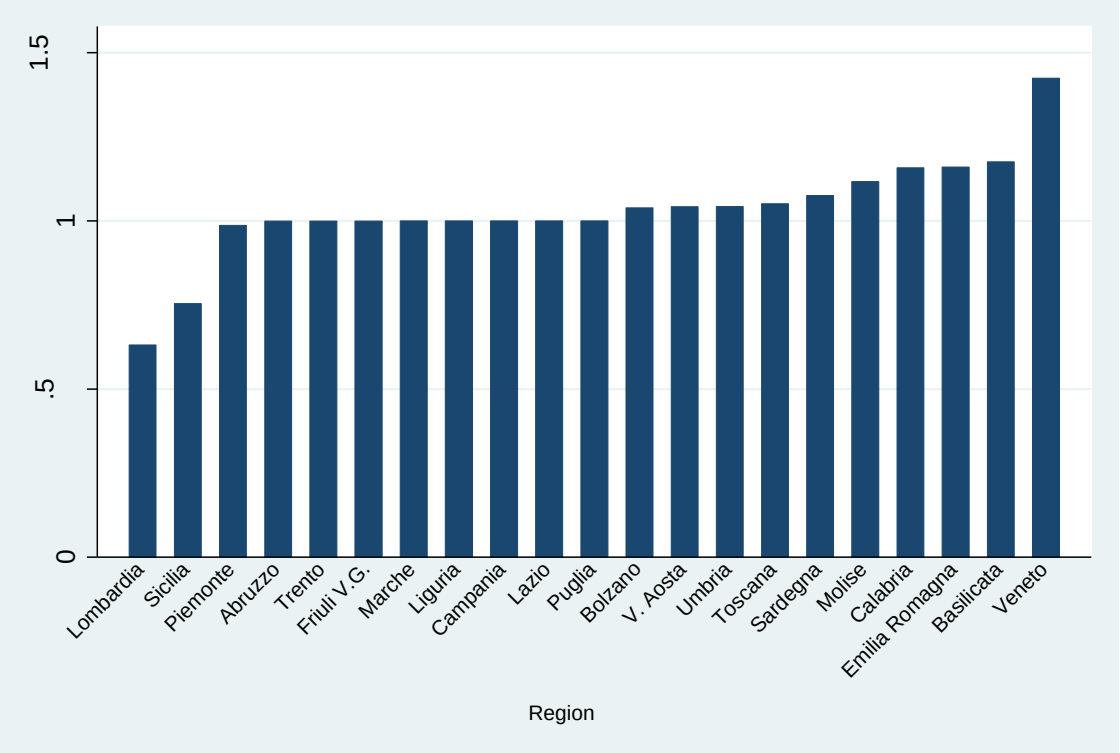

Figure 4. Tariff differentials between cesarean and vaginal deliveries W CC (FEEDIFF2) by region (year 2011).

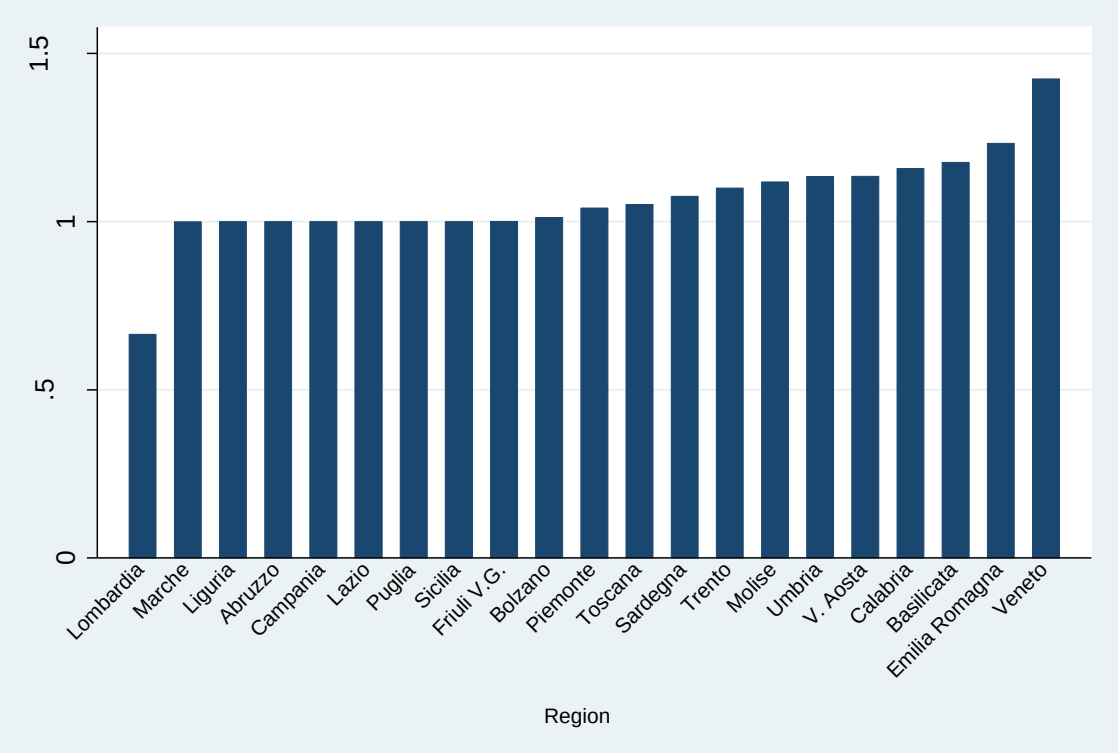

Figure 5. Scatter plots of risk-adjusted cesarean rates for first-time mothers against FEEDIFF1, FEEDIFF2 with fitted values and 95% confidence intervals.

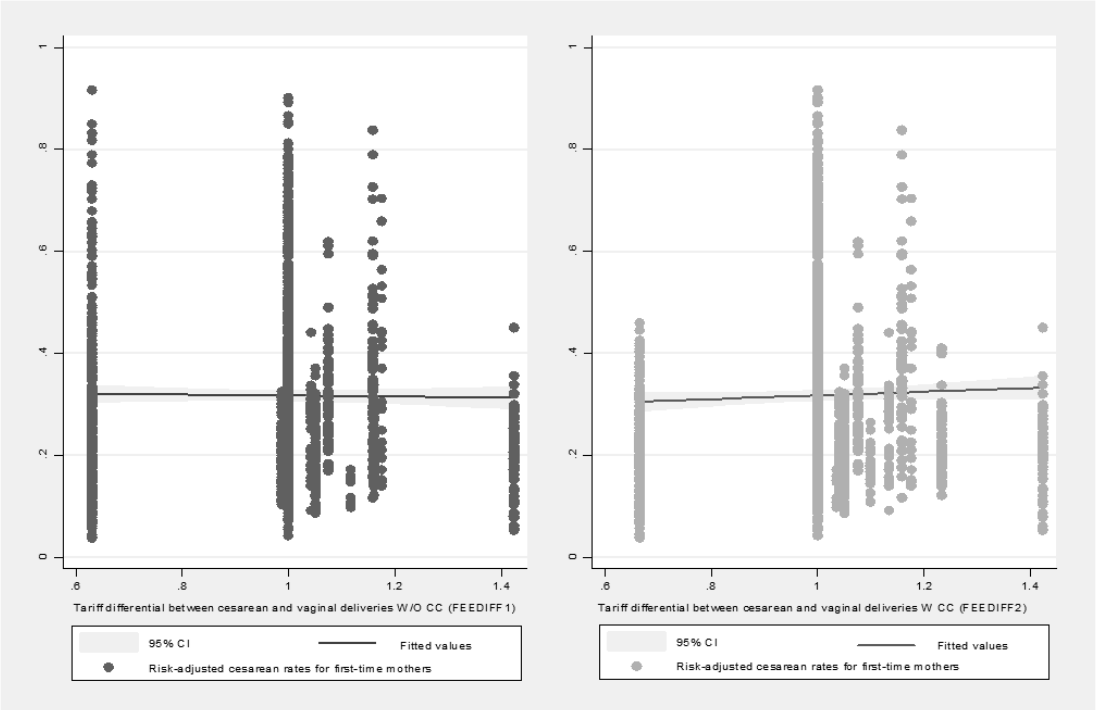

Table 2. Risk-adjusted cesarean rates for first-time mothers (*LOGIT model*)

	(1)	(2)	(3)	(4)	(5)	(6)
	LOGIT[a]	LOGIT[a]	LOGIT[a]	GLM[b]	GLM[b]	GLM[b]
BED	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
BIRTH	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***
FEEDIFF1	0.210 (0.038)***		-0.326 (0.034)***	-0.015 (0.108)		-0.481 (0.208)**
FEEDIFF2		0.512 (0.037)***	0.845 (0.047)***		0.238 (0.120)**	0.742 (0.245)***
HOSPITAL UNIT	-0.333 (0.023)***	-0.352 (0.014)***	-0.365 (0.011)***	-0.305 (0.157)**	-0.312 (0.153)**	-0.319 (0.154)**
PRIVATE HOSPITAL (FP)	0.363 (0.031)***	0.345 (0.028)***	0.327 (0.018)***	0.370 (0.167)**	0.366 (0.162)**	0.360 (0.163)**
PRIVATE HOSPITAL (NFP)	-0.036 (0.109)	-0.055 (0.113)	-0.053 (0.115)	-0.108 (0.169)	-0.114 (0.165)	-0.119 (0.170)
NORTH-WEST	-0.243 (0.019)***	-0.159 (0.020)***	-0.169 (0.018)***	-0.301 (0.056)***	-0.237 (0.056)***	-0.245 (0.056)***
NORTH-EST	-0.489 (0.015)***	-0.535 (0.020)***	-0.526 (0.021)***	-0.461 (0.051)***	-0.511 (0.052)***	-0.524 (0.052)***
SOUTH	0.474 (0.017)***	0.486 (0.015)***	0.487 (0.014)***	0.479 (0.049)***	0.477 (0.049)***	0.481 (0.049)***
ISLAND	0.465 (0.018)***	0.446 (0.015)***	0.394 (0.018)***	0.408 (0.059)***	0.410 (0.055)***	0.325 (0.067)***
CONSTANT	-0.851 (0.038)***	-1.154 (0.053)***	-1.140 (0.045)***	-0.577 (0.200)***	-0.827 (0.202)***	-0.831 (0.202)***
HOSPITAL TYPE DUMMIES	YES	YES	YES	YES	YES	YES
REGIONAL DUMMIES	YES	YES	YES	YES	YES	YES
YEAR DUMMIES	YES	YES	YES	YES	YES	YES
Conditioning Number	9.39	9.37	10.21	9.39	9.37	10.21
Observations	1441	1441	1441	1441	1441	1441

LOGIT: logit transformation; GLM: generalized linear model for fractional regression; FEEDIFF1: first index of fee differential (differential between cesarean and vaginal DRG tariffs W/O CC); FEEDIFF2: second index of fee differential (differential between cesarean and vaginal DRG tariffs W CC).

[a] GLS estimator for panel data. [b] Generalized linear estimator for fractional response variable by Papke and Wooldridge (1996).

Robust standard errors in brackets. * significant at 10%, ** significant at 5%, *** significant at 1%.

Figure 6. Coefficients of FEEDIFF1 and FEEDIFF2 from the reduced sample

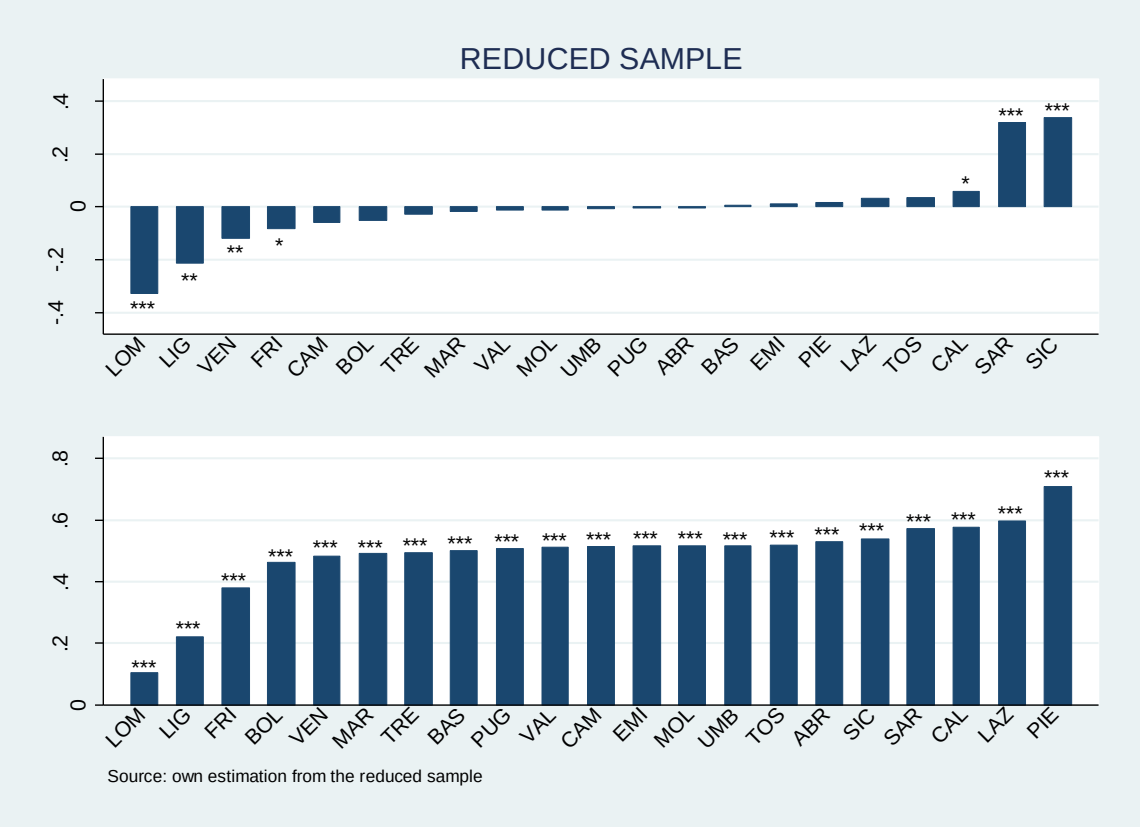

Table 3. Risk-adjusted cesarean rates for first-time mothers (*Differential effect*)[c]

	(1)	(2)	(3)	(4)
	LOGIT[a]	LOGIT[a]	GLM[b]	GLM[b]
BIRTH	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***
FEEDIFF1	-0.006 (0.064)		-0.224 (0.130)*	
FEEDIFF2		0.278 (0.087)***		0.047 (0.013)***
HOSPITAL UNIT*FEEDIFF	0.021 (0.038)	0.040 (0.041)	0.094 (0.062)	0.103 (0.060)*
PRIVATE HOSPITAL (FP)*FEEDIFF	0.734 (0.055)***	0.771 (0.060)***	0.765 (0.086)***	0.785 (0.083)***
PRIVATE HOSPITAL (NFP)*FEEDIFF	0.201 (0.061)***	0.222 (0.067)***	0.294 (0.087)***	0.296 (0.084)***
HOSPITAL UNIT	-0.870 (0.520)**	-1.133 (0.590)**	-1.189 (0.546)**	-1.210 (0.602)**
PRIVATE HOSPITAL (FP)	0.189 (0.544)	-0.639 (0.659)	0.629 (0.693)	-0.865 (0.769)
PRIVATE HOSPITAL (NFP)	-0.625 (0.547)	-0.762 (0.631)	-1.075 (0.676)	-1.141 (0.740)
NORTH-WEST	-0.254 (0.031)***	-0.178 (0.037)***	-0.298 (0.056)***	-0.229 (0.056)***
NORTH-EST	-0.445 (0.027)***	-0.483 (0.033)***	-0.442 (0.052)***	-0.500 (0.053)***
SOUTH	0.506 (0.027)***	0.503 (0.032)***	0.477 (0.049)***	0.473 (0.049)***
ISLAND	0.447 (0.035)***	0.414 (0.038)***	0.412 (0.059)***	0.408 (0.056)***
CONSTANT	-0.981 (0.065)***	-1.298 (0.092)***	-0.764 (0.127)***	-1.054 (0.136)***
HOSPITAL TYPE DUMMIES	YES	YES	YES	YES
REGIONAL DUMMIES	YES	YES	YES	YES
YEAR DUMMIES	YES	YES	YES	YES
Observations	1441	1441	1441	1441

LOGIT: logit transformation; GLM: generalized linear model for fractional regression; FEEDIFF1: first index of fee differential (differential between cesarean and vaginal DRG tariffs w/o cc); FEEDIFF2: second index of fee differential (differential between cesarean and vaginal DRG tariffs w cc).

[a] GLS estimator for panel data. [b] Generalized linear estimator for fractional response variable by Papke and Wooldridge (1996). [c] The reference group for the interpretation of the differential effect is "Hospital Trust".

Robust standard errors in brackets. * significant at 10%, ** significant at 5%, *** significant at 1%.