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Does private supply drives personal health choices? A spatial approach of health tax detractions at municipal level

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Abstract

The provision of health services plays a central role in the promotion of public welfare and maintaining a healthy society. However, inequalities in access to health care persist between countries, regions, and communities, reflecting the complex interplay of many social, economic, and cultural factors. This article aims to explore the complex relationship between tax deductions and the spatial correlation between health demand and private supply. By using an original data set at an unprecedented municipal level and employing a spatial counterfactual empirical strategy, we contribute to the existing literature in two ways. First, we show a strong territorial heterogeneity of health tax expenditure at the municipal level, which persists even after controlling for explanatory factors, and essentially rewards northern Italian regions and penalizes southern ones. Second, we investigate whether greater proximity to a private health provider respects a public one produces a different spending behavior in citizens, highlighting once again the specificity of private healthcare provision in the Italian context. This behavior was analyzed with a geographically weighted analysis, which allowed us to assess the strong spatial non-stationarity by including local potential hidden confounders.

Keywords: Tax expenditures, Health tax expenditures, Spatial counterfactual approach
JEL: I14, H24, C21

1. Introduction

The provision of health services plays a central role in the promotion of public welfare and the maintenance of a healthy society. Understanding the dynamics between health demand and public and private supply is crucial for policy makers, as it informs them on how to implement effective strategies to optimize resource allocation, improve health outcomes and hence equity in access to health care.

Among the key strategies available to public policy makers, access to quality health services is an essential component of social and economic growth (Bloom et al., 2004). However, inequalities in access and outcomes persist in regions and communities, reflecting the complex interplay of many social, economic, and cultural factors in both developing (Peters et al., 2008) and developed countries (Mangano, 2010; Goodyear-Smith and Ashton, 2019)[1].

As originally noted by Andersen and Newman (1973), while there exists a clear correlation between demographic variables and health care use, it should be emphasized that these variables do not inherently imply the consumption of healthcare services – the clearest example is Long-term care (Ltc), home care and personal assistance for aged people, who need in kind service, much less consumption of health care. Income, employment status and education are the key variables, but also, of course, the structure of the health care supply and the place where one lives[2].

Personal and social factors are evidently key drivers, but the thesis of this paper is that local cost factors, resulting from distortion due to tax expenditures are crucial[3]. In many countries, the reduction of tax payment

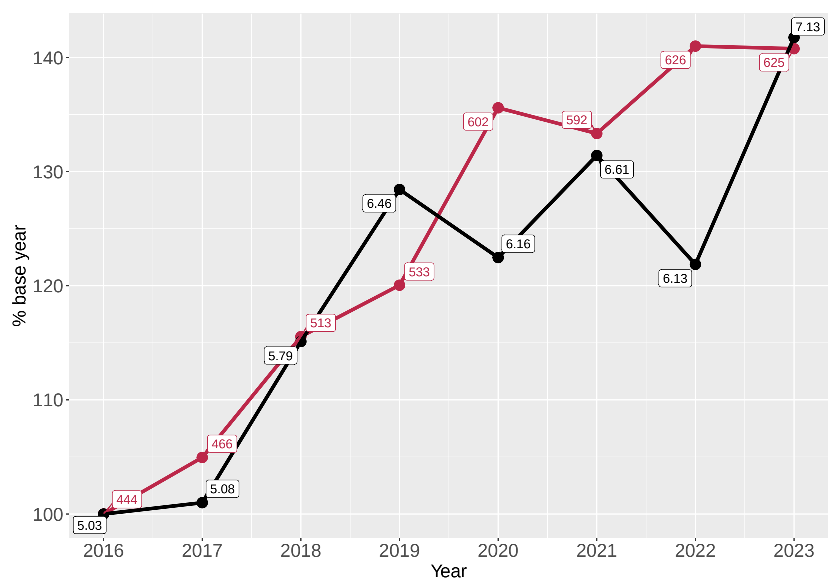
[1]Goodyear-Smith and Ashton (2019) shows that, although New Zealand was one of the first countries to establish a universal tax-funded national health service, to reduce health inequities, problems with access to care persist and the health service system does not deliver the promise of equitable health outcomes for all population groups. "*Primary health services and hospital-based services have developed largely independently, and major restructuring during the 1990s did not produce the expected efficiency gains*". The Italian situation shows many similar drawbacks to achieving a satisfactory result in health access and outcomes

[2]Some studies (Kind and Buckingham, 2018; Hu et al., 2018) have shown that people with a lower socioeconomic status who reside in more affluent neighborhoods can experience better health outcomes compared to those in highly disadvantaged neighborhoods

[3]There are many forms of tax expenditures. The most common are: a) tax deductions, when a certain amount is deducted from the taxable income; b) a reduction in the tax payments, which it is usually used to incentive the consumption of certain items – drug,

for the income personal tax for some health expenditure is one of the most relevant type of tax expenditure that (Poterba, 2011) play an important role in individual behavior and shape local health care provision. Tax deductions and credit tax, in fact, have emerged as a strong policy instrument that can influence health behavior and consumer/patient choices, as well as territorial demand for health services (Jakobsen and Søgaard, 2022; Ugbor et al., 2022). Furthermore, some reports on the size of tax expenditures in some OECD countries show that they have increased enormously over time in recent years (Aliu et al., 2022; von Haldenwang et al., 2021), especially in Italy (see Figure 1).

Figure 1: Italian tax expenditures, number (red line) and the % of less revenue to GDP (year t+1) (black line), Fiscal year 2016-2023 (base year 2016), % and absolute values in points label.



Source: Authors' elaboration from Commission for the Tax Expenditures, Annual Reports, Italian Ministry of the Economy and Finance

health expenditures, private pension and health funds, etc. c) a credit tax, when taxpayers may use this credit against tax payments in their tax return; d) other forms, of tax expenditures, such as rebates, exclusions etc. In this paper, we focus on tax reductions, i.e., on the case when a right to reduced tax payment is allowed to taxpayers – these form are called in Italy "tax detractions").

More specifically, tax deductions and tax credits refer generically to incentives provided by governments to encourage specific behaviors or types of expenditures. In the context of healthcare, tax detractions can be designed to promote private health insurance coverage (Park et al., 2023), encourage healthier lifestyles (Volpp et al., 2009) or discourage the consumption of unhealthy foods (Wright et al., 2017; Puig-Codina et al., 2021; Kurz and König, 2021), or more simply, to support progressively[4] monetary income of people who consume health services. However, they may also change the choice of using specific local providers over others, and that between public and private health infrastructure, only on the basis of tax convenience. The potential impact of tax deductions on health-seeking behavior is particularly relevant in the context of private supply, as individuals and families make decisions about insurance coverage, healthcare provider selection, and treatment choices.

In the literature, the lack of territorially disaggregated tax expenditure data has not allowed for an analysis of how these incentives locally change the behavior of individuals in choosing between public and private health care.

By analyzing a comprehensive and original dataset at an unprecedented municipal level and by employing a spatial counterfactual empirical strategy, we contribute to the existing literature in two ways. First, we show a strong territorial heterogeneity of health tax expenditure at the municipal level, which persists even after controlling for explanatory factors and which essentially rewards northern Italian regions and penalizes southern ones. Second, we test whether greater proximity to a private hospital, than to a public one, can be an explanatory factor for higher health expenditure and thus higher tax detractions. Third, the stationarity of the mean estimates has been verified by varying the spatial window of estimation, thus including all omitted local confounders.

The remainder of the paper is organized as follows. Section 2 introduces the economic and applied literature, Section 3 introduces the institutional

[4]The issue of the redistributive effects of tax expenditures has drawn a lot of attention by public finance specialists; see for example Feldstein, 2014; Feldstein et al., 2011. Please note that a tax expenditure does not need *per se* to be progressive (as is supposed in the general working of any income taxes), and the effects on the distribution of personal income depend on how the tax expenditures are defined and constructed.

structure of healthcare supply in Italy, Section 4 describes the empirical strategy and the data, while Section 5 presents the main results. Section 6 discusses the main findings and concludes.

2. What Literature Says

The literature on the effects of tax expenditures on individual choice and efficiency is not extensive. Most of the existing works try to assess the effect of different tax expenditures on equity and progressivity. Potrafke (2010) address the correlation between health tax subsidies and electoral motivation; some other papers discussed specific issues, such as how incentives can distort demand through price (Holmer, 1984), or how specific detraction or deductions may stimulate private insurance plans (Gruber and Poterba, 1994; Finkelstein, 2002 by using a differences-in-differences framework).

Tax credits and deductions usually benefit taxpayers at all income levels by reducing their total tax liability and changing the cost of some personal spending[5]. However, in many OECD countries, health tax detractions tend to be implemented in different ways - with certain limits in absolute value or as a percentage of taxable income, with the definition of some franchises for some health expenditures, or by setting a threshold in terms of gross income[6].

There are of course many possible effects of tax expenditures: empirical studies have shown that some tax expenditures tend to be progressive, such as child allowances and work income tax credit while incentives for some special consumption and merit goods (micro-detractions for sport practices, pets, and so on), reductions for real estate work maintenance, mortgages' interests expenses, private pensions and health sectors, tend to be regressive and to benefit wealthier people (Burman and Phaup, 2012; Department of Finance, Canada, 2016; Fookes, 2009; Tax Administration Research Centre, 2014).

Honekamp and Possenriede (2008) address the redistributive outcomes of health services and possible ways of financing them. They consider the

[5]See on this, the Italian Commission on Tax Expenditures, various years, `https://www.mef.gov.it/ministero/commissioni/red_spe_fis/index.html`.

[6]Feldstein et al. (2011) suggested the introduction in the US income tax of a threshold of 2 per cent of disposable income for most tax expenditures. This approach can produce a considerable increase in tax revenue without forcing the government to abolish any tax expenditures, and, at the same time, it is also its drawback.

impact of different financing options for public health insurance on the "*redistribution from good to bad health risks and from high- to low-income individuals*". The range of financing options varies from income-related instruments (income, payroll, and indirect taxes) to health-related instruments (coinsurance schemes and deductibles) to some flat-rate option payments. In conclusion, when reforming access to health care, the issue of financing is crucial: the potential redistributive effects are fundamental and need to be taken seriously.

Furthermore, Di Novi et al. (2018) investigates the potential effects of health-related tax credits on income-related health disparities within the context of the Italian institutional framework. Employing a tax-benefit microsimulation model that replicates the personal income tax system and incorporates behavioral responses to changes in the tax credit rate, the analysis reveals that the current design of healthcare tax credits tends to disproportionately benefit the wealthier segments of the population.

Pfarr and Schmid (2016) consider how to assess citizen preferences on tax expenditures by discussing how large the extent of social health insurance has to be and the possible role of supplementary private insurance. Individuals likely to benefit from public coverage show a "positive marginal willingness to pay" (MWTP) for both a shift away from other beneficiary groups toward the sick and an expansion of publicly financed resources, and the expected net payers have a negative MWTP and prefer lower levels of public coverage".

Although there are few studies on the redistributive effects of tax expenditures, even fewer address the public/private effects and the different impact in space.

The private/public choices induced by fiscal expenditures are discussed by Cheng (2011), who examines the impact of reducing subsidies for private health insurance on public sector spending on hospital care and finds that reducing subsidies for private health insurance has the potential to produce a net positive fiscal impact by achieving cost efficiencies that offset potential increases in public health spending.

Finally, Comber et al. (2011) investigates the interplay between public perceptions of access to surgeries and hospitals of general practitioners in relation to health status, car ownership, and geographical distance, aiming to uncover different dimensions associated with access to facilities and overall accessibility. Geographically weighted regression (GWR) was used to identify spatial (local) variations in global relationships, suggesting that the impact of poor health and non-car ownership on difficulties in accessing health services varies spatially across the study area.

3. Institutional framework

The Italian public health system has deep historical roots and has gradually developed over time. The formal introduction of the public health system in Italy is mainly linked to the creation of the National Health Service (Servizio Sanitario Nazionale, SSN), established by Law No. 833 of 23 December 1978.

Before this reform, health care in Italy was characterized by a fragmented and unequal system, with different regions managing their health services independently. The main objective of the SSN was to guarantee universal and free access to basic health services for all Italian citizens, based on the principles of universality, solidarity, and equality, and to ensure an adequate level of health care for all citizens, regardless of their economic circumstances (de Belvis et al., 2022).

The national health system in Italy is actually mainly financed by taxes and social contributions at national level, but is mainly administered at regional level (see Appendix A for a more in-depth discussion of the different regional models of management); given this financing scheme, it is, therefore, crucial to increase the need for strong coordination and control of regional expenditure by the Central Government (Ferrario et al., 2023; Guccio et al., 2024) in order to overcome the "*soft budgeting constraint*" problems (Bordignon and Turati, 2009).

National and regional taxes primarily support the SSN, with additional contributions coming from co-payments for medications and outpatient services. The main source of funding is the IRAP, a form of value-added tax (income-type) similar to Michigan's long-standing business tax (Lock et al., 1955). Another source of revenue comes from the additional regional surcharge on the progressive income tax; for the same purpose, VAT revenue is used to compensate for regional needs and differences in order to guarantee the same level of health services in all regions (LEA, basic level of assistance), as provided for by the Italian Constitution.

This financing system is currently suffering from the severe aging of the population, the gradual erosion of the tax base, the need to eliminate a distorting tax such as IRAP and the difficulty of guaranteeing a uniform level of care throughout the territory. Today, SSN can no longer be defined as " *full*

national public" since, according to ISTAT[7], in 2017 out-of-pocket private expenditure of Italian households amounted to almost 36 billions euro (25% of the total expenditure) and given the strong heterogeneity of regional supply (*e.g.* different waiting times, Fattore et al., 2013) "*driven by differences in co-payment schemes, unified booking centers, and promotion of private health insurance [that provide] a fragmented framework*" (Riganti et al., 2017).
Despite experiencing funding cuts in both the public and private sectors, accredited private hospitals in Italy experienced an increase in their share from 46% of the total number of hospitals in 2010, to 48% in 2017 (Ministero della Salute, 2023); spending cuts in less efficient regions have also penalized the efficiency of public hospitals more than private ones (Guccio et al., 2024).

4. Empirical strategy

Our main objective is to evaluate whether more proximity to a private health provider compared to a public one generates a different spending behavior in citizens *i.e.*, to measure the impact of being closer to a private hospital compared to a public one by using the municipal average health tax deduction. This is based on the assumption that citizens tend to prefer the closest and cheapest health care offer and that tax deductions may shift citizens' preferences towards a more expensive offer.
Since we analyze non-experimental data, the identification of effects poses a challenge due to treatment selection (Angrist and Pischke, 2009). Although causal inference models aim to provide an in-depth understanding of causal relationships between variables in observational data, these models rely on several key assumptions, whose violations can lead to biased or misleading causal estimates. Therefore, it is necessary to construct an experiment in which treatments are assigned to all municipalities according to a completely randomized design (Figure 2), where, in other terms, each municipality has the same marginal probability of receiving treatment.
Few papers in the literature have exploited space to construct a random discontinuity except for a few in which there were administrative or geographical boundaries that justified the presence of a border (see, for example, Spatial Regression Discontinuity Designs as in Keele and Titiunik, 2015; Keele et al., 2017).

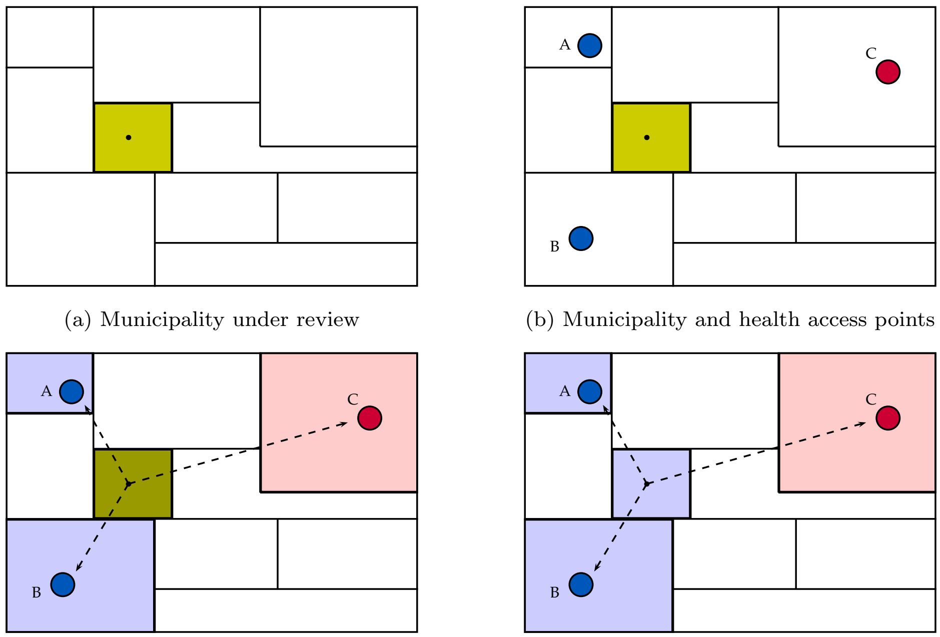
[7] https://www.istat.it/it/archivio/201949.

Since we do not have a similar framework (citizens of all Italian municipalities have the same right to deduct), we have constructed an empirical strategy to assign each individual municipality to a typology/treatment (public or private) based on the distance to the nearest hospital following these steps: for each municipality under analysis (Figure 2 a) hospitals are considered, marked as public or private (Figure 2 b), the distance to each is calculated (Figure 2 c) and finally each municipality marked as public or private according to the minimum distance (Figure 2 d)[8] to the relative supply.
The underlying assumption is that citizens choose to use a public or private provider based on distance alone: we are aware that this is a simplistic assumption, but data on hospital quality, reputation, shorter waiting times were not available for all considered care centers in Italy[9].

[8]In the case of more than one hospital in the same municipality, allocation could be problematic: for this reason, two scenarios were considered in the empirical application. In the first, these municipalities were assigned according to the minimum distance from the centroid to the hospital; in the second, such municipalities were excluded from the analysis.

[9]However, if they had been available, they could have been easily integrated into the proposed approach.

Figure 2: Empirical strategy



(a) Municipality under review

(b) Municipality and health access points

(c) Municipality and distance calculation

(d) Assignment of the Municipality

In more formal terms, we are interested in evaluating the Average Treatment Effect (ATE) to reside close to a private healthcare facility as opposed to a public one; but on which variable do we want to test this setting? Not directly on Y the municipal average level of tax detractions for health expenditure, but on a measure called "health overspending" (H), i.e., excess tax deductions given a standard level given by a number of local factors X. Against this background, the subject of our analysis will be the estimation of:

$$\begin{cases} Y = \alpha + \beta X + H \\ ATE = E(E[H|W, C = 1]) \end{cases} \tag{1}$$

where C is the dummy variable representing proximity to a private ($C = 1$) or public ($C = 0$) care provider and W a vector of confounders.

Once the quasi-random experiment has been designed, some key standard assumptions need to be checked to ensure that the model is correctly identified and estimated. For the sake of clarity, we will list them by point.

a) **Causal Consistency (Stable Unit Treatment Value Assumption - SUTVA)** hypothesis: this assumption states that the potential outcome of one municipality is not influenced by the treatment assignment of other municipalities. In other words, the treatment status of one unit does not affect the outcomes of other units. Since in our case, the data are divided into different territorial regions based on the criterion of geographical distance, a generic municipality is not affected by the treatments/allocations in the other municipalities.

b) **Ignorability (Unconfoundedness or Exchangeability)** hypothesis: the treatment/assignment should be independent of potential outcomes, given observed covariates. In our setting, the treatment depends only on physical distance, and it is, therefore, independent of the tax deduction data.

c) **Overlap (Common Support)** hypothesis: every municipality should have a non-zero probability of receiving either treatment or control. In other terms, there should be an overlap in the distribution of covariates between the treated and control groups. This hypothesis is related to the applicative part (see Section 5) and has been successfully tested (see *e.g.* Figure B.3).

d) **No Measurement Error** hypothesis: the observed data should be free of significant measurement error, namely errors in measuring the treatment or outcome variables can introduce bias in causal estimates. In our case, the outcome value is an average of 4 years of official data, in order to have robust data over time; the treatment (location of hospitals) is a reliable data (obtained via the Google Maps API), too.

e) **No Hidden Confounders** hypothesis: all relevant confounding variables should be measured and included in the analysis, that is, if there are unmeasured confounders, causal estimates may be biased. To answer this requirement, a geographical weighted estimation of the treatment to account for unobserved local confounders has been proposed in Section 5.4.

4.1. Data

To empirically evaluate the approach described in Section 4, an original database of average detractions per municipality has been created with an unprecedented level of municipal granularity. The database includes data on

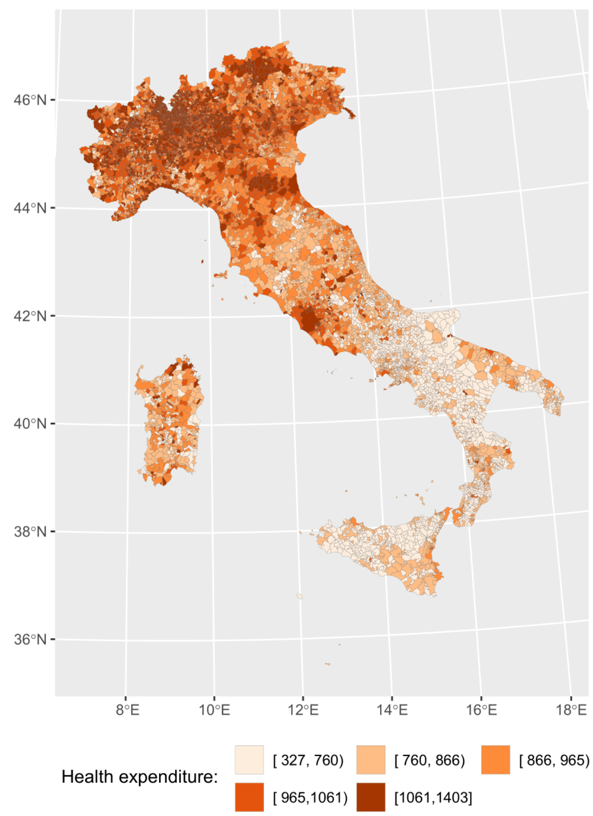
several categories of tax deductions related to personal income tax, specifically requested from the Dipartimento delle Finanze (DF) of the Ministry of Economy and Finance covering the period 2018-2021.
In addition to municipal data on health tax expenditure, geographical data (latitude and longitude) of 606 private[10] and 800 public hospitals or clinics have been collected.
Finally, some economic and social contextual variables have been collected at the municipal level to control the heterogeneity of the territories in terms of income capacity (`per capita income`, source: Ministry of Economy and Finance), population structure (`resident population by age group`, source: ISTAT) and local prices (`property rental prices`, source: Observatory of the Real Estate Market, Italian Revenue Agency).
A robustness analysis of the data has been mainly carried out (further results are available from the authors, see *e.g.* Figure B.1) slightly reducing the estimation sample (from 7,960 to 7,756 municipalities).

5. Main results

Information on average deductions per municipality for healthcare expenditures, described in Section 3, has initially been used to verify its spatial distribution and correlation.
Two straightforward insights can be deduced from Figure 3: the first concerning the clear difference between the North, the Center with the sole exception of Rome and the South; the second concerning its strong local persistence (also called local spatial autocorrelation) over the territory.

[10] "Accredited private hospitals", "Non-accredited private hospitals", "Private university polyclinics" and "Private scientific hospitals" have been considered as private; please note that the term "accredited" means that fees can be reimbursed by the Italian National Health Service if the patient is officially resident in Italy. All other types of hospital were considered public. Source: Italian Ministry of Health.

Figure 3: Average value of health tax expenditure per capita by municipality



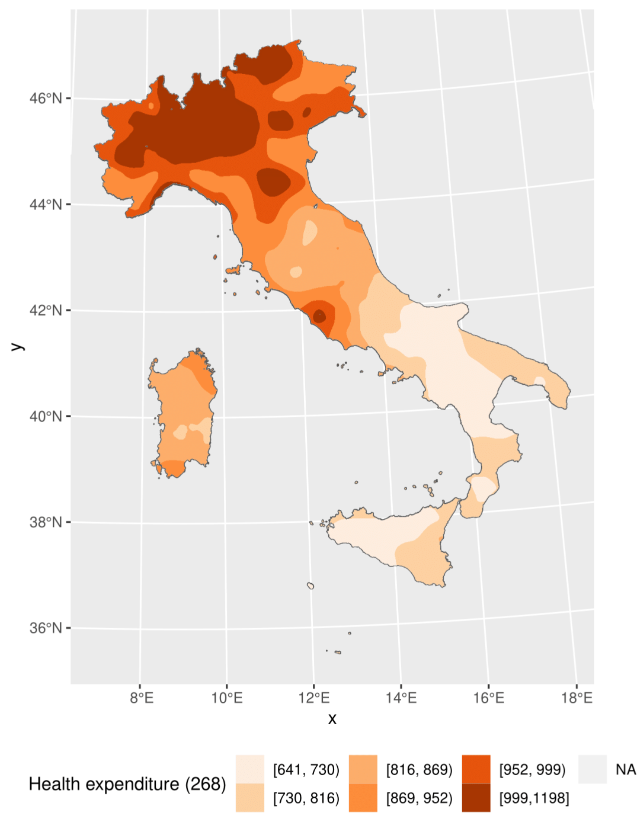
Regarding spatial per capita differentials, raw data can be spatially interpolated to derive information that is less affected by local data and, therefore, more reliable; Kriging-type models, also known as Gaussian process regression, can be used to estimate values at unmeasured locations based on observed data, minimizing the estimation variance while providing the best linear unbiased predictions[11].

Figure 4, thus, shows that the most densely populated parts of Piedmont

[11]The primary advantage of kriging interpolation lies in its ability to provide not only the interpolated values, but also to produce smoother and more realistic surfaces compared to simpler interpolation methods like inverse distance weighting. In this way, assuming that points closer to each other have a stronger correlation, we take into account the spatial correlation and variation in the data that perform well even when data points are irregularly distributed in the study area.

and Lombardy, parts of Veneto and Emilia Romagna, and the area around Rome are the regions with the highest per capita tax expenditure.

Figure 4: Kriging interpolation of the municipal average values of health tax expenditure per capita



5.1. Health overspending

As noted above, this sharp regional differential is accompanied by a strong spatial autocorrelation of the mean values (Figure B.2), reflecting a phenomenon that is not only related to large cities, but appears more local and is more closely related to specific local factors.

This is in stark contrast to the ultimate purpose of a national tax system, which should also be "*territorially fair*" because it should not discriminate against taxpayers based on where they live or work. A territorial tax system taxes income where it is earned, not where the taxpayer lives or works.

If it is unfair, it may be because of different tax bases, different demographic structures, or other local factors, but also because some specific deductions/distortions may have been introduced over time to favor certain territories.
So, the first step in our analysis is to check whether (and to what extent) this concentration is due to objective factors such as differences in `per capita income` (a wealthier population will require more services), `age groups` (a younger or older population than a middle-aged population will have greater health care needs) and `local price` differences (the higher the prices, the greater the deductions). In other terms, this step is necessary in order to get to a measure that is no longer conditioned by specific local factors, but can be seen as "*overspending*" (relative to an average level) in relation to other factors not yet considered[12].

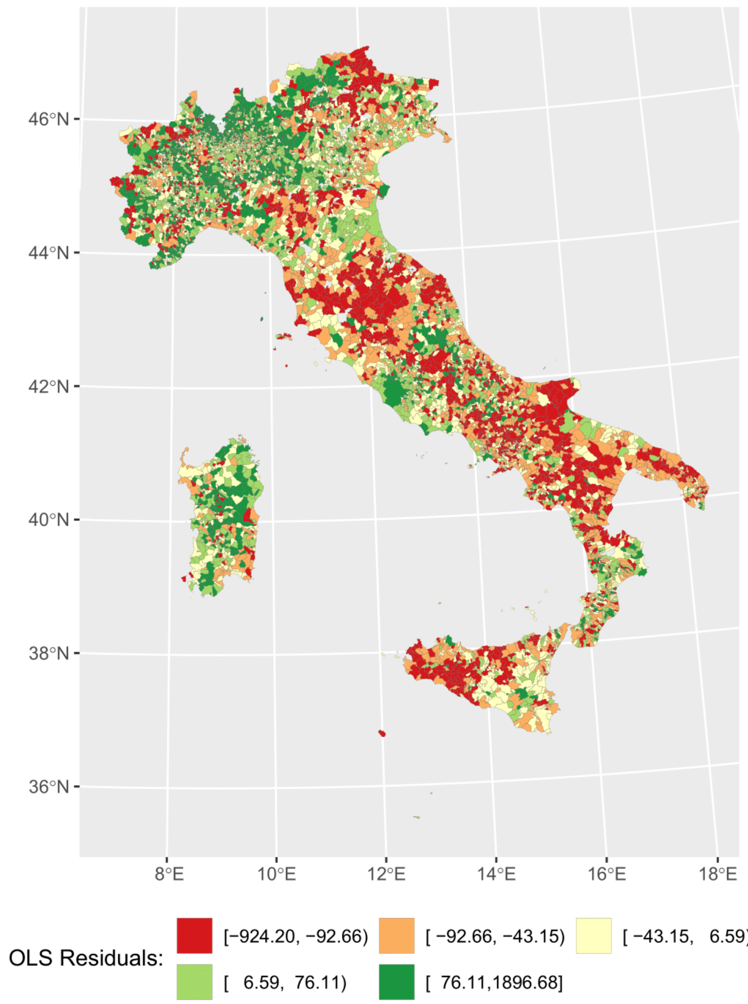
[12]Note that we refer to both positive and negative differences from a conditional mean level as overspending; where unclear, we refer to positive overspending and negative overspending depending on the sign, whether greater or less than an expected level.

Table 1: OLS estimates

	Dependent variable:		
	Health tax expenditure per capita		
	(1)	(2)	(3)
Per capita income	0.047***	0.047***	0.046***
	(0.002)	(0.002)	(0.002)
Per capita income (square)	−0.00000***	−0.00000***	−0.00000***
	(0.00000)	(0.00000)	(0.00000)
Resident population aged 0-14		0.018**	0.015*
		(0.009)	(0.009)
Resident population aged 15-64		−0.006**	−0.006**
		(0.002)	(0.002)
Resident population over 65 years		0.008***	0.007***
		(0.002)	(0.002)
OMI price (Euro/mq)			6.592***
			(1.085)
Constant	204.294***	201.746***	203.543***
	(22.486)	(22.496)	(22.446)
Observations	7,756	7,756	7,756
R^2	0.482	0.483	0.486
Adjusted R^2	0.482	0.483	0.485
Residual Std. Error	127.859	127.775	127.480
	(df = 7753)	(df = 7750)	(df = 7749)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 1 reports, from specific to general, OLS estimates that relate per capita tax expenditure to `income` (including the quadratic term, column 1), to `population` groups (column 2, showing higher expenditure for younger and older groups), and to the `OMI price` per square meter (column 3), which is a proxy for local prices at the municipal level. Once the significance of the coefficients and the overall goodness of fit of the model in column 3 have been verified, this model can be used to obtain the estimation residuals, *i.e.*, as mentioned before, a measure of health overspending.

Figure 5: Map of OLS residuals, column (3) model

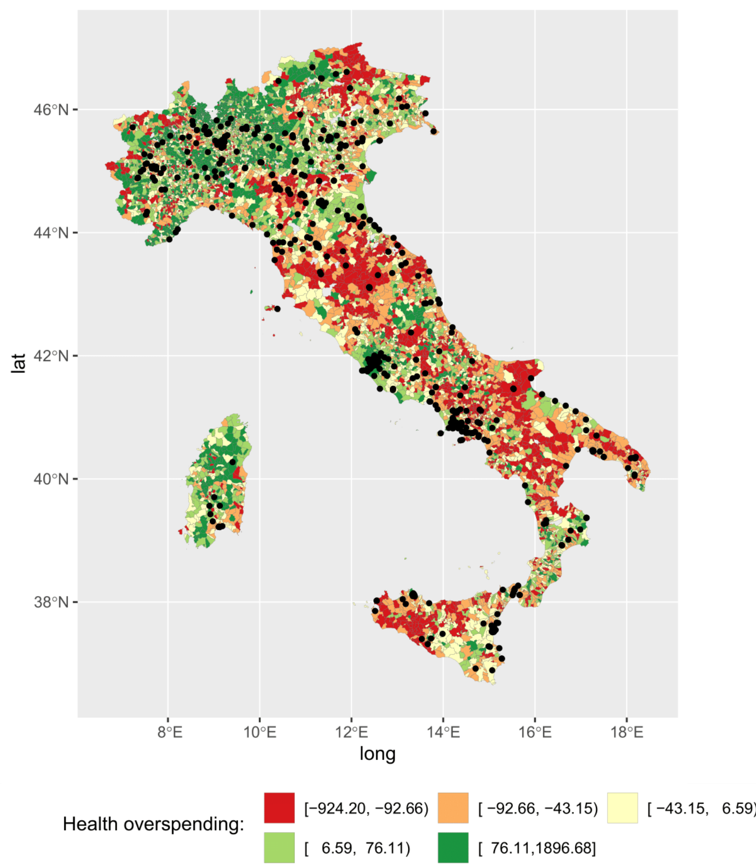


This estimate gives us a spatial overview (Figure 5) not too far from the map constructed on the basis of the unconditional values; positive residuals (conditional expenditure values higher than the average all things being equal, in green) are present in the Norther regions, in Emilia and around Rome, while negative residuals (expenditure values lower than the average all things being equal, in red) are present in the Center and the South.

5.2. Health overspending and private supply

What other factors could be responsible for such a spatially autocorrelated differential? We will try to answer this question first in a descriptive way, aware of the limitations of this approach, and then by adopting a counterfactual approach that allows us to derive some answers to at least one of the factors that might have justified such spatial latent differentials.
Our hypothesis, as described in Section 4, is that the presence of a private provider in the neighborhood may have prompted the citizens of that municipality to consume more health care, partially reimbursed by the State; thus, not a value judgment (private providers may, in some cases, offer a service that is complementary to the public one), but the assessment of a rational behavior of citizens who choose one service or another according to the distance from it and tax advantage.
To do this, we overlap the municipal map identified on the basis of health overspending with the location of the only 606 private hospitals on the territory (Figure 6). A first impression, again descriptive, can be derived: it can be seen that private supply points are located within areas with positive overspending (Norther regions, Rome, Naples), while, for example, in Tuscany or the South, more limited private supply is spatially associated with a negative overspending in health tax expenditure, all things being equal.

Figure 6: Health overspending and the private supply

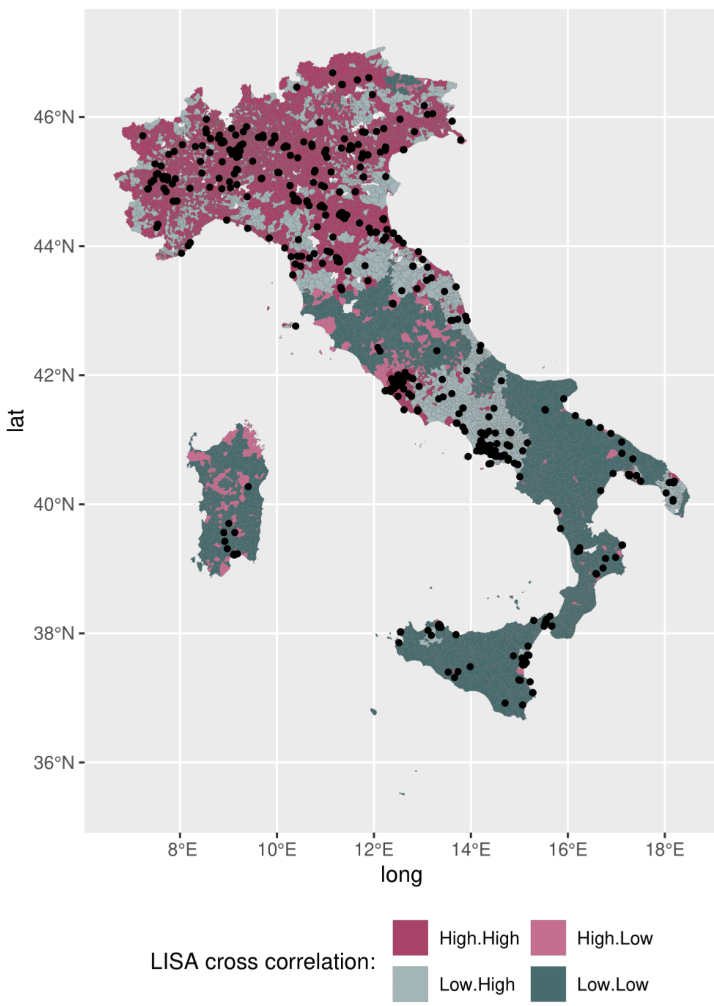


Let's, therefore, try to calculate a more objective measure of the local spatial autocorrelation between the health overspending and the proximity to private supply[13] via the bivariate spatial cross-correlation using local Moran's-I (LISA) (Chen, 2015); more specifically, this metric considers the point-to-point relationships between two spatial patterns, thus outperforming conventional bivariate association measures such as Pearson's correlation

[13]The `standardized measure of proximity to a private hospital` has been calculated, for each municipalities as the distance to the nearest private hospital ($dist_{min}$) standardized with respect to all other municipalities: $[1 - ((dist_{min} - min(dist_{min}))/(max(dist_{min}) - min(dist_{min})))]$; the variable is, therefore, equal to 1 when the municipality is the closest to a private hospital among all municipalities and 0 if it is the furthest away always with respect to all others.

coefficient, which do not take into account the spatial distribution characteristics of the data, too.

Figure 7: Bivariate LISA cross-correlation and the private supply



Thanks to this measure we can verify where locally an higher positive value of the health overspending is associated with a higher proximity to a private healthcare facility (dark purple, high-high, Northern Italy), where lower than average tax deductions are associated with a lower proximity to a private healthcare facility (dark green, low-low, Southern Italy), and the other cases in between.

5.3. Treatment-effects estimation

These descriptive measures of local spatial autocorrelation, although very detailed spatially, provide only an initial measure of association that does not verify the causal link between health care supply and demand. Using the empirical strategy described in Section 4, we try to better answer this question by first dividing the set of Italian municipalities into a control group and a treatment group according to the relative proximity of public and private care; for this purpose, a dummy variable (`closer to private`) is calculated, equal to 1 if the centroid of the municipality is closer (in terms of the great circle distance according to the Haversine formula) to any private hospital than to any other public one, and equal to 0 otherwise[14].
Please note that since we have chosen to measure the neighborhood effect on a measure of overspending deduction (and thus deprived of the effect of contextual variables), we can consider the treatment - *i.e.* the choice of private supply to locate in wealthy or higher demand areas of the country - as not endogenous to the chosen measure.

In observational data, as opposed to experimental data, treatment groups are often not randomly assigned, which means that the characteristics between groups may not be equal. For this reason, treatment effect estimators reweight observational data in order to obtain balanced experimental results. Figure B.3 shows the original and model adjusted distribution of the propensity score that highlights the perfect balance between the treated group (3,673 observations) and the untreated group (4,165 observations) after the matching phase.
Given these premises, it is possible to estimate (see Table 2) average treatment effects (ATE) on health overspending using augmented inverse probability weighting, nearest-neighbor matching and regression adjustment, and by matching the propensity score[15] to assess the robustness of the results obtained and the validity of the basic assumptions[16].

[14] 129 municipalities had at least one private hospital and one public hospital within their territory making the assignment potentially non-unique; these municipalities have been included in the estimation in Table 2 and removed in Table B.1 to check the robustness of the estimates obtained.

[15] The matching variables used were income, population and OMI price, which allowed us to control for any differences in the two samples.

[16] The presence of the overlap assumption is necessary, stating that every individual has

Table 2: Treatment-effects estimation (ATE coefficients), Treatment model: logit (7,838 units)

	Estimator	ATE	Std. err.	z	P>z	[95% conf. interval]	
Closer to private (1 vs 0)	Prop. score	11.036	3.148	3.510	0.000	4.867	17.205
	Augmented IPW	9.735	2.733	3.560	0.000	4.378	15.092
	Nearest-neighbor	9.057	2.954	3.070	0.002	3.268	14.846
	Reg adjust.	9.665	2.683	3.601	0.000	4.406	14.924

The results are, therefore, clear, robust, and confirm the descriptive measures: the proximity (in relative terms, *, i.e.,* in relation to public hospitals) of a private hospital leads citizens to spend more (around 10 euro per capita) in relative terms, and thus the State to reimburse a higher amount.
Whether this is the cost to be borne for a higher quality of care and treatment or whether it is an extra cost cannot be determined with the data at our disposal, but it is clear is that this tax advantage is clearly localised in certain well-defined areas of the country that are already richer and more developed than others.

5.4. Geographical weighted estimation of the treatment-effects

Can these results be considered as illustrative of all regional conditions or, in other terms, can the average treatment effect be considered spatially stationary, *i.e.* the average hides highly differentiated treatment effects? It is a check that we consider useful especially in Italy where regional competences - and planning itself - have been the responsibility of the regions since 2001 (for a detailed discussion of regional governance models, see Appendix A).
An empirical strategy based on local estimates has been carried out by repeatedly estimating the average treatment effects over several spatial windows. More precisely, for each municipality, an area of 2 degrees latitude and 2 degrees longitude was drawn around it (see *e.g.* the black dot and the square in Figure 8); on the municipalities that fell within this window,

a favorable chance of receiving any treatment level. In Figure B.3 (left side) neither plot reveals a significant concentration of probability near 0 or 1, and the estimated densities predominantly coincide in overlapping regions. As a result, there is no indication of a violation of the overlap assumption.

the average effect has been estimated for the municipalities that fell within this window (with decreasing weights with respect to the distance from the central point of estimation), and this approach replicated recursively for all municipalities[17], thus obtaining a spatial distribution of estimated ATEs.
This GW approach tends to mitigate the problem of unobserved confounding because neighbouring municipalities have similar unobservable variables, health risk profiles and socio-economic characteristics[18].
Figure 8 essentially shows that the positive effect of the proximity of private supply on the overspending on tax deductions is not stationary, but is very strong and positive in the northern regions (much more than the average effect) and in the south, especially in Calabria, where private supply is a necessary substitute for the low quality of public supply, and is instead negative or zero/not significant in central Italy (Tuscany, Marche, Lazio), where the regional governments have preferred public supply.
Finally, this approach also makes it possible to better assess the out-of-scale effect of Rome in relation to the spatial dynamics of its neighbours, highlighting once again the specificity of private health care in the Italian capital.

[17] For this reason, we have called the estimates obtained Geographically Weighted (GW, Brunsdon et al., 1998) treatment effect. Due to its relatively low range relative to the chosen estimation window, the Sardinia region was not the subject of this analysis

[18] For example, one factor that may affect deduction variables is, *e.g.*, health mobility especially from southern regions to the northern ones; this confounding factor is clearly controlled for when comparing locally treated and untreated municipalities.

Figure 8: Map of the estimated GW treatment effect

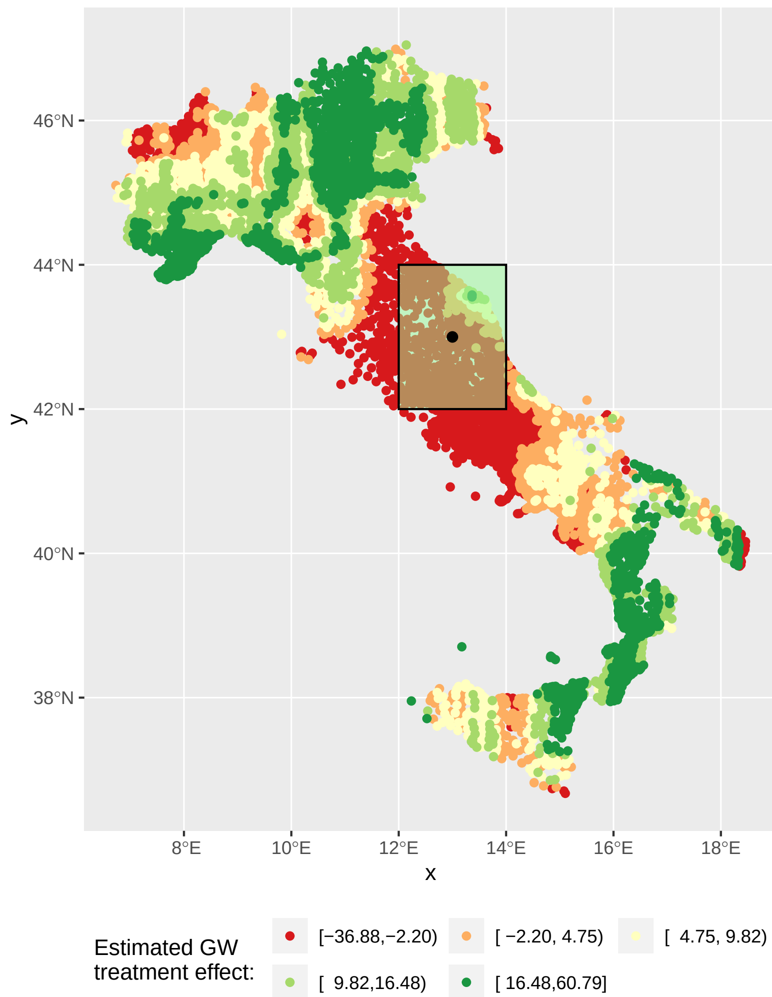
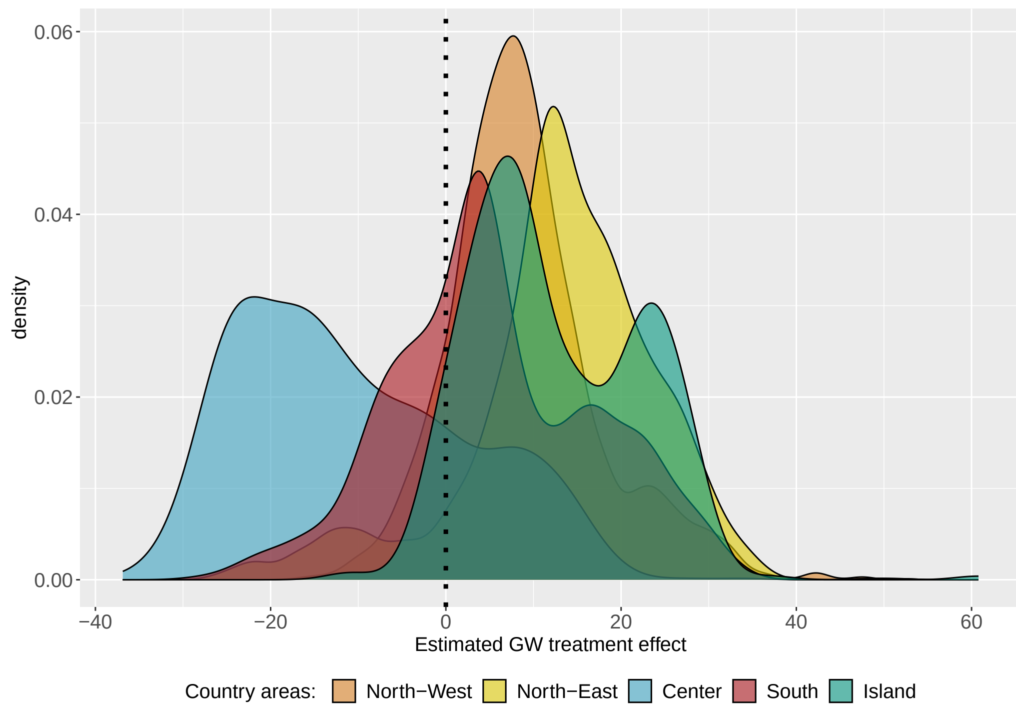


Figure 9 shows the distribution of estimated local ATEs; it clearly highlights the different average behaviour of citizens in different areas of Italy, in terms of distributions, too.

Figure 9: Distribution of the estimated GW treatment effect by country area



6. Final remarks

In this paper we contribute to the existing literature by providing a better understanding of the interplay between tax deductions, territorial demand and the spatial correlation between health care demand and private supply. In particular, we asked whether territorial differences in health care provision could be one of the drivers of higher tax deductions by citizens. We answered this question by adopting a counterfactual framework in which each municipality was assigned to a treatment variable depending on its distance from a private or public provider.

Some basic results emerge. First, a highly territorially unequal average health detractions (even when exogenous factors are equal) have been highlighted, showing how currently more resources are refunded to richer regions. Second, the proximity to a private health care provider has a positive systematic effect on the mean requested detractions and this effect is non-stationary and much higher in the northern regions and in Calabria.

More generally, it seems that part of the national tax expenditure on health

is used to reward the difference between public and private care; this is not necessarily negative, unless one wonders whether private care is substitute (in terms of quantity/quality/waiting times) or complementary to public care. In policy terms, what kind of health expenditure should the government subsidise, what kind of tax incentive mechanisms, what kind of health planning on the territory should be clear and public information because these choices have a direct impact on equity, public budget and income distribution.
Finally, there is still much to be done from an empirical point of view: richer panel data on the side of quality assessment, reputation and waiting times can make it possible to better describe citizens' choice mechanisms in order to obtain more robust estimates.

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Appendix A. Regional models of management

The decentralisation of health management has given each region the authority to plan and supervise its healthcare services, going beyond mere considerations of quantity, quality, and efficiency. This shift has led to notable alterations in the regulatory framework that governs regional services and their relationships with other institutions. Presently, regions have substantial autonomy in shaping the overall structure of health systems and local health units within their jurisdictions. In this context, different reference architectures can be identified (Pammolli et al., 2020):

1. The Competitive Model: Distinguished by intense competition among regional health sub-organisations, this strategy has been prominently implemented in Lombardy. In this model, citizens enjoy the freedom to select from a diverse range of public and accredited private service providers. Local health units contribute to expense planning and control by establishing activity limits in collaboration with the service providers.

2. The Integrated Model: This approach underscores collaboration and integration within healthcare organisations, irrespective of ownership or classification. It is characterised by thorough negotiation and planning. Various adaptations of this model are observed in regions like Tuscany, Emilia-Romagna, Veneto, or Friuli-Venezia Giulia. Within these service delivery networks, each structure is an integral part of the entire system and complements the others. Regions have chosen negotiated contractual arrangements, often consolidating services in a few larger facilities to streamline costs and improve service quality. The accreditation of new private entities is restricted, subject to meticulous control.

3. The Bureaucratic Model: Dominant in specific southern regions such as Campania, Calabria, and Basilicata, this model is characterised by thorough bureaucratic oversight of the health system. It relies on extensive planning, management control, and limited contractual arrangements. Hospitals receive direct funding from the region through budget cap agreements. Integration or collaboration between private accredited entities and the public sector is weak and frequently inefficient.

In summary, the decentralisation of health management in Italy has given rise to a variety of models with different levels of competition, integration and bureaucratic control in the provision of health services.

Appendix B. Robustness checks

Figure B.1: Health tax detractions at municipal level, average 2018-2021 - outlier check and relative distributions

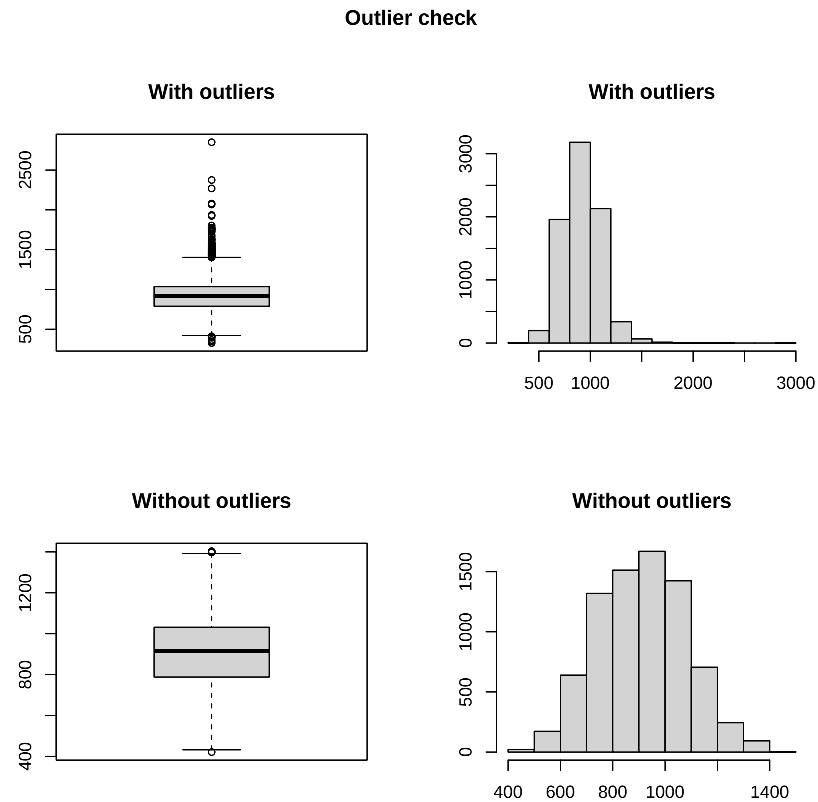

Figure B.2: Moran plot of the municipal average values of health tax expenditure per capita

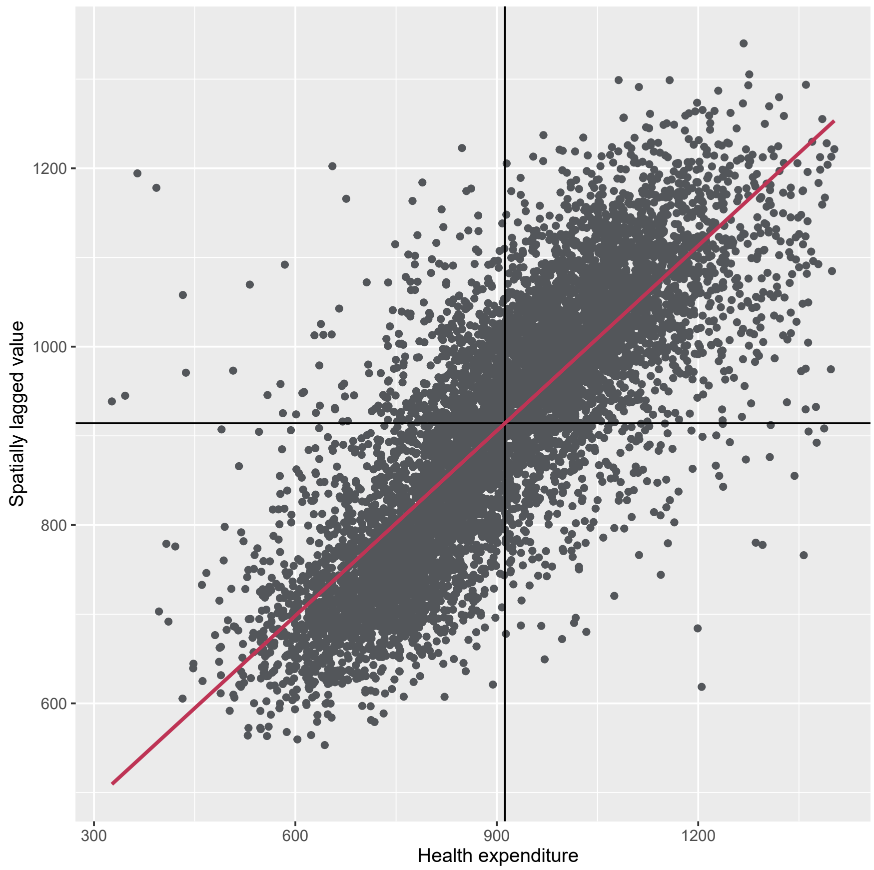

Figure B.3: Kernel densities of the estimated propensity score by treatment level before and after matching

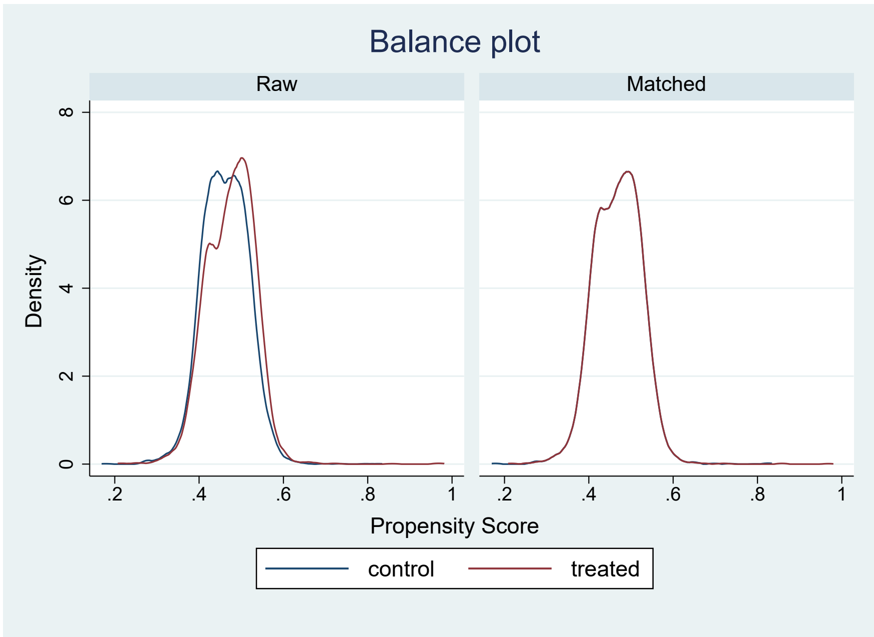

Table B.1: Treatment-effects estimation (ATE coefficients), Treatment model: logit - without municipalities with at least one private hospital and one public hospital within their territory

	Estimator	ATE	Std. err.	z	P>z	[95% conf. interval]	
Closer to private (1 vs 0)	Prop. score	7.440	3.267	2.280	0.023	1.037	13.843
	Augmented IPW	10.349	2.742	3.770	0.000	4.974	15.724
	Nearest-neighbor	8.833	2.946	3.000	0.003	3.059	14.606
	Reg adjust.	10.206	2.692	3.790	0.000	4.931	15.482