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UNDERSTANDING INAPPROPRIATENESS IN HEALTH CARE. THE ROLE OF SUPPLY STRUCTURE, PRICING POLICIES AND POLITICAL INSTITUTIONS IN CAESAREAN DELIVERIES

A grayscale photograph of a large, multi-story building with a classical facade, featuring arched windows and a prominent entrance. The image is slightly faded and serves as a background for the authors' names.

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Understanding Inappropriateness in Health Care.

The Role of Supply Structure, Pricing Policies and Political Institutions in Caesarean Deliveries [♦]

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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 excessive expenditure levels. In this paper, we exploit the significant regional variation in the share of caesarean sections recorded in Italy to explore the impact on inappropriateness of three groups of variables: 1) structural supply indicators (e.g., the incidence of private providers); 2) pricing policies (role of DRG tariffs); 3) political economy indicators (to capture different approaches to the governance of the health care sector). The analysis controls for demand side factors, such as the demographic structure of the population and education levels. The results suggest that DRG tariffs might be an effective policy tool to control inappropriateness, once the composition of the regional health care system – in terms of private vs. public providers – is taken into account. Also some characteristics of regional governments and the funding sources of regional health spending do matter.

JEL Classification: D78, H75, I18, L33

Keywords: health care, inappropriateness, regional disparities, pricing policy, political economy

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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 contemporaneously assuring citizens' health (e.g., OECD, 2004). The incidence of cesarean sections is an indicator of (in)appropriateness commonly considered in the literature, and by policy-makers (see, e.g., OECD, 2009 and, for Italy, the indicators regularly published by the Italian Health Ministry in its annual report on hospital production, and Fortino *et al.*, 2002). Being a surgical treatment, a caesarean section is characterised by a large cost (and risk) differential with respect to the alternative classical vaginal delivery (a medical treatment). Absent any therapeutic reasons, this latter treatment is generally considered an appropriate (and less risky) 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, which would suggest an increase in inappropriateness and unproductive spending. The main explanations proposed by the literature focus, however, mostly on microeconomic issues, leaving the relation at the aggregate level between inappropriateness and spending substantially unexplored. In particular, the literature claims a role for technological changes affecting for instance the treatment of pain in delivery, for changes in patients' preferences (for instance, due to the increase of the age of the mother at the first delivery), and for physicians and providers behaviours, clearly influenced also by the payment system.

In this context, Italy represents an interesting case study. Caesarean section rate has more than trebled from 1980 to 2007, from about 10 to about 40%, and – not surprisingly – the necessity to monitor its dynamics has drawn the attention of policymakers. For instance, the 2003-2005 National Health Plan stated the objective of containing the average share of caesarean deliveries at about 20% by the end of the

planning period.¹ Over those years, however, the increasing trend in the incidence of caesarean births did not stop. Moreover, regional variations (both in the growth rate and the incidence rate) are also significant: for instance, caesarean section rates are above 50% and 60% in Sicilia and Campania respectively, two regions characterised by relatively high deficits, and where the room for cost savings is estimated to be large (e.g., Piacenza and Turati, 2010). These savings can be obtained – without reducing or limiting the quantity or the quality of health care services to be supplied to patients – by improving appropriateness, which has been shown to be strongly correlated with the expenditure differentials observed across regions (e.g., Francese and Romanelli, 2011).

This paper addresses the issue of which factors affect the observed regional variations in (in)appropriateness, interpreted mainly as an indicator of health spending inefficiency, providing an analysis of the determinants of caesarean section rates in Italy. Besides more traditional variables that the microeconomic approach in the literature identifies as important drivers of caesarean deliveries, our interest here is to study the role played by the “characteristics” of regional governments. Indeed, given a national regulatory framework, health policies in Italy are implemented and managed by regions in a way that reflects a complex net of intergovernmental relationships between the central and the regional governments. And the modern fiscal federalism theory suggests that the way in which different layers of government interacts affect policy outcomes. More precisely, exploiting available data on caesarean deliveries, we disentangle the impact of three groups of variables: 1) structural supply indicators, to take into account the impact of different organisational arrangements; 2) reimbursement and pricing policies, such as DRG fees, to control for the effect of hospital financing mechanisms; 3) characteristics of regional governments, a group of “political economy” variables aimed at capturing different approaches to the governance of the health care sector. We also provide checks for the presence of possible imitative behaviours driven by geographical proximity, and serial correlation. Our results suggest that the “quality” of regional governments, the pricing policy and the structural characteristics of the health sector do really matter (at least to some extent) in explaining inefficient spending, as proxied by caesarean sections.

¹ 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

The remainder of the paper is structured as follows. Section 2 provides a brief survey of the available literature on caesarean sections. Section 3 provides preliminary evidence on the Italian case. The empirical strategy and the data are presented in Section 4, while the econometric results are discussed in Section 5. A brief section of concluding remarks follows.

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

An upward trend characterised the incidence of caesarean deliveries at the international level in recent decades. Among the OECD countries, the caesarean section rate in the US has increased, for instance, 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, e.g., Lumbiganon *et al.*, 2010 on the 2007-2008 WHO global survey). On the contrary, the economic literature has been mainly concentrated on identifying the drivers of the observed upward trend, mainly taking a microeconomic approach. According to this view, many factors can help explaining the increase in the incidence of caesarean deliveries (e.g., Ecker and Frigoletto, 2007). These factors can be grouped under three main categories.

1. *Technological changes in deliveries*: these include, for instance, the shift from home to hospital delivery, the use of anaesthesia and newly 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. All these factors work in the direction of making caesarean sections less risky with respect to the past.

2. *Changes in patients' preferences*: patients might be willing nowadays to accept a lower risk of an adverse outcome to avoid a caesarean delivery. The way in which they balance and assess risk associated with the different delivery procedures could have changed also. This might reflect both social and cultural factors, as well as modification in the reproductive behaviour. For example, the age of the mother has significantly

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 the DRG reimbursement fees.

increased with respect to the past, and parents educational levels and employment statuses (particularly for mothers) have experienced dramatic variations. As we will discuss below, for instance 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 increased from 41.9 per cent in 1993 to 51.6 in 2008. Furthermore fertility rates and household's size and composition are now significantly different than just a few decades ago. Again, taking Italy as an example, the total fertility rate has dropped from 1684 per thousand in 1980 to 1396.4 in 2009. The average size of the family has shrunk by 0.3 members per household (to 2.47 members) between 1994 and 2009 while the share of one-member households has increased from 21.14 per cent to 28.09 over the same period. All these factors make today (and probably more so in the future) vaginal delivery less preferred than caesarean delivery.

3. *Changes in physicians and 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 and providers behaviours induced by exogenous factors. An example are the incentive effects of the payment system: if the level of the tariff relative to the costs is higher for a caesarean section than for a vaginal delivery, there is a clear incentive to supply the former instead of the latter. 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. For instance, 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 vaginal births. Another issue that has received attention in the literature is the increasing fear of malpractice lawsuits, which might have influenced physicians decisions in promoting caesarean sections (e.g., Localio *et al.*, 1993; Dubay *et al.*, 1999).

Not surprisingly, the role of fee differentials has drawn most of the economists' attention. Gruber and Owings (1996) investigate for instance the impact of the exogenous income shock induced on physicians incomes by the drop in fertility on the providers'

decisions to substitute a cheaper treatment (the vaginal delivery) with one characterised by a higher reimbursement (the caesarean delivery). Such a reaction would be consistent with a model of induced demand (see, e.g., the model developed by McGuire and Pauly, 1991). Considering US data, the authors find a positive relation between the fall in fertility and the incidence of caesarean births, even though the impact is small (about 1/6 of the total change in the caesarean section rate). This incentive effect of fee differentials has been confirmed by other studies. Gruber *et al.* (1999) find that differences in tariffs have a positive effect on the probability of caesarean delivery for Medicaid enrollees. In particular, they estimate that the larger differentials for patients that are privately insured with respect to Medicaid enrollees accounts for between 1/2 and 3/4 of the differential in the rate of caesarean births in the two groups. Grant (2009), replicating the analysis by Gruber *et al.* (1999), estimates a much lower impact of the tariffs (about 1/4 of the one reported originally), the difference being mainly due to sample selection and the adopted estimation procedure. 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).

Despite the relevance of caesarean sections, contrary to US, studies on Italy are quite rare. Pizzo (2008) highlights for instance a significant difference in reimbursement fee between vaginal and caesarean delivery in the Italian DRG payment system, but she does not provide any estimate of the impact of fee differentials on the probability to observe a caesarean birth. After noting the wide regional variation in caesarean delivery rates, Pizzo attempts at assessing the potential savings that would have been observed had the caesarean section rate been fixed to a given reference value (like, e.g., the one proposed by the WHO). Savings are shown to be substantial (about 10 per cent of total expenditure for deliveries). Fabbri and Monfardini (2008) consider the issue of assortative matching between mothers and two types of providers, public and private hospitals, with the latter being characterised by a higher (unconditional) inclination to resort to a caesarean section. According to the authors' findings, the assortative matching between patients and providers is of minor relevance: the selection mechanism of patients into hospitals is largely driven by risk factors, with the more risky patients being admitted into public hospitals, which can be considered of higher quality with respect to private

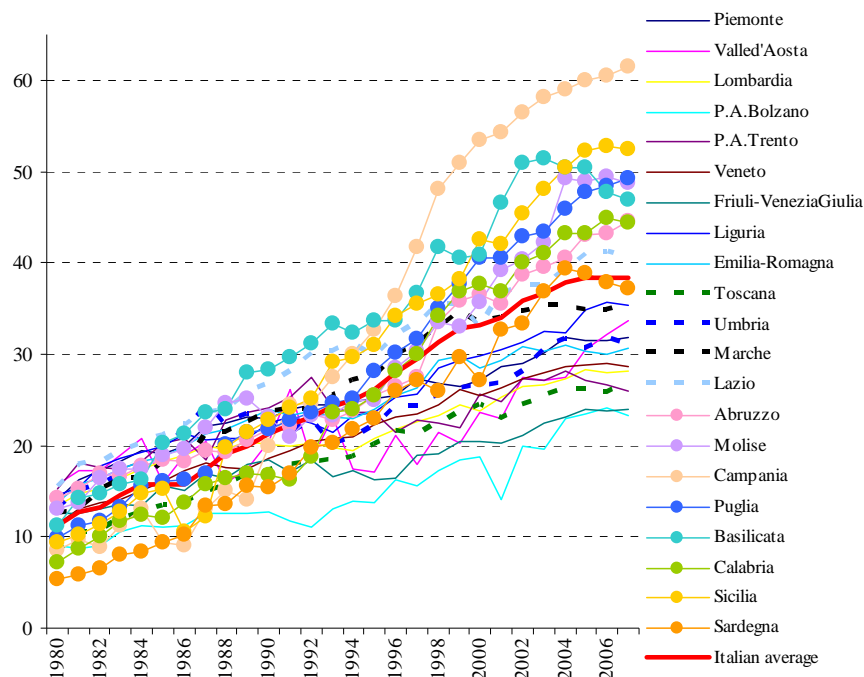
providers, since the latter often do not have emergency surgical capacities or intensive care units. Indeed, after controlling for selection and other observable characteristics, the conditional probability of resorting to a caesarean delivery is still higher in private hospitals than in public ones. A finding that leaves open the issue concerning the effects of financial incentives, which is not addressed in the study.

Both at the national and international level, an overall evaluation of the relevance of financial incentives, supply structure indicators, and – more generally – the “quality” of the governments in charge of managing health care policies for explaining the rapid increase observed in caesarean deliveries is still missing in the literature. This work is an attempt to contribute in filling this gap by considering Italy and wide regional variations it displays in the variables of interest.

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

With respect to trends registered at the international level, the increase in the share of caesarean deliveries in Italy has been remarkable (Fig. 1) and its dynamics showed significant regional variations and a clear geographical pattern (Fig. 2, panel a, b, c).

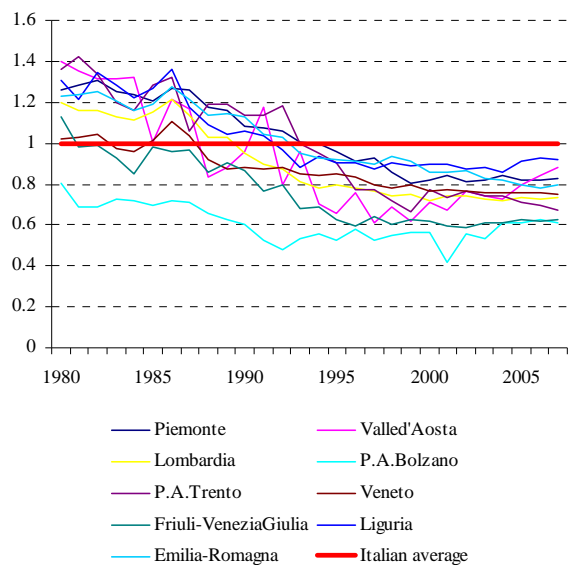
Figure 1. Caesarean deliveries in the Italian regions (share on total deliveries)



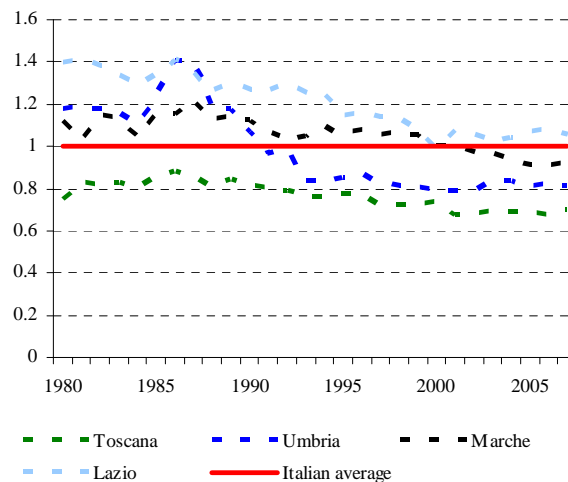
Note: continuous lines are used for Northern regions; broken lines for regions located in the Center; lines with circles for the South and the Islands.

Figure 2. Caesarean deliveries in the Italian regions normalised with respect to national average

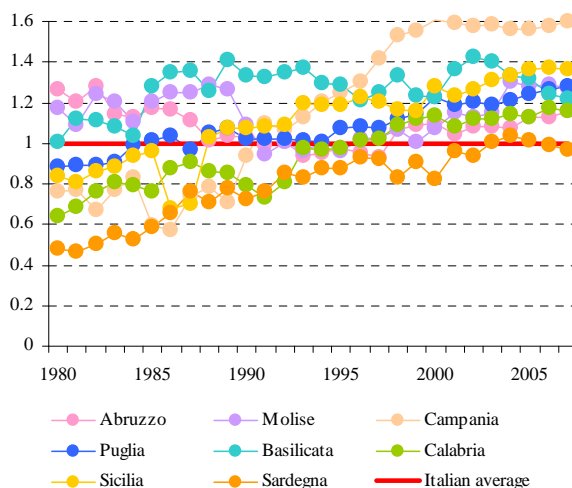
a) North



b) Centre



c) South and Islands



Note: continous lines are used for Northern regions; broken lines for regions located in the Center; lines with circles for the South and the Islands

Of course, unconditional means might simply reflect different changes in regional populations. A first glance at the data shows that the more frequent use of caesarean sections was accompanied by changes in patients characteristics across regions and time. For instance, 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 mother's age, which rose considerably over the last decades in

almost all regions (Fig. 4). But the impact of changes in patients' characteristics is different in the different areas of the country. A simple OLS regression of the incidence of caesarean deliveries on 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 determinants can account, at least in part, for such evidence.

Figure 3. Casarean deliveries and share of discharges with complications

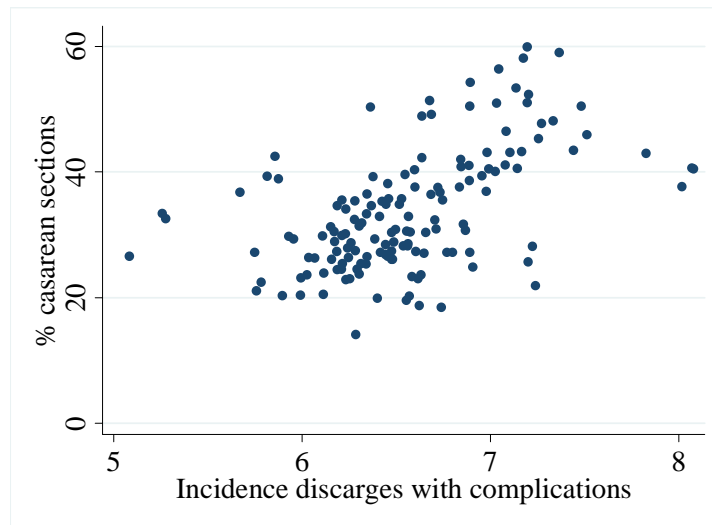


Figure 4. Incidence of caesarean sections and mother age

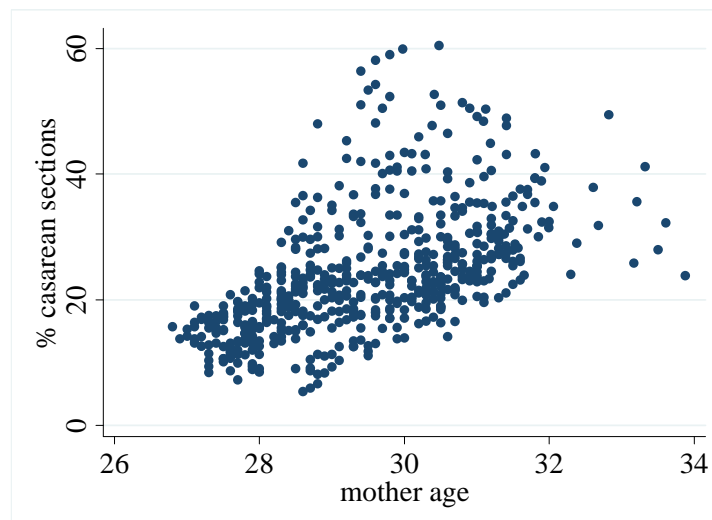
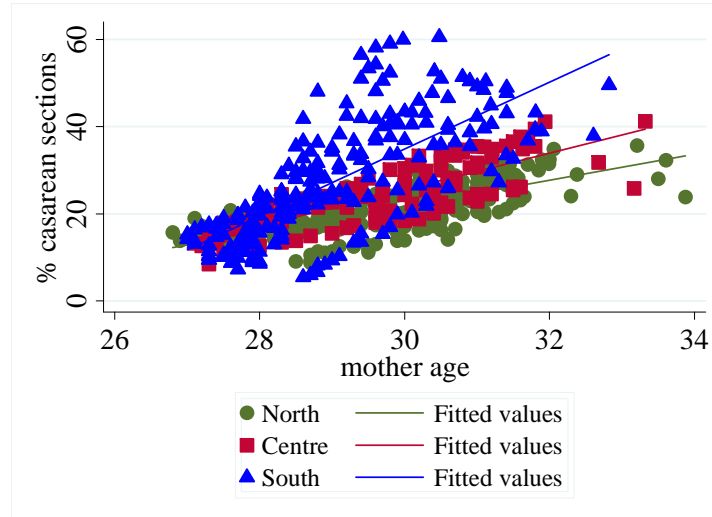


Figure 5. Incidence of caesarean sections and mother age by macro area



To understand which factors can play a role, we need to briefly describe the institutional characteristics of the Italian NHS. This is a public universalistic scheme – founded in 1978 – to provide all citizens a set of 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 definition of regional DRG tariffs within the nationally defined reimbursement mechanism (that, starting from 1995-1997, is a *Prospective Payment System* based on DRG), the purchase of some services from private providers. As for hospital services, which include also the two types of delivery, the share of beds in private hospitals is about 16% at the national level, with significant variations across regions. Notice that each patient is free to choose the (public or private) hospital which will provide the treatment without having to pay for the service received; the hospital will be directly reimbursed by the competent regional government.

Given that generally regional tariffs are more favourable for caesarean sections than for vaginal deliveries, regional variability in the share of private providers should help explain the differential trends observed in our data. Indeed, we do find in our data a positive correlation between the incidence of caesarean deliveries and the relevance of private hospitals, measured by the share of beds in private hospitals on the total number

of beds (Fig. 6), confirming the evidence emerged in Fabbri and Monfardini (2008). 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 pricing 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 play a role in determining (in)appropriateness. In order to disentangle the impact of these many different factors, we therefore proceed to estimate a multivariate regression model.

Figure 6. Incidence of caesarean sections and share of beds in private hospitals

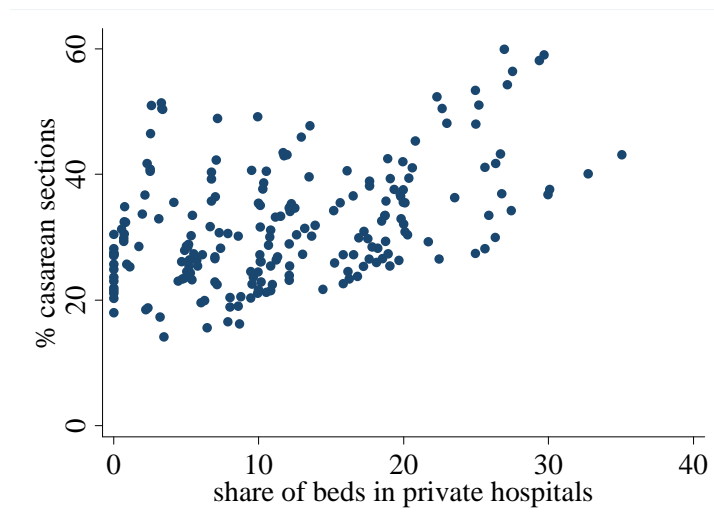
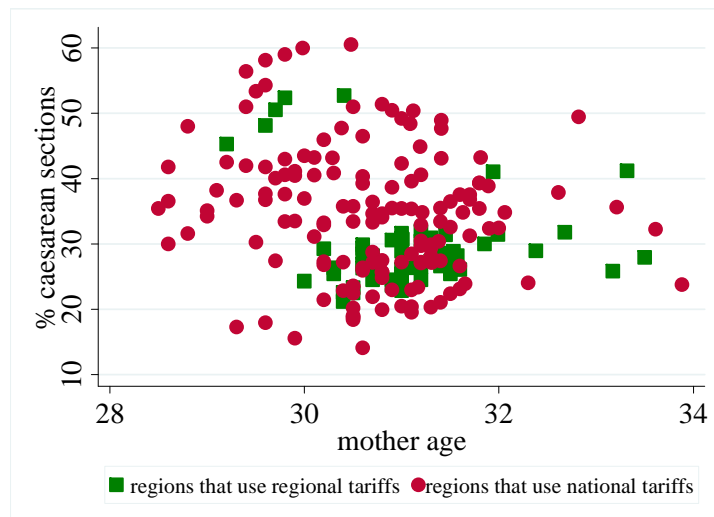


Figure 7. Incidence of caesarean sections and average mother age by regions that use national or regional DRG tariffs



4. The empirical strategy

4.1. Model specification

To test the impact of different group of variables on the caesarean section rates, we consider the following multivariate specification:

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

where the dependent variable y_{it} is the (log of the) odd ratio of the share of caesarean deliveries in region i in year t . In the light of the previous discussion, covariates are grouped into four categories: [a] *control* variables x_{it}^j ($j = 1, \dots, J$), such as demographic characteristics of patients (e.g., mothers' age) and their education levels. These variables should proxy the 'demand' for caesarean deliveries, by capturing the effect of patients' characteristics, their health status and preferences; [b] *supply* indicators w_{it}^f ($f = 1, \dots, F$), 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] *pricing policy* indicators k_{it}^k ($k = 1, \dots, K$), such as the presence of regional DRG fees; [d] *political economy* indicators z_{it}^h ($h = 1, \dots, H$), such as the political orientation of regional government, the political experience of regional government's president, and the importance of own funds to finance current spending. These variables should capture the influence of regional governments' characteristics and quality on caesarean section rates; finally, [e] we also include regional (α_i) and year (d_t) dummies for controlling space and time fixed effects, respectively.

Statistical inference from the model presented in Equation (1) can be influenced by two different sources of bias: spatial correlation, due to the presence of possible imitative behaviours among regions driven by geographical proximity, and serial correlation, due to the clear upward trend characterising the growth of caesarean rates. We will take into account both these issues when estimating our model.

4.2. Data

Equation (1) is estimated on the sample of all Italian regions over the years 1997-2005. We consider both Ordinary and Special Statute regions, including the two autonomous

provinces of Trento and Bolzano, for a total of 21 units observed for 9 years. Descriptive statistics for all the variables used in the empirical analysis are reported in Tab. 1.

Table 1. Descriptive statistics

		# obs	mean	std. dev.	min	max
Dependent variable	<i>odds ratio of% caesarean deliveries</i>	189	-0.761	0.429	-1.805	0.403
Control variables (<i>x</i>)	mother's age	189	30.639	0.776	28.500	32.060
	birth rate	189	9.167	1.205	6.900	12.230
	% primary school educ (females)	189	18.241	3.435	10.083	26.244
	neonatal mortality (first 6 days)	189	11.419	5.380	0.000	37.105
Supply indicators (<i>w</i>)	medical staff (per 1000 residents)	189	54.559	3.212	47.031	59.612
	bed in private hospitals (ratio)	189	11.754	8.381	0.000	35.051
Pricing policies (<i>k</i>)	regional tariffs (dummy)	189	0.280			
Political economy indicators (<i>z</i>)	in line with central government (dummy)	189	0.508			
	share of own funding	189	0.380	0.149	0.065	0.728
	president gender (dummy)	189	0.963			
	president experience	189	3.190	3.010	0.000	15.000
	president is a doctor (dummy)	189	0.085			

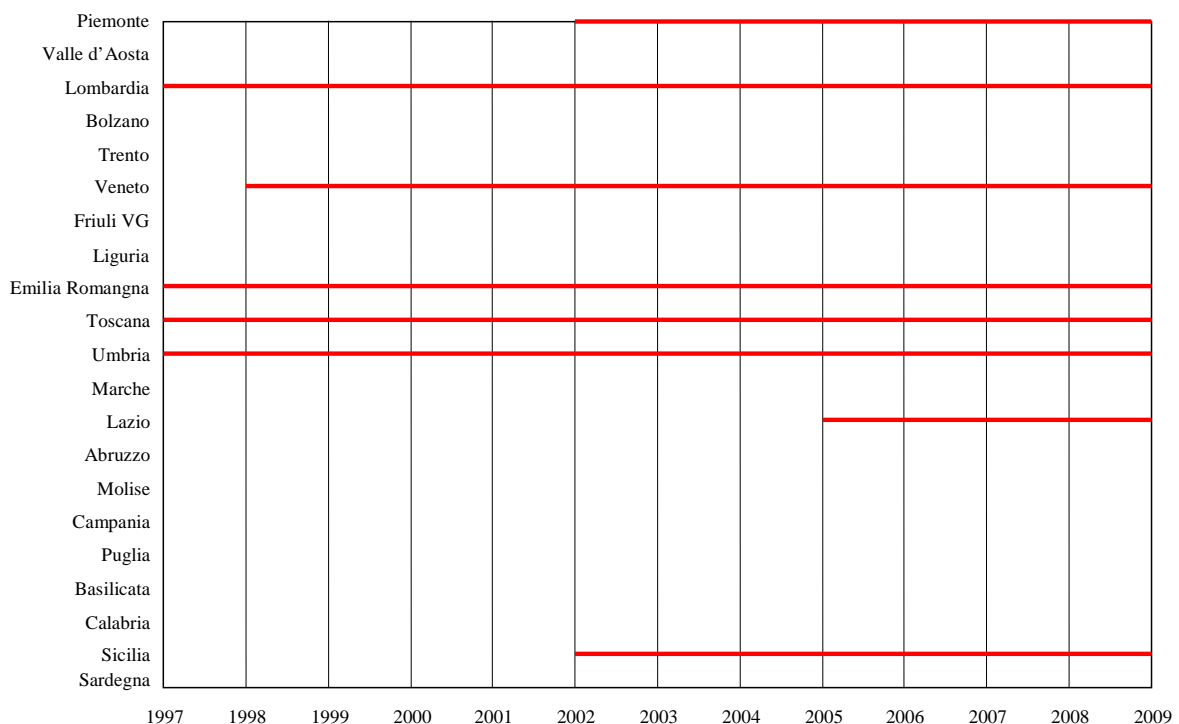
Control factors are drawn from various Istat publications, and are all computed at the regional level. They include: an indicator for mother's age, defined as the average age of the mother when giving birth; the birth rate, that is the number of childbirths per 1,000 people; the share of women with only primary school education; the neonatal mortality, that is the number of deaths within the first 6 days of life per 10,000 live-born babies.

Supply indicators for the structural characteristics of the hospital sector are published by the Italian Health Ministry. We consider two variables here: the relative size of the medical staff, as a percentage of the total number of employees in the regional health service, to capture potential effects of demand induction; the share of beds in private hospitals out of the total regional supply of beds, to control for the "preference" of private hospitals for caesarean sections with respect to vaginal deliveries.

As for reimbursement and pricing policy indicators, we build different variables starting from available information provided by the *Agenzia Nazionale per i Servizi Sanitari Regionali* (Agenas, literally the National Agency for Regional Health Services). In particular, we consider a dummy variable equal to one when regional governments set different DRG tariffs from national tariffs (as established by the decree DM 30.06.1997). We expect governments that implemented a system of regional tariffs to be more active

in the management of health care services, hence more attentive in expenditure control. As the new tariffs can require some time to be effective, we also define a dummy picking up the year in which each regional government has introduced regional DRG tariffs (if they have decided to do so), following the reconstruction presented in Carbone *et. al.* (2006). Figure 8 provides a visual interpretation of this dummy, showing when each region has adopted its own DRG tariffs. We finally interacted these two variables with the share of beds in private hospitals, expecting a different impact of pricing policies where the importance of private producers is higher.²

Figure 8. Time line of the introduction of regional tariffs in the period 1997-2009



Note: source data from Carbone *et. al.* (2006) and Agenas; a red line means the region has its own DRG tariffs.

Political economy indicators are built upon information provided by the Italian Ministry for Domestic Affairs, or directly requested to regional administrative offices. These include three variables describing the characteristics of regional government's president: the gender (a dummy equal to zero in case the President is a woman, to control for the specific care she might have for the issues related to health care), the

² One could also have considered the relative tariff of caesarean sections with respect to vaginal delivery for each region and each year of the sample. Unfortunately, these data are not available at the Agenas, and Regional governments are not keen at providing such information, so that we were able to collect only very partial information that we cannot use in our estimations.

occupation (a dummy equal to one in case the President is a physician, to control for the particular attention a doctor can have for health care in general), the experience (a variable measuring the number of years the President has been in office, in the light of the concept of management capacity building; see, e.g., Honadle and Howitt, 1986), expecting a more experienced president to be more able to effectively control spending. We then define two variables proxying for the characteristics of regional governments. In particular, we look at the political alignment between central government and regional government, by building a dummy equal to one in case the political orientation of two government levels is the same. As governments in Special Statute regions are formed by local autonomist parties, we checked the correct political alignment for each of these by considering affiliations at the central level. We classified as left (right) oriented the autonomist parties forming majorities at the central level with left (right) wing parties. We finally consider a variable for the degree of vertical fiscal imbalance, defined as the ratio between regional own funding and public health expenditure. Regional own resources follow the classification proposed by the Ministry of the Economy in the *Relazione Generale sulla Situazione Economica del Paese* (General Report on the Economic Situation of the Country), and include mostly regional taxes like the Irap (i.e., a regional tax on productive activities), and the regional surcharge on Irpef (the Italian personal income tax). According to modern fiscal federalism theory (e.g., Weingast 2009), we expect that the lower the share of decentralized own resources, the higher the degree of vertical imbalance, the lower the fiscal accountability of regional government, hence the higher the inappropriateness of public spending.

5. Estimation results

We first discuss the two methodological issues concerning the possible presence of serial and spatial correlation, and then present our main results.

5.1. Methodological issues

As a baseline approach, we estimate Equation (1) using a panel fixed-effect estimator. Tab. 2 reports the results. We performed a Hausman test comparing fixed and random-effect estimators; the results suggest the use of the former. We tested the adopted specification and estimation strategy in several ways. In particular we controlled for two kinds of problems: serial and spatial correlation.

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. 2, including regional fixed effects. The weighting matrix was computed on the basis of the Euclidean distances between the capitals of the regions³; 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 confirmed⁴.

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

³ Distances have been calculated using the google maps distance calculator. This tool measures distances “as the crow flies”.

Table 2. Equation (1): estimation results

Dep. variable: <i>log of odds ratio of % caesarean deliveries</i>		MODEL SPECIFICATION [§]				
		A	B	C	D	E
[a] <i>control variables</i> (x)	mother's age	0.138 *** <i>0.043</i>	0.142 *** <i>0.040</i>	0.144 *** <i>0.040</i>	0.141 *** <i>0.034</i>	0.129 *** <i>0.035</i>
	birth rate	-0.124 *** <i>0.020</i>	-0.124 *** <i>0.019</i>	-0.120 *** <i>0.018</i>	-0.103 *** <i>0.019</i>	-0.084 *** <i>0.021</i>
	% primary school educ (females)	0.013 * <i>0.007</i>	0.010 <i>0.008</i>	0.010 <i>0.008</i>	0.013 * <i>0.007</i>	0.011 <i>0.009</i>
	neonatal mortality (first 6 days)	0.003 <i>0.002</i>	0.003 * <i>0.002</i>	0.004 * <i>0.002</i>	0.002 * <i>0.001</i>	0.004 ** <i>0.002</i>
[b] <i>supply indicators</i> (w)	medical staff (% of total NHS employees)		0.008 * <i>0.005</i>	0.007 <i>0.005</i>	-0.000 <i>0.005</i>	0.003 <i>0.006</i>
	bed in private hospitals (ratio)		-0.001 <i>0.003</i>	-0.002 <i>0.002</i>	-0.002 <i>0.002</i>	0.001 <i>0.002</i>
[c] <i>pricing policy indicators</i> (k)	regional tariffs (dummy)			-0.137 ** <i>0.062</i>	-0.165 ** <i>0.071</i>	-0.260 *** <i>0.080</i>
	introduction of regional tariffs					0.066 ** <i>0.031</i>
	regional tariffs×(bed in private hospitals)			0.009 ** <i>0.003</i>	0.009 ** <i>0.004</i>	0.015 *** <i>0.005</i>
	introduction of tariffs×(beds in private hospitals)					-0.006 ** <i>0.003</i>
[d] <i>political economy indicators</i> (z)	in line with central government				-0.017 <i>0.017</i>	-0.013 <i>0.016</i>
	share of own funding				-0.411 *** <i>0.125</i>	-0.435 * <i>0.211</i>
	president gender				-0.013 <i>0.042</i>	-0.021 <i>0.042</i>
	president experience				-0.009 *** <i>0.003</i>	-0.010 ** <i>0.003</i>
	president experience×(in line with central government)				0.009 ** <i>0.004</i>	0.008 *** <i>0.002</i>
	president is a doctor				0.061 ** <i>0.025</i>	0.075 *** <i>0.018</i>
constant	-3.957 *** <i>1.283</i>	-4.487 *** <i>1.338</i>	-4.492 *** <i>1.367</i>	-4.029 *** <i>1.189</i>	-4.012 *** <i>1.267</i>	
# of observations	189	189	189	189	168	
within R ²	0.85	0.86	0.86	0.88	0.87	

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

[§] Panel fixed effect estimation; robust standard errors in italics; all regressions include year dummies and region fixed effects.

5.2. The determinants of caesarean rates

Tab. 2 compares estimation results for a baseline model including structural controls only (column A) with those obtained from augmented specifications adding the other three groups of variables listed above (columns B-E). In general, the sign of the coefficients and their significance levels are quite robust across model specifications. Region-specific fixed effects are significant: the geographical pattern confirms the

⁴ Results for the serial correlation tests and for the spatial error and spatial lag models are available upon request.

descriptive evidence discussed above, with Northern regions displaying, *ceteris paribus*, a lower odds ratio.

Considering *control* variables first, we find that – as expected – the coefficient of the mother age is positive and statistically significant, 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 the 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 days⁵, which could be a factor of a more intense use of caesarean sections. The estimated coefficient for neonatal mortality is indeed positive, suggesting that caesarean sections increase with riskiness. Finally, we control for the education level of (potential) mothers, by considering the share of females holding at least a primary school diploma. The estimated coefficient is positive, but marginally significant in just two out of five models.

As for *supply* indicators, the incidence of medical staff on the total number of employees positively affects the number of caesareans, but it is statistically significant at the usual confidence levels only in the less complete specification (column B). The coefficient for the share of beds in private hospitals is negative but never statistically significant.⁶

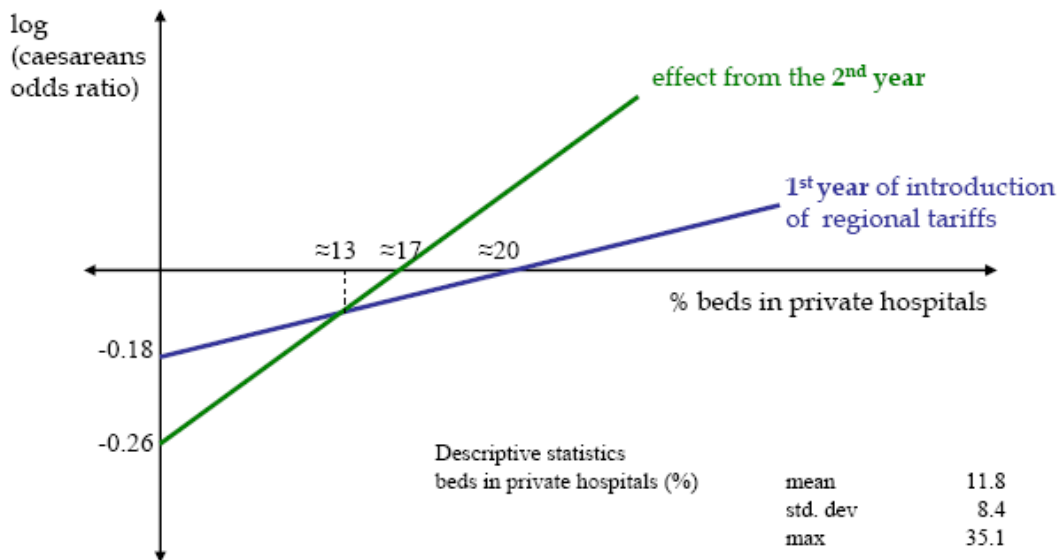
Looking at *pricing policy* indicators, the presence of region-specific DRG tariffs might be a signal that the region is putting effort in managing health expenditure using available policy tools. Indeed, the dummy variable accounting for regional tariffs has a

⁵ The neonatal mortality rate 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.

⁶ 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) yields a non significant coefficient and does not alter the other findings. Overall, then, supply indicators do not seem to exert any important influence on caesarean sections.

negative impact on the number of caesarean deliveries (columns C-E).⁷ However, when interacting the dummy for the presence of regional tariffs with the relative size of the private hospital sector, we find a positive coefficient for the interaction term. As it is clear from Fig. 9, the reducing effect on caesarean sections stemming from the regulation of reimbursement tariffs is mitigated (or even reversed) the higher the relevance of private hospitals.⁸ A likely interpretation is that, where the share of private providers is particularly large, lobbying efforts by these providers aimed at obtaining a remunerative DRG tariff for caesarean deliveries offset the efforts of regional government in defining a pricing policy aimed at controlling the inappropriateness and spending inefficiencies.

Figure 9. Graphical representation of the results on regional DRG tariffs



This interpretation is reinforced by the evidence on the effects originated by the introduction of region-specific tariffs (column E). The positive and significant sign associated with the dummy variable accounting for the introduction of regional tariffs (which takes on value 1 the year DRG tariffs are introduced) 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 hospital treatments. However,

⁷ This dummy variable is essentially a Centre-North dummy; in the South only one region has deviated from the level set for national tariffs.

interacting the dummy accounting for the introduction of specific DRG tariffs with the share of beds in private hospitals, we find that the larger is the incidence of private providers the more rapid is the adaptation to the reimbursement scheme, presumably due to the incentives of these providers to exploit the benefits associated to the new tariffs schedule.

Finally, considering the role played by *political economy* factors (columns D-E), we find that the personal characteristics of regional government's president matter. In particular, we find that the coefficient for president's experience (measured as the number of years the president has been in charge) is negative and statistically significant, suggesting that a more experienced president helps containing the inappropriateness of treatments. This result is in line with recent findings of the literature on electoral discipline of the duration of legislative terms, which point out that longer terms tend to improve the performance of governments (e.g., Dal Bó and Rossi, 2008). This effect is mainly due to the possibility for the legislator to devote more resources for facing relevant policy issues, like increasing the appropriateness of health care treatments. However, when interacting the president's experience with a dummy capturing the political alignment between regional and central government, we find a positive and significant coefficient. Hence, the positive effect stemming from experience vanishes in the case of presidents politically aligned with the central government. As discussed, e.g. by Arulampalan *et al.* (2009), this finding can be interpreted in terms of increased president's expectations of a more 'benevolent' treatment (for instance, in terms of deficit bailout) by a friendly central government than by an adversary one. We also control for the type of president's occupation, defining a dummy equal to 1 when the president is a physician, whose coefficient is positive and statistically significant, thus being associated to higher inappropriateness.

As for the characteristics of regional governments, we consider two variables. First, political alignment *per se* appears to have no influence on caesarean sections, working through the past president's experience only. On the contrary, the coefficient for the share of own regional resources on total health spending shows a negative sign and it is statistically significant: the lower the degree of vertical fiscal imbalance, the

⁸ The estimates for specification E in Tab. 2 imply that when the share of beds in private hospitals is larger than 20%, the introduction of regional tariffs does result, all other things being equal, in an increase in the odds ratio of caesarean deliveries.

lower the importance of caesarean sections, hence the inappropriateness of health care services. As the institutional rules governing own resources in Special Statute regions are different from those in Ordinary Statute ones, we also interact our proxy for vertical fiscal imbalance with a dummy identifying Special Statute regions. However, coefficient for this interaction term turns out to be neither statistically significant nor altering the magnitude of the other coefficients, probably because of the presence of regional fixed-effects already accounting for differences in institutional rules.⁹ This inappropriateness reducing effect is consistent with different interpretations. First, in line with modern theories of fiscal federalism (e.g., Weingast, 2009), a higher degree of fiscal autonomy determines higher electoral accountability, leading to a tighter control on government spending and increased cost efficiency. From this perspective, our result adds to recent empirical literature investigating how tax decentralization and vertical fiscal imbalance affect local government size (e.g., Jin and Zou, 2002; Borge and Rattsø, 2008; Eyraud and Lusinyan, 2011). Second, regional differences in the share of own funding mostly reflect tax base distribution across the country (e.g., De Matteis and Messina, 2010), and might then capture north-south inequalities in per capita GDP.

6. Concluding remarks

Available evidence for Italian regions suggests a positive link between inefficiency in the production of health services and inappropriateness of treatments. To better understand inefficiency determinants, this work aims then at identifying the factors that have an impact on inappropriateness considering caesarean deliveries, an indicator usually adopted both in the literature and by policy makers. Besides structural control variables (like the mother's age, and the birth rate), we look in particular at three group of factors: supply indicators, reimbursement tariffs, and political economy variables. While we find no significant effects from supply indicators, our results suggest that the adoption of regional DRG tariffs could be an effective policy tool to control inappropriateness. The active management of reimbursement mechanism can reduce inappropriateness as measured by caesarean sections. However, differentiating the reimbursement mechanism from the national setting does not guarantees superior outcomes *per se*. Attention to providers' behavioural responses has to be paid by governments since the importance of

⁹ Results are not reported here for brevity, but are available upon requests from authors.

private providers does matter. Indeed, a process of regulatory capture could be at work if the private sector is large enough.

More importantly, we find that both president's and government's characteristics have a relevant impact on inappropriateness. In particular, the experience of regional administrators can play a positive role in building the necessary management capacity which allows setting (or at least duplicating) the best practices in the sector. But this improving effect on inappropriateness can be mitigated by political alignment of regional government with central government: politically aligned regions emerge as less prone to control inappropriateness the longer the experience of their president. Finally, confirming previous findings in fiscal federalism literature, having access to significant own resources for financing health expenditure appears to provide the right incentives to regional governments to control inappropriateness, making them more accountable for the use of resources.

The paper focuses on the inappropriateness of health treatments, which – besides being related to spending efficiency – can be considered one dimension of the broader concept of quality in health services. We leave the analysis of this further aspect (and of the issue of effectiveness) to future research.

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