

UNDERSTANDING INAPPROPRIATENESS IN HEALTH TREATMENTS:  
THE CASE OF CAESAREAN DELIVERIES ACROSS ITALIAN REGIONS

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# Understanding Inappropriateness in Health Treatments: the Case of Caesarean Deliveries across Italian Regions<sup>♦</sup>

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## Abstract

The upward trend in the incidence of caesarean deliveries is a widespread stylised fact in many countries. Several studies have argued that it does not reflect, at least in part, patients' needs but that it is also influenced by other factors, such as providers/physicians incentives. Not surprisingly, the incidence of caesarean sections is often used as an indicator of the degree of (in)appropriateness in health care, which has also been found to be strongly correlated with expenditure differentials between regions. We exploit the significant regional variation in the share of caesarean deliveries in Italy to explore the impact on inappropriateness of three groups of policy variables: 1) political economy indicators (as a way to capture different approaches to the governance of the health care sector); 2) reimbursement and pricing policies (as DRG fees); 3) structural supply indicators (such as the incidence of private providers and the number of employees). The analysis controls for the demographic characteristics of patients and their education levels. Results suggest that tariffs might be an effective policy tool to control inappropriateness; however, the structure of the regional health care system matters. More importantly, also some characteristics of the regional governments and the financing mechanisms play a role.

**JEL Classification:** H75, I18, D70

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## 1. Introduction

The expected growth in public health expenditure constitutes a relevant policy problem in almost all developed countries. Not surprisingly, improving spending efficiency while guaranteeing (or even improving) citizens' health is becoming a key challenge for policy-makers. A common suggestion to reach this goal coming from the policy-oriented literature is to improve service appropriateness: deliver appropriate services (at the lowest possible cost) would produce cost savings, while assuring citizens' health. Evidence on these potential savings is provided for instance for Italy which displays a significant variation across Italian regions in the degree of (in)appropriateness. Moreover, this (in)appropriateness is shown to be strongly correlated with the expenditure differentials observed between regions (Francese and Romanelli, 2010). Improving the appropriateness of medical treatments could then clearly contribute to the efforts of containing public health expenditure, without reducing or limiting the quantity or quality of services to be supplied to patients.

The incidence of cesarean sections is an indicator of (in)appropriateness commonly considered in the literature, and by policy-makers<sup>1</sup>. Being a surgical treatment, a caesarean section is characterised by a large cost differential with respect to the alternative classical vaginal delivery (a medical treatment). Absent any therapeutic reasons, this latter treatment is generally considered an appropriate way of delivery, which can clearly help in containing health care costs.

An upward trend in the incidence of caesarean deliveries is a well documented stylised fact at the international level. The main explanations proposed by the literature focus on the role of many different factors: from technological changes (affecting for instance the treatment of pain in delivery), to changes in patients' preferences and the physicians/providers behaviours (the latter being also influenced by the remuneration system).

A remarkable rising trend in the rate of caesarean sections has also characterised Italy, where this indicator has more than trebled from 1980 to 2007. Not surprisingly, the need to monitor its dynamics has drawn the attention of policymakers. For example, the 2003-05 National Health Plan stated the objective of containing the average share of caesarean deliveries in Italy at about 20% by the end of the planning period.<sup>2</sup> Over those years, however, the increasing trend in the incidence of caesarean births did not stop, bringing the Italian average to exceed 38% in 2005. Regional variation (both in the growth rates and the incidence rates) is also

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<sup>1</sup> See for example the indicators regularly published by the Italian Health Ministry (Ministero della Salute, Rapporto annuale sull'attività di ricovero ospedaliero) and Fortino *et al.* (2002).

<sup>2</sup> In particular the plan included among its objectives the aim to decrease the frequency of caesarean deliveries and reduce regional differentials (p. 82). The stated goal was to achieve – by the end of the three years period – a national average equal to 20%, in line with mean values for other European countries. The reduction was to be obtained also through a revision of DRG reimbursement fees.

significant: for instance, caesarean section rates are above 50% and 60% in Sicilia and Campania respectively, two regions characterised by high per capita public health expenditure and where the room for cost savings is estimated to be large (Piacenza and Turati, 2010 and Francese and Romanelli, 2010).

This paper addresses the issues of what affects (in)appropriateness (proxied by caesarean section rates). Besides more traditional variables, we analyse also the role of the characteristics of the Regional governments. As we will discuss below, given a national regulatory framework, health policies are implemented and managed by Regions in a way that reflects a complex net of intergovernmental relationships between the Central and the Regional governments. The modern fiscal federalism theory suggests that the way in which different layers of government interact affect policy outcomes. Exploiting available data on caesarean deliveries, we disentangle the impact of three groups of policy variables: 1) political economy variables, in order to capture different approaches to the governance of the health care sector; 2) reimbursement and pricing policies, such as DRG fees to control for the effect of financing mechanisms; 3) structural supply indicators, to take into account the impact of different organisational arrangements. We also provide checks for the presence of imitative behaviour driven by geographical proximity, and serial correlation. Our results suggest that the “quality” of Regional governments and structural characteristics of the health sector do matter.

The remainder of the paper is structured as follows. Section 2 provides a brief survey of the available literature on caesarean sections. Section 3 presents the Italian case. The model and the empirical strategy are discussed in Section 4. We describe the data and our results in Section 5 and 6 respectively. A brief section of concluding remarks follows.

## **2. Why are caesarean sections on the rise? A brief survey**

The incidence of caesarean deliveries is characterised by an upward trend at the international level. For instance among the OECD countries, in the US the caesarean section rate has increased by about 9 percentage points over the period 1990-2006; the increase in Germany and Spain has been respectively about 13 and 12 percentage points (OECD Health Data, 2010). Given this evolution over time, it is not surprising that the impact of caesarean sections on maternal and perinatal health has drawn the attention of scholars, international organisations, and national policymakers (see for example Lumbiganon *et al.*, 2010 on the 2007-08 WHO global survey). The economic literature has been mainly concentrated on identifying the drivers of the observed upward trend. Many factors help explaining the increase in the incidence of caesarean deliveries (Ecker and Frigoletto, 2007). They can be summarised under three main categories:

1. *technological changes*: such as the move from home to hospital delivery, the use of anaesthesia (and improved anaesthetic techniques), the introduction of modern antibiotics, the creation of blood banks, neonatal intensive care units, techniques for monitoring the fetus health during pregnancy and labour, and for inducing labour;
2. *changes in patients' preferences*: nowadays patients might be willing to accept a lower risk of an adverse outcome to avoid a caesarean delivery. The way in which they balance risks and assess risk levels associated with the different procedures have changed. This might reflect both social and cultural factors as well as changes in reproductive behaviour. For example, the age of the mother has significantly increased with respect to the past and parents educational levels and employment statuses (particularly for mothers) have experienced dramatic changes<sup>3</sup>. Furthermore fertility rates and household's size and composition are now significantly different than just a few decades ago.
3. *changes in physicians/providers behaviour*: organisational characteristics of the health sector and medical best practices have displayed large changes over the last decades. Such changes are often linked to technological progress. However, many times they are also driven by physicians/providers behaviours induced by exogenous factors. An obvious example are the incentive effects of payment systems. In this category one may also consider the more intense use of induced labours, which might reflect the scheduling of deliveries to suit providers timetables (such as physicians and obstetricians work shifts).<sup>4</sup> Another issue that has received attention by the literature is the increasing fear of malpractice lawsuits, which might have influenced physicians decisions (see for example Localio et al., 1993 and Dubay et al., 1999).

Several studies have analysed one or more of the drivers accountable for the increase in caesarean section rates. Gruber and Owings (1996) for example investigate the impact of declining fertility trends on the rapid rise of caesarean births. They study how much the exogenous income shock induced on physicians incomes by the drop in fertility might have influenced doctors' decisions, inducing the substitution of a cheaper practice with one characterised by a higher reimbursement. Such a reaction would be consistent with a model of induced demand (see, e.g., the model developed by McGuire and Pauly, 1991). The authors find a

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<sup>3</sup> For example in Italy the average age of the mother has increased from 27.5 in 1980 to 31.6 in 2008, the share of women with tertiary education has almost trebled (from 4.9 per cent in 1993 to 12.8 in 2007) and female labour force participation has increase form 41.9 per cent in 1993 to 51.6 in 2008.

<sup>4</sup> Brown (1996) examines the impact of physicians demand for leisure on caesarean section rates, observing that the probability of a caesarean delivery over the weekend and at certain hours of the day (and night) is significantly different (lower) than that for unplanned births.

positive, even though small<sup>5</sup>, relation between the fall in fertility and the incidence of caesarean births.

In general, the role of fee differentials has drawn most of the economists' attention. For instance, Gruber, Kim and Mayzlin (1999) find that fee differentials have a positive effect on the probability of caesarean delivery for Medicaid enrollees; furthermore they estimate that the larger differentials for patients that are privately insured with respect to Medicaid enrollees accounts for between  $\frac{1}{2}$  and  $\frac{3}{4}$  of the differential in the rate of caesarean births in the two groups. Grant (2009), which replicates Gruber, Kim and Mayzlin (1999) analysis, estimates an effect which is about  $\frac{1}{4}$  of that reported originally, the difference being mainly due to the sample and estimation procedure adopted. According to Grant's analysis, other factors account for most of the difference observed between the two populations, in particular risk factors and non-random matching between privately insured patients and providers which are more inclined to resort to caesarean deliveries (Grant, 2005).

The issue of assortative matching between mothers and providers is also explored by Fabbri and Monfardini (2008) on a sample of Italian patients. In particular, the authors consider two types of providers: public and private hospitals, with the latter being characterised by a higher inclination to resort to a caesarean section.<sup>6</sup> According to the authors' findings, the assortative matching between patients and providers is of minor relevance, while the selection mechanism of patients into hospitals is largely driven by risk factors (with the more risky patients being admitted into public – higher quality – hospitals<sup>7</sup>). Furthermore after controlling for selection and other observable characteristics, the probability of resorting to a caesarean delivery is higher in private hospitals than in public ones. A finding that leaves open the issue of measuring the impact of financial incentives which is not estimated in this study. The significant difference in the reimbursement fee between vaginal and caesarean delivery in Italy is discussed in Pizzo (2008). The author does not estimate the impact of fee differentials on the probability of observing a caesarean birth. However, after noting the wide regional variation in caesarean delivery rates, Pizzo attempts to estimate the potential savings that would be observed had the caesarean section incidence been equal to a given reference value<sup>8</sup>.

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<sup>5</sup> About 1/6 of the total change in the caesarean section rate.

<sup>6</sup> It should be noted that the Italian National Health System includes both public and private hospitals (the latter being subject to a formal procedure for being recognised within the system). At the national level, the share of beds in private hospitals is about 16 per cent, with significant variations across Regions. Each patient is free to choose the hospital which will provide the treatment (with no difference in out-of-pocket expenditure); the hospital will then be directly reimbursed by the competent level of government.

<sup>7</sup> It should be noted that often in Italy private hospitals do not have emergency surgical capacity or intensive care units.

<sup>8</sup> For example the reference value proposed by the WHO or that computed by isolating deliveries which are not characterised by risk factors commonly associated with the need to proceed with a caesarean section.

An evaluation of the relevance of financial incentives, supply structure indicators, and the “quality” of governments in charge of managing health care policies in explaining the rapid increase in caesarean delivery rates in Italy and its wide regional variation is still missing in the literature. This work is an attempt to contribute in filling this gap.

### **3. Setting the stage: preliminary evidence on caesarean deliveries in Italy**

With respect to trends registered at the international level, the increase in the caesarean delivery rate in Italy has been remarkable (fig. 1). The rate in 2007 was almost 3.5 times the value observed in 1980. Its dynamics showed significant regional variation (fig. 2, panel a, b, c) and a clear geographical pattern: Southern regions - which in 1980 displayed values below the national average - showed a much faster increase in the caesarean section rate, which reached maximum values above 50% and 60% in Sicilia and Campania respectively.

A first glance at the data shows that the more frequent use of caesarean sections was accompanied by changes in patients characteristics. The correlation between the incidence of caesarean births and the number of patients with complications at the moment of delivery is positive (fig. 3). The same is true if one considers the mother’s age (fig. 4), which rose considerably over the last decades. However, the impact of changes in patients’ characteristics have been different in the different areas of the country. For example, a simple OLS regression of the incidence of caesarean deliveries on the mother’s age shows a statistically significant difference in the coefficient between the South (for which the estimated coefficient is higher) and the rest of the country, while differences between the regions in the North and in the Centre are not statistically significant (fig. 5). This raises the questions of what other institutional or policy factors can account, at least in part, for such evidence.

However, to understand which factors can play a role, one should have in mind the institutional characteristics of the Italian NHS. This is a public universalistic scheme – founded in 1978 – to provide all citizens a set of compulsory health care services, involving a complex net of intergovernmental relationships between different layers of governments (see, e.g., France et al., 2005). In particular, while funding of the NHS is mostly in the hand of the Central government (despite some recent moves towards a higher degree of fiscal decentralisation), the management of the services is devolved at the regional level. Management of the services includes for instance decisions on the network of hospitals and their staffing, the purchase of some services from private providers, the definition of regional tariffs within the nationally defined reimbursement mechanism (that, starting from 1995-1997, is a prospective payment system based on DRG). Regional variability in this factors can help explain the differential trends observed in our data. For instance, a number of studies (e.g., Fabbri and Monfardini, 2008) pointed out a higher

propensity for caesarean sections in private hospitals. We as well do find in our data a positive correlation between the incidence of caesarean deliveries and the relevance of private hospitals (measured as the share of bed in private hospitals on the total number of hospital beds – fig. 6). From a preliminary look at the data, however, it is not easy to highlight the impact of other policy variables. This is the case for example of reimbursement policies. If one separates the regions that have established their own DRG tariffs from those whose reimbursement levels are in line with national DRG tariffs, a clear pattern is not immediately traceable (fig. 7). Moreover, other variables such as the “quality” of regional governments can affect the incidence of caesarean sections. In order to disentangle the role of these many different factors, we therefore proceed to the estimation of a reduced form model whose specification is outlined in the next section.

#### 4. The model

We estimate the following model on the sample of Italian regions<sup>9</sup> over the years (1996-2006):

$$(1) \ y_{it} = \alpha + \alpha_i + \sum_{t=1}^T \beta^t d_t + \sum_{j=1}^J \beta_j^x x_{it}^j + \sum_{f=1}^F \beta_f^w w_{it}^f + \sum_{k=1}^K \beta^k k_{it}^k + \sum_{h=1}^H \beta_h^z z_{it}^h + \varepsilon_{it}$$

The dependent variable ( $y_{it}$ ) is the log of the odd ratio of the share of caesarean deliveries in region  $i$  in year  $t$ ;  $\alpha_i$  and  $d_t$  are respectively regional and year dummies. Regressors are grouped into the following categories:

- a)  $j = 1, \dots, J$  control variables ( $x_{it}^j$ ) such as demographic characteristics of patients and their education levels. These variables should proxy the ‘demand’ for caesareans by capturing the effect of patients characteristics, health status and preferences;
- b)  $f = 1, \dots, F$  structural supply indicators ( $w_{it}^f$ ) such as the incidence of private providers, hospital characteristics and the composition of the workforce, in order to control for organisational and structural differences which could influence physicians choices;
- c)  $k = 1, \dots, K$  reimbursement and pricing policies indicators: for this category we consider variables related to the DRG fees ( $k_{it}^k$ );
- d)  $h = 1, \dots, H$  political economy indicators ( $z_{it}^h$ ) as a way to capture the influence of regional government characteristics and their quality.

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<sup>9</sup> We consider all the Italian regions (ordinary and special statute) and the two autonomous provinces of Trento and Bolzano. Overall we therefore have 21 regions, 4 in the North West (Piemonte, Valle d’Aosta, Lombardia, Liguria), 5 in the North East (Bolzano, Trento, Veneto, Friuli Venezia Giulia, Emilia Romagna), 4 in the Center (Toscana, Umbria, Marche, Lazio), 6 in the South (Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria) and 2 Islands (Sicilia, Sardegna).

The analysis also checks for the presence of imitative behaviours among regions driven by geographical proximity, and take into account the potential presence of serial correlation in the data. Equation (1) is estimated using a panel fixed-effect estimator.<sup>10</sup>

## **5. The data**

Economic and socio-demographics data and health status variables are drawn from various Istat publications, while information on structural characteristics of the hospital sector are published by the Italian Health Ministry.

As for the DRG tariffs variables, we have used the data on national tariffs as established by the decree DM 30/06/1997 and for the more recent years as published on the Agenas<sup>11</sup> website. To identify the years in which each regional government has introduced regional DRG tariffs (if they have decided to do so) we have followed the reconstruction presented in Carbone et. al. (2006).<sup>12</sup>

The data on the characteristics of the regional governments are derived from the archives on regional and local administrations published on-line by the Italian Ministry for Domestic Affairs. Further information has been requested directly to regional administrative offices.

Descriptive statistics for the variables used in the empirical analysis for the years 1996-2006 are reported in Tab. 1. Fig. 8 sketches the period over which each region has adopted their own DRG tariffs.

## **6. Empirical analysis**

The empirical analysis is presented by addressing first the methodological issues, in particular the possible presence of serial and spatial correlation. The section that follows discusses our main results.

### ***6.1. Methodological issues***

As a baseline approach we estimate equation (1) using a panel fixed-effect estimator. Tab. 2 reports the results.

We tested the adopted specification and estimation strategy in several ways. In particular we controlled for two kinds of problems: serial and spatial correlation.

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<sup>10</sup> We performed a Hausman test comparing fixed and random-effect estimators; the results suggest the use of the former.

<sup>11</sup> Agenzia Nazionale per i Servizi Sanitari Regionali (<http://www.agenas.it/>).

<sup>12</sup> We have also requested DRG tariffs time series directly to each regional administration, which are the moment not yet available. Updates of this work will take into account any progress in data collection from regional administrations.

Concerning serial correlation, we performed three tests. While the Woolridge (2002) statistics does not reject the hypothesis of no serial correlation, the Bargava et al. (1982) modified DW and the Baltagi and Wu (1999) LBI statistics suggest the presence of serial correlation. Therefore for all estimated specifications robust standard errors are provided. Furthermore we extended the model to include time lagged regressors, to check for the presence of a dynamic dimension of the model which could be due to time persistence in agents behaviour. None of them turned out to be significant.

As for the problem of spatial correlation, we recognize that in a decentralised setting – such as that of regional governments in Italy – the economic policies of neighbouring jurisdictions may show a certain degree of correlation, as highlighted in several empirical studies (e.g., Brueckner, 2003). This interaction can be the result of political opportunism. The intuition behind this motivation is related to the presence of private information about either the quality of the incumbent or the costs and benefits of the policies implemented. Citizens can get some information by comparing the performance of their politicians with the performance of politicians in neighbouring jurisdictions; as a consequence, the incumbent government would mimic neighbouring jurisdictions' policies – e.g., health care policies – in order not to lose political consensus. This strategic behaviour was firstly described by Salmon (1987) in terms of yardstick competition and has been investigated empirically by several authors (e.g., Elhorst and Fréret, 2009; Foucault et al., 2008). In order to control for these effects, we estimated a spatial lag and a spatial error model considering the same regressors as in column E of Tab. 1, including regional fixed effects. The weighting matrix was computed on the basis of the Euclidean distances between the capitals of the regions<sup>13</sup>; we considered both a row standardised and not standardised version (Anselin, 1988). When using the latter weighting matrix the hypothesis of spatial correlation is always rejected, while when considering the row standardised version results are mixed, given that the hypothesis of spatial correlation is not rejected. However the magnitude, sign and significance of the coefficients is generally confirmed<sup>14</sup>.

All in all our baseline approach seems adequate. We therefore proceed with the discussions of the main results.

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<sup>13</sup> Distances have been calculated using the google maps distance calculator; this tool measures distances "as the crow flies".

<sup>14</sup> Results for the serial correlation tests and for the spatial error and spatial lag models are available upon request.

## 6.2. Estimation results

Tab. 2 compares estimation results when adding the regressors categories listed above. We start by considering control variables only. As expected the coefficient of the mother age is positive while the birth rate coefficient is negative and significant. This is in line with the findings in Gruber and Owings (1996) where a drop in the fertility rate is accompanied by an increase in caesarean sections. The rationale is that a drop in the hospital revenue (due to the reduced number of births) triggers a substitution between vaginal births (reimbursed at a cheaper rate) and caesarean births (which are accompanied by a higher tariff). Another possible explanation for the negative impact of the birth rate on caesarean deliveries may be the presence of a learning effect, i.e., the greater experience gained by hospitals when the number of births increases which should imply a reduced need for caesarean sections. As in Gruber and Owings (1996), we also take into account a measure of the underlying riskiness of births, in particular by including as regressor the neonatal mortality rate within 6 days<sup>15</sup>, which could be a factor of a more intense use of caesarean sections. As concerns supply indicators, the incidence of medical staff on the total number of employees positively affects the number of caesareans, while the share of beds in private hospitals is not statistically significant<sup>16</sup>.

The presence of regional DRG reimbursement levels might be a signal that the region is putting effort in managing health expenditure using the policy tools at its disposal. Indeed, the dummy variable accounting for regional tariffs has a negative impact on the number of caesarean deliveries<sup>17</sup>. However when interacting the dummy for the presence of regional tariffs with the relative size of the private hospital sector the positive effect of regulating reimbursements is mitigated (or even reversed)<sup>18</sup>. This suggests a note of caution: deviating from the national reimbursement levels does not *per se* imply superior outcomes. When the share of private providers is very large, it could reflect lobbying efforts and result in a worsening of the incentive mechanisms. This interpretation is reinforced by the evidence on the effects of introducing the tariffs.

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<sup>15</sup> The neonatal mortality rates is defined as the fraction of live births that die within 6 days. The results are confirmed also using the neonatal mortality rate at 29 days.

<sup>16</sup> We also controlled for a measure of use intensity of hospitals facilities (average stay in hospital). The variable is not significant and does not affect neither the magnitude nor the significance of the other coefficients. Similarly, including the ratio of beds on population (as a measure of productive capacity) yealds a non significant coefficient and does not alter the other findings.

<sup>17</sup> This dummy variable is essentially a Centre-North dummy, in the South only one region has deviated from the level set for national tariffs.

<sup>18</sup> The estimates for specification E in Tab. 1 imply that when the share of beds in the private hospitals is larger than 20%, the introduction of regional tariffs does, other things being equal, result in an increase in the odd ratio of caesarean deliveries.

Indeed the positive and significant sign associated with the variable accounting for the introduction of regional tariffs<sup>19</sup> suggests that the ability of keeping under control the number of caesarean deliveries requires some time to become thoroughly effective. In the first year there are some ‘adjustment costs’ which mitigate the positive effect of regulating the reimbursement of medical treatments. However, the larger is the share of private providers the lower are the adjustment costs suggesting that a wider private sector might push for a change in reimbursement levels as an effect of lobbying efforts. Unfortunately given that we lack complete series for reimbursement fees for the different types of treatments (caesarean and vaginal delivery) for all the regions, we are not able at this stage to isolate the impact on the incidence of caesareans of a one euro increase or decrease in the payment.

If we consider the characteristics of the regional government and of the president of the region we see that the president’s experience (measured as the number of years the president has been in charge) seems relevant. In particular a more experienced president helps containing the inappropriateness of treatments. This results is in line with recent findings of the literature on electoral discipline of the duration of legislative terms, which show that longer terms tend to improve governments’ performance (e.g., Dal Bó and Rossi, 2008), mainly due to the possibility for the legislator to devote more resources for facing relevant policy issues (e.g., increasing the appropriateness of health care treatments). The political alignment with the central government matters as well: the interaction between the president experience and the dummy variable capturing political alignment between the local and central government is positive and significant, suggesting a loosening of the pressure to control inefficiencies. This finding can be interpreted in terms of increased president’s expectations of a more ‘benevolent’ treatment in terms of deficit bailout by a friendly central government than by an adversary one.<sup>20</sup>

The share of own regional funding on the total resources spent for health displays a negative sign and it is significant. This is coherent with several interpretations (and their mix). First, in line with modern theory of fiscal federalism (e.g., Weingast, 2009), a higher degree of fiscal autonomy determines higher electoral accountability, leading to a tighter control of government spending and increased efficiency. From this perspective, the result adds to recent empirical literature investigating how decentralization and vertical fiscal imbalance affect government size (e.g., Jin and Zou, 2002; Fiva, 2006; Borge and Rattsø, 2008). Second, the regional differences in the share of own funding mostly reflect the tax base distribution and GDP

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<sup>19</sup> The variable is equal to 1 when regional tariffs are introduced and it is equal to zero otherwise.

<sup>20</sup> See Arulampalan et al. (2009) for further discussion on this issue.

inequality across the country; the variable might then capture north/south differences (de Matteis and Messina, 2010).

In general, the signs of the coefficients and their significance levels are quite robust across specifications. Finally, it must be noted that the empirical analysis point to the presence of regional fixed effects of significant magnitude. The geographical pattern is as expected, with Northern regions displaying, *ceteris paribus*, a lower odds ratio.

## **7. Concluding remarks**

The goal of expenditure containment can be achieved by reducing inefficiencies through an increase of the appropriateness of treatments. Changes in the structure and level of fees paid to providers can contribute. Attention must be paid to providers behavioural responses, but also to the impact on care quality and health outcomes which are not discussed in this work.

This work considers the case of caesarean deliveries in Italy. The study analyses the effects of the presence of regional DRG tariffs as an effective policy tool to control inappropriateness. The results suggest that the effectiveness of differentiating the reimbursement mechanism from the national setting does not guarantees superior outcomes. The structure of the regional health care system (for example the relevance of the private sector) does affect the outcome. The experience and the stability of regional administrators can also play a role. Furthermore having access to significant own resources for financing health expenditure seems to provide the right incentives to regional governments.

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**Table 1**

		<b>Descriptive statistics</b>				
		# obs	mean	std. dev.	min	max
<b>dependent variable</b>	odds ratio of caesarean deliveries	210	-0.740	0.435	-1.805	0.426
<b>control variables (x)</b>	mother's age	210	30.799	0.933	28.500	33.880
	birth rate	189	9.167	1.205	6.900	12.230
	% primary school educ (females)	210	17.715	3.700	9.680	26.244
	neonatal mortality (first 6 days)	210	11.108	5.300	0.000	37.105
<b>structural supply</b>	medical staff (per 1000 residents)	210	54.753	3.361	45.671	61.607
<b>indicators (w)</b>	bed in private hospitals (ratio)	189	11.754	8.381	0.000	35.051
<b>political economy</b>	share of own funding	210	0.376	0.149	0.065	0.728
<b>indicators (z)</b>	president experience	210	3.314	3.157	0	16

Table 2

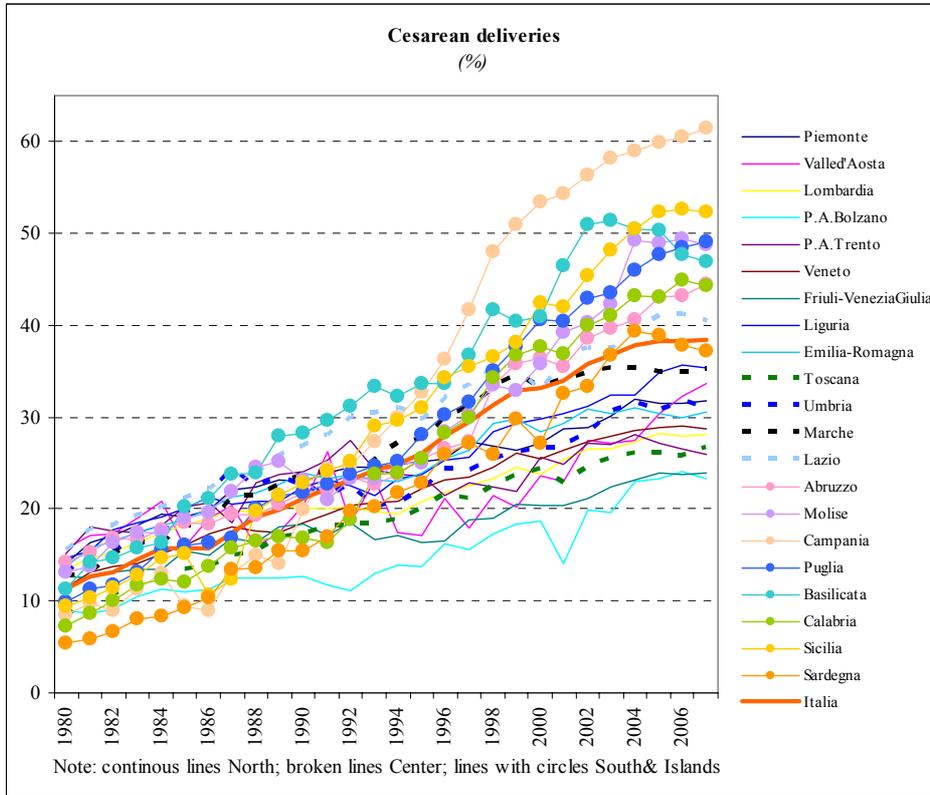
	Dependent variable - log of odd ratios of % caesarean deliveries				
	A	B	C	D	E
<b>control variables (x)</b>					
<b>mother's age</b>	0.171 ***	0.211 ***	0.144 ***	0.141 ***	0.129 ***
	0.051	0.044	0.040	0.034	0.035
<b>birth rate</b>	-0.167 ***	-0.137 ***	-0.120 ***	-0.103 ***	-0.084 ***
	0.032	0.029	0.018	0.019	0.021
<b>% primary school educ (females)</b>	-0.026 ***	-0.022 ***	0.010	0.013 *	0.011
	0.007	0.005	0.008	0.007	0.009
<b>neonatal mortality (first 6 days)</b>	-0.002	0.000	0.004 *	0.002 *	0.004 **
	0.002	0.003	0.002	0.001	0.002
<b>structural supply indicators (w)</b>					
<b>medical staff (% of total NHS employees)</b>		0.014 ***	0.007	-0.000	0.003
		0.003	0.005	0.005	0.006
<b>bed in private hospitals (ratio)</b>		0.003	-0.002	-0.002	0.001
		0.003	0.002	0.002	0.002
<b>reimbursement tariffs (k)</b>					
<b>regional tariffs (dummy)</b>			-0.137 **	-0.165 **	-0.260 ***
			0.062	0.071	0.080
<b>introduction of regional tariffs</b>					0.066 **
					0.031
<b>regional tariffs*(bed in private hospitals)</b>			0.009 **	0.009 **	0.015 ***
			0.003	0.004	0.005
<b>introduction of tariffs*(beds in private hospitals)</b>					-0.006 **
					0.003
<b>political economy indicators (z)</b>					
<b>in line with central government</b>			-0.017	-0.017	-0.013
			0.017	0.016	0.016
<b>share of own funding</b>			-0.441 ***	-0.435 *	
			0.125	0.211	
<b>president gender</b>			-0.013	-0.021	-0.021
			0.042	0.042	0.042
<b>president experience</b>			-0.009 ***	-0.010 **	-0.010 **
			0.003	0.003	0.003
<b>president experience*(in line with central government)</b>			0.009 **	0.009 **	0.008 ***
			0.004	0.002	0.002
<b>president is a doctor</b>			0.061 **	0.075 ***	0.075 ***
			0.025	0.018	0.018
<b>constant</b>	-4.045 **	-6.403 ***	-4.492 ***	-4.029 ***	-4.012 ***
	1.877	1.566	1.367	1.189	1.267
# of observation	273	210	189	188	168
within R2	0.87	0.85	0.86	0.88	0.87

Significance levels: 1% \*\*\*, 5% \*\*, 10% \*

Robust standard errors in *italics*; all regressions include year dummies and region fixed effects.

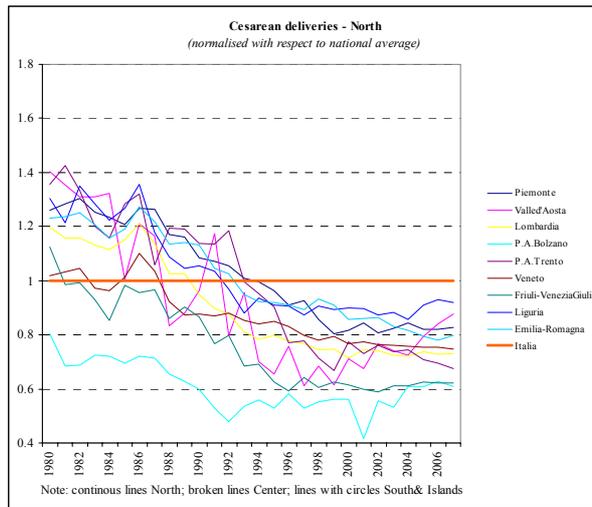
# Figures

## Figure 1 – Caesarean deliveries (%)

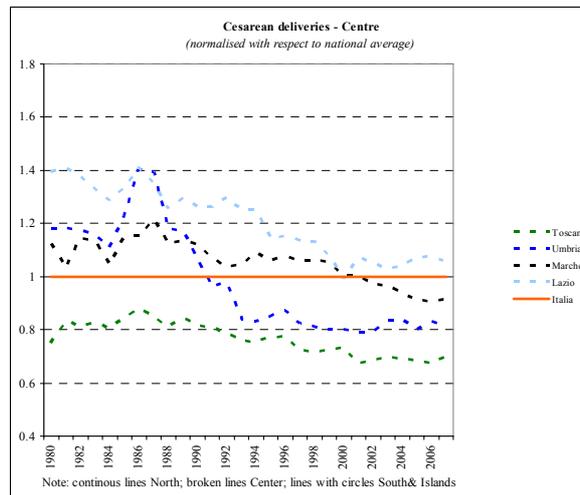


**Figure 2**

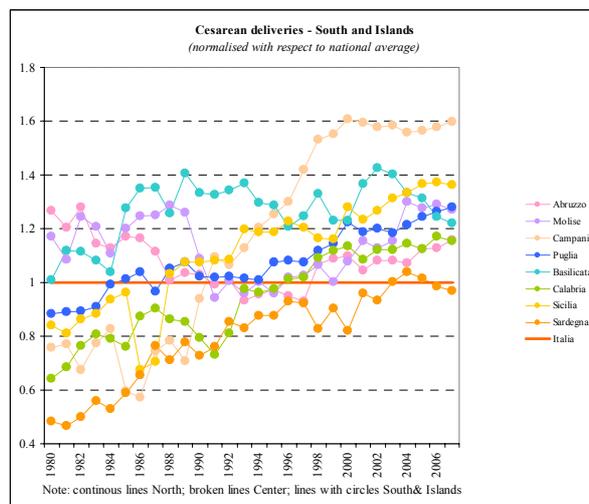
*a) North*



*b) Centre*

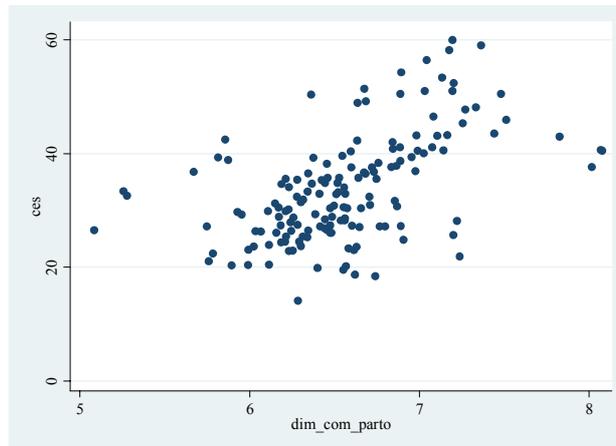


*c) South & Islands*



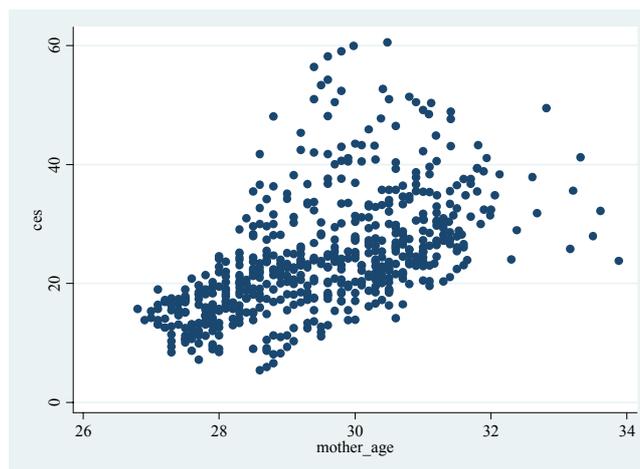
**Figure 3**

% of caesarean and discharges with complications



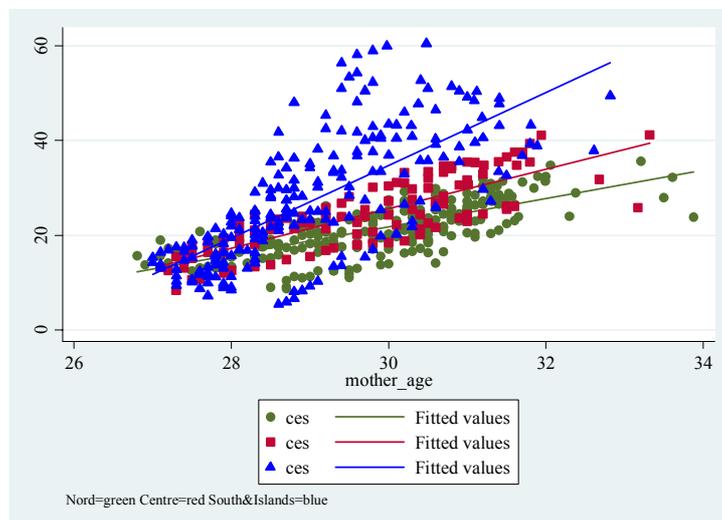
**Figure 4**

% of cesarean and average mother's age



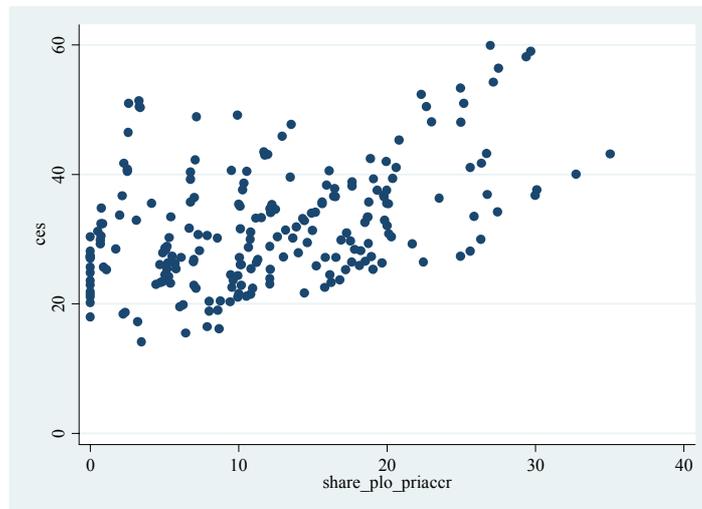
**Figure 5**

% of caesarean and mother age by macro area



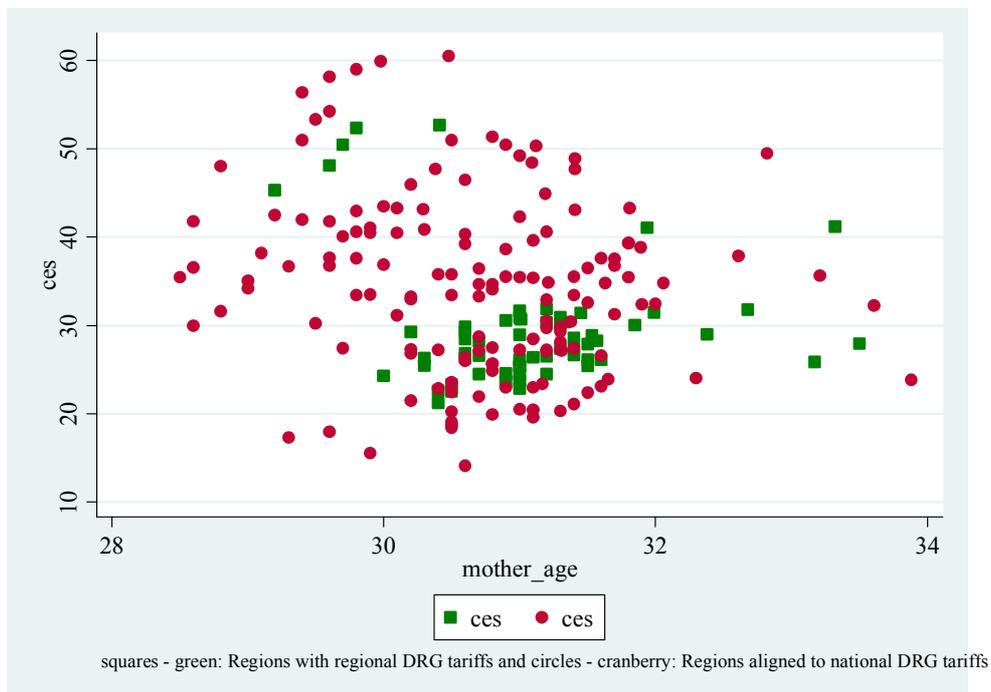
**Figure 6**

% of caesarean and share of beds in private hospitals



**Figure 7**

% of caesarean & average mother age  
in region which have established their own DRG tariffs (green)  
and in regions aligned with national DRG tariffs (red)



**Figure 8**

Time line of the introduction of regional tariffs in the period 1997-2009  
(a red line means the region has its own DRG tariffs)

