Modelling the individual choice of distant hospital care.

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Abstract

Distance has a leading role in allowing or pre-empting hospital care choice. In this paper we single out the determinants of hospital attractiveness once the distance hurdle has been overcome by patients. Patient mobility from the Sardinia Island to the (roughly equally distant) hospitals in the mainland for receiving care makes this exercise easier. By merging the information on hospital characteristics with the administrative data on hospital admissions in Italy for the year 2012, we model patient mobility between alternative hospitals services as a mutually exclusive choice, determined by provider (hospital) level characteristics. Important differences emerge with respect to the role of hospital economies of scale, specialisation in more complex cases, competition indicators and clinical indicator outcomes.

Keywords: hospital choice, health-care demand, health-care and quality, discrete choice models

JEL: C25, I11, I12, I18.

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1 Introduction

The Italian National Health System (NHS) was established in 1978 after the introduction of a general reform that ensured the universal coverage of care and replaced a previous system based on separated national health services organizations. The subsequent problems linked to the national health systems indebtedness have required further reforms, initiated in the early 1990s, introducing quasi markets, managerialism as well as free patient choice (Jommi et al. 2001). These reforms have been accompanied by the regionalization of the NHS, which has become organized in twenty-one regional health services (RHS) with significant autonomy in choosing their own organizational model and to set the mechanism to funding Local Health Authorities (LHA). Free patient choice all over the country, coupled with regional budget responsibility, has been implemented by means of the Diagnosis Related Group (DRG) system. Each admission episode is figuratively reimbursed by the RHS where the patient is enrolled.

In case of extraregional mobility, a bilateral compensation system is at work. This adds an “institutional competition” dimension to the “market” competition in which the elementary providers (i.e. hospitals) are involved. Thus, the economic relevance of extra-regional free patient choice is manifold. First, it generates an incentive to providers to foster quality, especially in a context of fixed prices (eg. Besley and Ghatak, 2003). Second, inter-regional mobility may help small regions to ensure all care services while exploiting economies of scale in the provision of specific health services (Levaggi and Menoncin 2008). However, inter-regional patient mobility may represent a potential source of financial loss for regions with net passive mobility, charged of the compensation of hospital treatment outside region while incurring in the fixed costs needed for ensuring care to the rest of the enrolees in their RHS.

When the unit of analysis is the single patient, the potential determinants of hospital choice and patient mobility refer both to the demand side (namely, patient characteristics such as education level, income and age), and to supply characteristics (“structure factors” such as the availability and accessibility of the providers. “Process factors” like the availability of information, continuity of treatment, waiting time and quality of treatment. “Outcome factors”, often in the form of objective indicators such as e.g. mortality statistics) (see Victoor et al. 2012, for a survey).

To the eye of the researcher, most of hospital’s quality in the Italian NHS takes the form of a latent variable, not appearing in the data, but effectively shaping patient’s decisions. The unique dimensions that can be unveiled are constituted by a series of indicators directly monitored by hospital discharges records of the Ministry of Health (such as the case mix index), and a new series of clinical outcomes (such as thirty-day Acute Myocardial Infarction (AMI)) monitored in the so-called “Programma Nazionale Esiti”(PNE), similarly to other international monitoring programmes such as the “NHS Outcomes Framework Indicators” in the UK.

Most of hospital “choice” is driven by distance and accessibility. However, at least in Italy, movements towards very distant hospitals represent an important part of overall inter-regional patient mobility. In this environment, the island of Sardinia represents an excellent case study. By exploiting its peculiar geographical location, which does not experience the typical bordering and neighbouring spillovers effects of most European regions, we are able to assess to what extent patients’ mobility towards distant hospital care constitutes a distinct phenomenon with its own intrinsic characteristics. Moreover, given the above-mentioned geographical location and the related costs associated with the decision to move to a hospital outside region, we can better appraise how health-care quality affects patient decisions.

This paper is structured as follows. In section 2 we review the literature on hospital choice. The following two sections describe respectively the data and key variables and the econometric model we are estimating in our analysis. Finally, section 5 contains and summary conclusion of the results and a discussion.

2 Related literature and approach

Patients in different European Health care systems are allowed to choose their favourite health-care provider within the country (e.g., Denmark, Netherlands, England, Sweden, Italy). The intuition behind patient choice is that, in a contest of fixed prices, providers of care will compete only in quality, and not in costs, in order to attract more patients (Gaynor et al. 2010, Gaynor and Town 2012).

Individual patient choice within European countries has been modelled in a number of studies, in which both structural and quality characteristics have been considered. The benefit of using "objective" indicators of healthcare quality is debated. For some scholars there is only evidence of a residual role (Rademakers, Delnoij and de Boer 2011). Selecting a good quality provider is not an easy practice for patients because of difficulties linked to data access and for patients' inability to understand quality rank measures and trust them. Furthermore, patients seem to follow friends and parent's advice rather than consider public information. In addition, evidence shows that only few patients analyse quality measures before taking a decision (Epstein and Schneider 1996, Cutler et al. 2004). In contrast, for some others the role is important. For example, Beckert et al. (2012) using patient-episode level data for elective hip replacements patients in England find that hospital demand increases with quality. Likewise, Santos et al. (2015) examining whether the choices of family doctor practices are affected by differences in the quality of the health services, they suggest that patients are more likely to seek care in practices with higher quality.

In the health choice literature, it is shown that there are other factors that may affect patient choice. For example, Varkevisser, van der Geest and Schut (2012) analysing the relationship between hospital quality and patient hospital choice for angioplasty in the Netherland find that patients are more likely to choose hospitals with a good reputation. Similarly, according to Messina et al (2003), patients would be willing to leave the hospital near home to the one with a better reputation, which provides them a higher utility level.

In the same line, other studies suggest that distance, quality rankings and waiting times may play a role in the probability of a hospital being chosen. This is the case of Beukers et al (2013), when investigating the determinants of patient choice for non-emergency hip-replacement over the years 2008-2010. Furthermore, Moscone et al. (2012) using data on all patients admitted to any hospital in Lombardy, show that geographical factors, such as the distance from the hospital, are important factors for patient hospital decisions.

Studies of patient hospital' choice determinants in the US have shown similar findings. For example Pope (2009), using Medicare data on all patients hospitalized in California and a sample of other bordering hospitals, finds that hospital rankings and geographically proximity affect patient choice. Another paper by Luft, Garnick, Mark et al (1990) has focused on patient choice in three geographic areas in California in the year 1983. They use a conditional logit model to analyse the influence of quality, ownership and distance in patient hospital choice. Their results suggest that patient flows are positively associated with high hospital quality. Moreover, they find that teaching hospitals are more likely to be chosen by patients.

Other studies on hospital choice find evidence that patients seem to respond positively to some attributes related to hospital capacity. For example, Roh et al. (2008) examining data from Colorado rural patients receiving Major diagnosis category (MDC) 14, show that patients are more likely to prefer hospitals with more services and with higher market share. Likewise, by examining data on Colorado rural patients, Roh and Moon (2005) find that hospital characteristics, such as the number of beds and the hospital ownership influence patient hospital choice.

3 Data and key variables

We use patient-level data provided by the Ministry of Health, which can provide us information on all patients enrolled in Sardinia and admitted to any hospital in Italy for the year 2012. In order to concentrate on actual patient choice, we focus on *"elective"* admission episodes by excluding from the data set all patients admissions considered as emergencies and for which there is not a doctor prescription.

Starting from that, two very different-in nature populations have been considered:

i. admissions for the five most common Major Diagnostic Categories (MDC) entailing extra-regional mobility (mdc 8-musculoskeletal system and connective tissue diseases; mdc 5-circulatory system disorders; mdc 1-nervous system disorders; mdc 6-digestive system disorders and mdc 17-myeloproliferative disorders mdc 17)[1].

ii. cancer admissions, which show the highest percentages of mobility.

In order to limit the analysis to a manageable set of alternatives, we consider all hospitals with at least 20 yearly discharges (in the case of cancer treatment) and 50 discharges (relatively to MDC admissions) referable to Sardinian residents

A small share of admissions was dropped from the analysis when referring them whether at the hospital or at the patient level. In the first case, we excluded those admissions with missing or invalid region codes (origin and destination) as well as without the specification of the ownership type. At the patient level, we dropped admissions without a major diagnostic code and those referred to patients with missing values for sex and age. Overall, we ended up with 81573 admission episodes in the first case and 40409 admissions in the case of cancer distributed among 54 hospitals in both cases.[2]

We consider all these records as the outcome of a "hospital choice" process, in which patient's choice set is composed of all potential 54 hospitals included in the sample. By

[1] Note that we have decided to exclude from our analysis the MDC 13 (Diseases and disorders of the female reproductive tract), on the grounds that this kind of interregional mobility could be mainly driven by "privacy" motives.

[2] Though the total number happened to be the same, the two sets of hospital do not coincide.

combining the information from the Hospital discharge dataset with the additional information from the database of the facilities of the Italian NHS, we are able to condition the choice to the following wide set of hospital-specific characteristics.

Hospital capacity, measured by the number of beds. This is a commonly used attribute about hospital choice literature (Addams et al. 1991, Goodman et al. 1997, Tay 2003). As suggested by Porell and Adams (1995), patients seem to prefer not only highly qualified hospitals, but also hospitals with more beds and with more services. In general, hospital capacity is shown to affect the probability of choosing or not a hospital. However, this is also a controversial variable because a high number of beds in hospital may raise problems of inefficiency.

Doctor intensity, measured by the ratio between number of doctors and number of beds. We expected that a high number of doctors per beds will be able to influence positively the inflow of patients.

Distance in kilometers of patients *i* to hospital *h.* This variable is expected to capture the disincentive effect generated by the cost of mobility.

Hospital type. We construct two dummy variables taking value 1 respectively when the hospital is a teaching or a private accredited institute.

Case mix index (CMI). This publicly monitored variable is calculated as the ratio between the average weight of admissions in a specific hospital and the average weight of admissions in the whole National Health System (NHS). The CMI reflects the clinical complexity (measured in terms of resource use intensity) associated with the need for more specialized hospital care (Buczko 1992, Tai et al. 2004). A value of the indicator higher (or equal) to 1 indicates a greater clinical severity compared to a set of reference hospitals. *Market share* . We use the market share measured by the ratio between the number of discharges in hospital *h* over the period and all discharges within the LHA over the same period of time. We look at this measure to analyse the size of a hospital and its ability to attract patients compared to its competitors. The higher the value the greater is the competitiveness and the patient perception of a hospital ability to provide services and generate business.

Hospital location (Rac). We finally consider whether a hospital is located in a regional administrative center or not.

Hospital performance (in terms of Acute Myocardial Infarction – AMI - *Mortality Rate)*. We exploit the information from the Programma Nazionale Esiti (PNE) as an "objective" indicator of hospital or district quality. An argument in support of the use of the aforementioned indicator is provided by Romano and Mutter (2004). They suggest that using AMI mortality it is possible to bypass "problems associated with unobservable differences in patient severity". We introduce both a "raw risk" and an adjusted one.

The descriptive statistics for our study samples are shown in Table 1.

TABLE 1. Descriptive statistics

		MDC				Cancer			
Variable name	Description	Mean	SD	Min	Max	Mean	SD	Min	Max
Patient characteristics									
Dist	Distance of patient *i* to hospial *h* (in Km)	255.43	235.63	0	726.80	259.25	235.03	0	726.80
Hospital attributes									
Case mix index (CMI)	ratio between the average weight of admissions in a specific hospital and the average weight of admissions in the whole NHS	1.03	0.22	0.74	1.71	1.01	0.16	0.74	1.43
Size (number of beds)	number of beds per hospital	377.74	441.43	26	1610	472.43	547.98	26	2270
Number of doctors per n. beds	number of doctors in hospital *h*/number of beds in hospital *h*	0.66	0.29	0.01	2.15	0.67	0.28	0.24	2.15
Teaching	1 if hospital *h* is teaching	0.37	0.48	0	1	0.39	0.49	0	1
Private accreditated hospitals	1 if hospital *h* is private accreditated	0.28	0.45	0	1	0.22	0.42	0	1
Market share	ratio between the number of discharges in hospital *h* and discharges within the LHA	0.24	0.24	0.01	1	0.26	0.24	0.01	1
Regional administrativ center (RAC)	1 if hospital *h* is located in a regional administrative center	0.39	0.49	0	1	0.41	0.49	0	1
Deaths for acute myocardial infarction (AMI) within 30 days (Rgrez)*	number of death within 30 days/number of admissions for myocardial infarction X100	15.5	12.0	0	50	15.78	11.86	0	50
AMI Risk adjusted (Radj)**	number of death within 30 days/number of admissions for myocardial infarction X100 adjusted for counfounding factors	11.19	3.62	5.16	16.92	11.58	3.30	6.05	16.92

* The descriptives on Ami Rgrez have been calculated on 39 hospital structures

** The descriptives on Ami Radj have been calulated on 20 hospital structures

4 Empirical analysis

4.1 Econometric approach

In principle, each admission episode can be seen as the result of a "choice" by a sample of $i = 1, 2, \ldots, N$ patients over a choice set of $h = 1, 2, \ldots, H$ mutually exclusive hospitals. This choice can be described by means of a random utility specification such as the following:

$$U(\text{choice } h \text{ by patient } i) \equiv U_h^i = V_h^i + \varepsilon_h^i = \boldsymbol{\beta}' \mathbf{x}_h + \varepsilon_h^i,$$

where the elements of the vector $\mathbf{x_h}$ may either refer to hospital characteristics, or be individual-specific. Individual utility is given by the sum between an observable component V_h^i and a stochastic unobservable component ε_h^i. In the present study, the elements included in the vector are the hospital attributes described in the previous section.

By assuming that the individual random components $\boldsymbol{\varepsilon}_h^i$ are independently and identically distributed (IID), with an extreme value type 1 (Gumbel) distribution, we get the "conditional logit" model,[3] in which the likelihood that patient i is admitted to hospital h is:

$$P[\text{hospital} = h] = \frac{\exp(\boldsymbol{\beta}' \mathbf{x}_h)}{\sum_{l=1}^{H} \exp(\boldsymbol{\beta}' \mathbf{x}_l)}.$$

4.2 Identification strategy of "distant care" attraction factors.

Several approaches can be adopted in order to assess whether the main explanatory factors in the vector $\mathbf{x_h}$ play the same role independently of the hospital being near or far from patients' place

[3] The IID assumption leads to the so-called independence of irrelevant alternatives (IIA) property, which states that the odds between two generic alternatives k and l is independent of the presence of additional alternatives other than k and l (McFadden, 1984). When there are subsets of similar alternatives, this independence condition may prove very strong.

of residence. In the present draft, we exploit the fact that insularity creates a clear dichotomy between regional hospital (accessible by car) and “mainland” hospitals, which different distance is in practice “normalised” by the necessity to take a flight. The control for the presence of differential effects is obtained by interacting each hospital characteristic with a “Sardinian hospital dummy”. This entails estimating the coefficients in the upper part of the Table for distant hospitals located in the mainland Italy. By doing this, we can better identify the reasons that drive patients to a particular hospital to get a specific treatment, once the distance hurdle has been overcome.

4.3. Results

The main results from the application of the Conditional Logit model to our dataset are presented in the Table 2 and 3, which reports four estimates for the sample of main MDCs (models 1a, 2a, 3a, 4a) and four for cancer DRGs (models 1b, 2b, 3b, 4b). Model 1a (1b) constitute baseline specifications that only differ from the exclusion/inclusion of interactions between hospital-level characteristics and a geographical dummy indicating whether the hospital is “near” (namely, located in Sardinia), whereas Model 3a and 4a (3b, 4b) are enriched by the presence of a basic death indicator for Ami and by the Ami risk adjusted respectively.

In models 1a it can be seen that all hospital attributes have and explanatory power in choosing the place of treatments given that the coefficients are statistically significant. The positive sign of the *case mix* indicator points out a direct relationship between specialization in relatively complex treatments and likelihood of choice of a given hospital.

The hospital capacity variable has been included both in levels and quadratic terms. This has allowed us to detect a significant non-linear behaviour, which entails a maximum positive impact on the choice probability for a size of about 725 beds (average size in the sample is 378). Similarly, the coefficient of the *number of doctors per beds* is positive and significant, which suggest that a higher intensity of doctors may be perceived by the patients as a signal of better hospital care (Moscone et. al 2012).

As expected, geographical distance has a negative and significant effect on patient choices. The positive sign of the quadratic term points out that the effect becomes relatively smaller for higher distances, suggesting us the likely presence of fixed switching between local hospitals and distant destinations.

The hospital type dummies must be evaluated with respect to the baseline category of public hospitals. Our regressions display small positive signs for *teaching* and *private accredited* hospitals. The first result could be the by-product of the public reputation of teaching institutes. The result for private accredited structures could be consistent whether with a demand-side or a supply-side interpretation. In fact, the positive sign may whether reveal that patients are more willing to choose a private for some intrinsic characteristics (e.g. reduced waiting lists, personalized care), or that private property makes hospitals more prone to carry out active policies aimed at attracting patients.

With regard to the market share, we find a significant and positive effect. This is in line with the simple fact that the larger the market share, the better will be the services a hospital will be able to offer to their patients.

We also see that *Rac* is positive and significant. There are two possible explanations for this result. First, a higher choice probability for hospitals in regional administrative capitals could reflect the geographical concentration of very specific treatments and doctors with high reputation. Furthermore, access to health services in these areas may be easier for patients, especially in the case of distant hospitals located in the Mainland.

Focusing on distant hospital care

Several interesting differences emerge from the estimation of the models with interaction terms (2a,3a and 4a), which represents the bulk of our analysis. Note that, overall, the value of the pseudo R^2 indicates a better fit of the estimated model than without interactions.

i. though positive, the effect of case mix increase is much smaller for distant hospitals: namely, in the linear effect, we have 0.933 for Mainland hospitals vs 1.402 for Sardinia;[4]

ii. a different reasoning applies to the attraction role of *Rac*, who seems be a positive and significant determinant of distant hospital choice.

iii. The role of teaching and privately accredited hospitals *vis à vis* public institutes is totally different. In the case of distant hospitals in the Mainland, these attributes clearly reduce the probability of admission. Conversely, they are positive drivers of patient mobility in the case of Sardinian hospitals.

iv. Doctor's intensity is a much stronger positive choice determinant for distant hospitals. This highlights a very strong role for an adequate "equipment" of human capital.

v. The market share indicator positively affects the choice probability of distant hospitals, while a negative effect is found for Sardinian hospitals. This suggests that positive externalities between near hospitals are mainly operating in the Mainland, where presumably hospitals experience a higher competitiveness.

In the specification 3a, the model with interactions is augmented by introducing a first indicator of hospital' quality (*Rgrezz*).[5] Model 3a shows that this measure has two opposite and significant effects: negative in the case of distant choice, while positive on patient flows in Sardinia. To better consider the effect of quality on hospital demand, in model 4a we include the risk adjusted mortality for acute myocardial infarction occurring within 30 days of first admission. Unlike the variable used in model 3a, the abovementioned measure is considered more accurate since it can take into account effects due to confounding factors (such as age, sex, comorbidities, et.). The drawback, at least in the present analysis, is the lack of information for

[4] Taking a different viewpoint, the result suggests that a case mix increase in Sardinian hospitals would effectively restrain extra-regional outflows.

[5] Though the literature considers the subsequent indicator (risk adjusted) much more reliable, the use of this one enables us to keep most of the hospitals in the analysis.

many structures (only 20 hospitals), which entails higher risks of sample selection bias. It is interesting to note that this quality measure has a negative and significant effect on patient outflows, but with a smaller effect in the case of “near” hospitals.

In Table 1b, we present the results from the models related to cancer treatments. Model 1b shows that the choice probability is positively correlated to the hospital case mix. Apparently, specialization in cancer DRGs does entail a specialization in expensive treatments. In this case, the use of hospitals’ CMI as an indicator for assessing the quality of healthcare specialization would nowadays constitute a “red herring”. The effects of the remaining explanatory factors confirm substantially the findings for the main MDCs.

Model 2b, 3b and 4b report the estimated results for the regression with interactions. The estimates in the upper part of the Table detect some important results for distant hospitals. First, hospital size is a poor predictor of the probability of choice. By assuming that Sardinian patients are exploiting some shared information on the good quality of treatments not revealed from the data, this implies the lack of economies of scale in cancer treatments. It should be emphasized, the very strong dichotomy regarding hospital doctors’ intensity.

Finally, looking at the specification reported in model 4d we can see that the AMI risk adjusted does have a positive effect in the choice of distant hospitals. However, these results must be examined carefully since the downsizing of the dataset, due to the lack of information on AMI risk adjusted for different structures, it may cause, as already mentioned, problem of selection bias.

TABLE 2. Conditional logit model of patient choice for main MDC admissions

	Mdc (8-5-1-6-17)											
	Model 1a			Model 2a			Model 3a			Model 4a		
	Coeff.		SE	Coeff.		SE	Coeff.		SE	Coeff.		SE
Distance	-0.0380262	***	0.0001384	-0.0116319	***	0.0010009	-0.0151547	***	0.0017652	-0.0267256	***	0.0035086
Distance^2	0.0000367	***	0.0000002	0.0000113	***	0.0000010	0.0000135	***	0.0000017	0.0000231	***	0.0000032
Case mix index	2.0727820	***	0.0380324	0.9332107	***	0.1666775	1.4429310	***	0.3225245	2.1141510	**	1.0223970
Size (number of beds)	0.0029063	***	0.0000603	0.0038661	***	0.0003554	0.0063671	***	0.0006733	0.0064587	***	0.0013260
Size^2	-0.0000018	***	0.0000001	-0.0000024	***	0.0000002	-0.0000034	***	0.0000003	-0.0000032	***	0.0000006
Number of doctors per n. beds	0.3019903	***	0.0151017	0.9315361	***	0.1952073	0.6240544	*	0.3806916	-2.1304820	***	0.6190690
Teaching	0.4992834	***	0.0151721	-1.6322050	***	0.2553772	-1.4612010	***	0.4259028	7.6137630	***	2.5273010
Private accredited hospitals	0.1842982	***	0.0116350	-0.4892340	***	0.0615153	0.0117797		0.1311735	0.4455642	**	0.2148477
Rac	0.8096018	***	0.0141433	1.0798630	***	0.0992720	1.3058140	***	0.1928235	0.4797104	**	0.2319895
Market share	1.1017050	***	0.0216763	1.3743440	***	0.2532736	1.5754160	***	0.5539083	0.9660762		0.5965340
Rgrez							-0.0698309	***	0.0155637	-		
Radj										-0.0565317	***	0.0198218
Dummy regio	Yes			No			No			No		
<u>*Interactions*</u>												
Distance*dsar				-0.0403804	***	0.0010370	-0.0379591	***	0.0017943	-0.0336693	***	0.0035216
Distance^2*dsar				0.0001421	***	0.0000021	0.0001295	***	0.0000029	0.0001629	***	0.0000043
Case mix index*dsar				1.4023310	***	0.1720111	1.5756670	***	0.3273585	5.6286500	***	1.1862940
Size*dsar				0.0032785	***	0.0003840	0.0000784		0.0006949	0.0041185	***	0.0013995
Size^2*dsar				-0.0000063	***	0.0000003	-0.0000048	***	0.0000004	-0.0000160	***	0.0000012
N. doctors per beds*dsar				-0.5594829	***	0.1959001	-0.3768353		0.3813853	3.0700770	***	0.6343735
teaching*dsar				2.3407420	***	0.2559040	2.3423810	***	0.4274585	-5.2737770	**	2.4922100
Private accredited hospital*dsar				0.7099233	***	0.0625627	0.0699454		0.1325420	-		
Rac*dsar				-0.3630777	***	0.0999962	-0.6090268	***	0.1939835	0.7150401	***	0.2393960
Market share *dsar				-0.6537078	***	0.2541245	-0.8210312		0.5544421	1.2607290	**	0.6107538
Rgrez*dsar							0.0722763	***	0.0155721	-		
Radj*dsar										-0.0373354	*	0.0221861
Log Likelihood	-202901.28			-200220.81			-129121.74			-52879.89		
Pseudo R2	0.38			0.38			0.46			0.60		
N. of admissions	81573			81573			65060			43770		
N. hospitals	54			54			39			20		

TABLE 3. Conditional logit model of patient choice for cancer-related admissions

	Cancer											
	Model 1b			Model 2b			Model 3b			Model 4b		
	Coeff.		SE	Coeff.		SE	Coeff.		SE	Coeff.		SE
Distance	-0.0385381	***	0.0002035	-0.0141184	***	0.0010595	-0.0160619	***	0.0028647	-0.0280911	***	0.0040733
Distance^2	0.0000424	***	0.0000003	0.0000173	***	0.0000011	0.0000164	***	0.0000026	0.0000281	***	0.0000040
Case mix index	1.0404650	***	0.0569462	-0.4564996	**	0.2059509	-7.1153660	***	0.6114349	10.1388000	***	2.1296180
Size (number of beds)	0.0024178	***	0.0000833	-0.0014999	***	0.0003236	-0.0068530	***	0.0006805	0.0051826	**	0.0022202
Size^2	-0.0000016	***	0.0000001	0.0000005	***	0.0000001	0.0000009	***	0.0000003	0.0000001		0.0000007
Number of doctors per n. beds	0.0988344	***	0.0310976	2.0228490	***	0.1962773	-3.6117160	***	0.5304565	2.5484520	*	1.4211390
Teaching	0.5111152	***	0.0208878	-0.1082449		0.1356272	9.1031680	***	1.1677570	-15.6234400	***	3.5376110
Private accredited hospitals	-0.5827781	***	0.0207736	0.2930229	***	0.0752243	2.2522420	***	0.2071550	0.2729480		0.3877927
Rac	1.6308350	***	0.0223966	0.9178833	***	0.1048969	6.2568840	***	0.4427303	-2.8512420	**	1.3211060
Market share	1.3724310	***	0.0317708	1.7714750	***	0.3183293	16.9797400	***	1.2574610	-6.3600930	*	3.2995110
Rgrez							-0.0480037	***	0.0156309	-		-
Radj										0.0854463	***	0.0213514
Dummy regio												
<u>*Interactions*</u>												
Distance*dsar				-0.0310479	***	0.0011315	-0.0310373	***	0.0028965	-0.0258311	***	0.0040971
Distance^2*dsar				0.0000844	***	0.0000031	0.0000858	***	0.0000044	0.0001144	***	0.0000059
Case mix index*dsar				1.5676060	***	0.2140282	8.0378580	***	0.6247469	-12.7409000	***	2.2390350
Size*dsar				0.0150744	***	0.0003821	0.0174595	***	0.0007261	0.0064352	***	0.0023191
Size^2*dsar				-0.0000199	***	0.0000003	-0.0000140	***	0.0000005	-0.0000096	***	0.0000016
N. doctors per beds*dsar				-1.6978010	***	0.1991612	3.5812660	***	0.5331053	-2.8259610	**	1.4310340
teaching*dsar				1.0118730	***	0.1372327	-8.5348120	***	1.1662940	15.5851000	***	3.5004350
Private accredited hospital*dsar				-0.9723711	***	0.0788133	-2.2852880	***	0.2103255	-		
Rac*dsar				0.3121548	***	0.1070788	-4.9483450	***	0.4456343	3.4084830	***	1.3229690
Market share *dsar				-1.4376600	***	0.3204778	-15.9623300	***	1.2592470	6.9804570	**	3.3018640
Rgrez*dsar							0.0655565	***	0.0156485	-		-
Radj*dsar										-0.1083902	***	0.0254239
Log Likelihood	-98693.51			-96200.94			-60628.40			-27602.53		
Pseudo R2	0.39			0.40			0.46			0.56		
N. of admissions	40409			40409			30745			20718		
N. hospitals	54			54			39			20		

5 Conclusions

In this paper, we investigate the effect of main characteristics on patient hospital choice for cancer and for five MDC treatments. Using data from all patients enrolled in a Sardinian LHA for the year 2012, we exploit the geographical location of Sardinia to model hospital admissions by means of a multinomial logit model. Our findings substantially confirmed what we expected on the basis of the literature related to hospital choice. The most effective pull factors are the number of beds, doctor intensity and low distance.

However, several differences in the estimated effects can be drawn from some indicators in the two samples of hospital admissions. Focusing on the MDC sample, we find that the case mix index affects positively the odds of a hospital being chosen, even if the effect is smaller for distant hospitals. Moreover, the *Ami risk adjusted* displays significant effects on the subsample of hospitals for which information are available. Moving on the econometric analysis for cancer treatments, we find that the choice probability is inversely correlated to the hospital case mix. Probably, after getting a medical consultation outside region, patients prefer receiving expensive treatment in hospitals near home. In addition results for distant hospitals shows that private accredited hospitals are good predictors of hospital choice.

Overall, attractiveness of distant hospital appears as a quite distinct phenomenon, for which many of the existing findings in the literature (dealing with short-run mobility) must be carefully re-considered (e.g. the role of economies of scale, especially for cancer treatments).

Future research should include data on Southern Italian LHAs in order to better understand the characteristics driving patient choice of distant hospital care, and whether the existence of bordering effects change the empirical evidence discussed in this work.

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