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Hospital choice with high long-distance mobility

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Abstract

Long distance hospitalizations may represent an important phenomenon, especially in the case of very serious pathologies. In this work we investigate patients’ elective admissions for cancers of the digestive system by distinguishing between (local) hospitals located in the region of residence and (distant) hospitals located at very long distances in other non-boundary regions. We study the determinants of hospital attractiveness by considering patients who might engage themselves in long distances moves. At this purpose we exploit data on admissions of patients enrolled in the local health authorities of the two insular Italian regions who occurred either in the region of residence or in hospitals of the Centre-North. We model patient mobility towards alternative hospitals as a discrete choice process determined by hospital-level characteristics, geographical distance and clinical quality. We present results from a mixed logit model that controls for patients’ heterogeneity. Clinical quality has a relevant role in the choice of distant hospitals whereas it does not affect the choice of local hospitals. Important differences emerge with respect to the role of hospital pull factors. We estimate that patients are willing to travel at least 14 km to be cured in a distant hospital for a clinical quality increase from the 75th to the 25th percentile. The willingness to travel is much larger for younger and higher educated patients. Our findings support the idea that long-distance mobility is a distinct phenomenon as compared to short-distance hospital choice.

Keywords: hospital choice, health-care demand, quality of care, discrete choice models
JEL codes: C25, I11, I12, I18.

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1 Introduction

In several publicly funded healthcare systems in Europe, patients are entitled to choose the provider for elective hospital care services among different providers. According to a large part of the literature on hospital choice and competition, patients' demand seems to react to quality changes. When prices are regulated, and hospital care is free at the point of use, the competition deriving from institutional arrangements on patient choice leads to improvements in the quality of hospital care services (Beckert et al., 2012; Brekke et al. 2014; Gaynor et al., 2013; Gaynor and Town, 2012). Likewise, when patients have great scope for hospital choice, high quality hospitals display higher market shares (Chandra et al., 2016).

Scholars have deeply examined the choice of hospital for specific elective treatments using patient-episode level data. In hospital demand functions, a key role is played by the relationship between distance and quality, because patients take both into account when seeking specific elective care (Gutacker et al., 2016). The empirical literature clearly shows that patients are willing to travel beyond the nearest hospital for their care, and that clinical quality (typically measured by mortality and readmission rates after inpatient hospital treatments) has an important role in driving individuals' choices of hospital.

However, the extant empirical studies on patients' hospital choice have mainly analysed hospitalizations that, due to the very nature of the healthcare context under analysis or due to data selections decided by researchers, are characterised by relatively short distances between patients and potential hospitals (for a review, see Aggarwal et al., 2017a). Hence, the focus was specifically on patients' movements within a restricted area, mainly internal to a local or a regional healthcare system, as in Guthacker et al. (2016) and Moscelli et al. (2016). The former find that a provider's demand is less and less elastic to quality changes in the other providers as the distance between providers increases. The latter study finds that for providers facing more rivals the demand is more elastic with respect to own clinical quality. However, both studies only consider hospitals that are maximum 30 km distant. Because competition is restricted to nearby hospitals (where a somewhat arbitrary threshold is used to define the geographical area of analysis), the validity of findings and policy implications on the effect of quality and distance on the choice of hospital is limited to contexts where patients can only choose between the nearest hospital and hospitals located in contiguous areas.

Departing from the constraint of closeness between patients and hospitals, opens up to new research questions about the interplay between distance and quality when the choice set is enlarged to very distant hospitals. It is crucial to understand whether and to what extent distance and quality of care differently influence the choice of hospital once considering not only the nearby hospitals but also the farthest ones. Is the relatively low demand for distant high-quality institutes only due to the offsetting disutility deriving from higher distances? Does the effect of quality change for faraway providers?

Long distance mobility for hospital care can be a relevant phenomenon. In 2016, in the Italian National Healthcare Service (NHS), where patient choice was allowed both within and across regions 25 years ago, 4.8 per cent of overall hospital admissions of residents in the southern (and poorest) regions (the Italian Mezzogiorno) took place in the northern regions.[1] This means that patients have experienced travels that covered not less than 350 kilometers. Another country for which we have found information on long distance mobility is Australia, where 3 per cent of patients have been classified as inter-state travellers (Spilsbury et al, 2015). In England, in years 2012-2013 2.7 per cent of patients bypassed the ten nearest hospitals for hip replacement surgery, though up to fifty-one hospitals could be available in a range of fifty km (Moscelli et al., 2016); while in 2014 2.5 per cent of patients undertaking radical radiotherapy for prostate bypassed the five nearest hospitals (Aggarwal et al., 2017b).

Understanding long distance hospital mobility is important in order to nourish the debate about centralization of complex treatments in high volume centers (e.g. Birkmeyer et al., 2002;

[1] Data from the Italian Ministry of Health (2017).

Gaynor et al., 2005; Learn and Bach, 2010) or that about policies of hospital consolidation and closure (e.g. Lu and Slusky, 2016). Whether such re-framing of national health care markets is effective, it will largely depend on the actual accessibility of specialised care poles to the whole population.

To the best of our knowledge, the peculiarities of long distance mobility have not been investigated in depth within a hospital choice framework. We study the demand for local and distant elective hospital care in Italy, where free patient choice has resulted in considerable movements of people to what they consider the best hospitals, even when located in very distant regions and despite the costs of travelling. In the Italian NHS patients do not need a GP's referral for receiving elective inpatient care in a specific hospital, and this rules out any problem in interpreting the nature of the choice. The Italian case is interesting because the economic geography of the country is characterised by a clear north-south economic divide that is reflected in differences between regional systems in terms of healthcare expenditures, quality and efficiency of services. Thus, the typical periphery-center pattern characterising hospitalizations at the local level is replicated at the national scale. Larger (hub) hospitals are located where the population and the economic activity are more concentrated, and teaching hospitals as well as specialised treatment and research hospitals are generally located close to universities, which are mostly placed in the main big cities of the North and (in part) of the Centre. This explains why an important share of southern patients not only bypass their nearest hospital, but also move towards hospitals that are very distant in kilometres and travelling time.

In this work we use administrative data on hospital discharges occurred in 2013 in the Italian NHS. We focus on elective admissions for neoplasms of the digestive system, which represent one of the three big killers together with lung and breast cancers. Elective cancer treatments often require high specialization levels, and usually come out of a previous planning of the hospitalisation and related outpatient treatments. Nationwide indicators on outcome quality, namely post-discharge 30-days mortality rate, are available at the hospital level for digestive system cancers.

We study in a unified empirical framework patients' choice for "close" and "distant" hospitalizations, where special attention is paid to changes in the substitution pattern between outcome quality and distance when potential hospitals in the choice set are located at very long distances (in the order of several hundred kilometers). In order to have a clear distinction of the definitions of geographic closeness and distance, we exploit the insularity condition of two regions, Sardinia and Sicily. The advantage of this strategy is threefold. Firstly, these two regions do not accidentally "trade" patients between each other, thanks to the absence of the typical bilateral flows that characterise bordering "mainland" regions. Secondly, because of the geographical condition, their residents have to take a flight or a ferry to reach (very distant) hospitals located in central and northern Italian regions. In spite of that, in 2013 outflows of patients resident in Sardinia and Sicily towards northern-central hospitals for elective care counted for 5.7 per cent of total admissions. Focusing the analysis on care for digestive system cancer, the outflow rate nearly doubled (10.7 per cent).[2] Thirdly, by including only local (i.e., located in the region of residence) and very distant hospitals, the choice set of alternative hospitals has a manageable size for the empirical modelling without imposing any additional relevant arbitrary restriction.

We model the hospital admission process in a mutually exclusive choice framework by means of discrete choice regression models, that descends from an individual utility function where the attribute parameters are allowed to vary across "local" and "distant" hospitals. We address unobservable heterogeneity in individual preferences by estimating mixed logit regression models where coefficients of quality and distance are random parameters. Observable heterogeneity between individuals is captured by allowing the distance and quality parameters to vary with individual socioeconomic characteristics. The share of individuals who moved towards

[2] Own calculation. See Section 3 for details on the sample of discharge cards under analysis.

very distant hospitals (those located at more than 215 km of distance from the LHA of enrolment) varies by age group and educational attainment: it decreases with age and increases with education with the highest share for individuals younger than 50 (21 per cent) and for those with tertiary education (28 per cent).

We find that, by considering long-distance hospitalizations, patients' willingness to travel for a decrease in 30-days mortality rate from the 75th to the 25th percentile takes values of at least 14 km, well above the smaller effects detected from the existent literature.

This paper is structured as follows. Section 2 provides a review of the relevant literature on hospital choice. Sections 3 illustrates the main features of the econometric model for hospital choice, while section 4 describes the data and variables used in the analysis. Section 5 presents the results. Summary conclusion and a general discussion of the main findings can be found in Section 6.

2 Related literature

Considering hospital choice within a standard framework of product differentiation, it is natural to characterize each "provider" in terms of location (relative to the patient) and quality. While location can be expressed in terms of a unidimensional measure (e.g. physical distance or travel time), quality typically has a multidimensional characterization where, citing a classification introduced by Donabedian (2003), *structure*, *process*, and *outcome* factors play a concurrent role. The first two are easily interpreted as inputs of a healthcare production function, whose outcome is typically summarized by objective clinical indicators.

Though outcome quality indicators are the subject of most studies, there is some awareness that a unilateral focus on these indicators can lead to misleading conclusions (e.g. Romano and Mutter, 2004). Structure and process determinants of the hospital ability to attract patients (sometimes generically considered as *inputs*) are considered when studying the determinants of hospital choice. This is the case of the seminal papers by Luft et al. (1990), in which patient choice in three geographic areas of California is conditioned both on clinical indicators (in-hospital mortality and post-operative complication) and structure factors such as hospital ownership; and Tay (2003), where hospitalizations for acute myocardial infarction in the U.S. are explained by quality indicators including ordinary and high-tech services as well as clinical measures (1-year mortality and complication rates of admitted patients).

In the last fifteen years, the scientific debate has been focusing on a few specific issues. One of these, regards the advantages of disseminating the hospital-level clinical quality measures to the public with the aim of increasing the demand responsiveness to quality and the ultimate goal of improving health outcomes. Berta et al. (2016) show that, when prices are fixed and information about hospital quality is not publicly available and patients choice is influenced by local information or social interaction, competition among providers does not lead to better health outcomes. In the presence of public reports on hospital outcomes, the effect of quality on patients' choice is generally strong, as shown by Pope (2009) with regard to the "America's Best Hospitals" rankings, and by Varkevisser et al. (2012), and Beukers et al. (2014) with regard to a few quality ratings for Dutch hospitals. A relevant exception is a study based on the publication of coronary artery bypass graft (CABG) quality scores for cardiac surgeons in Pennsylvania (Epstein, 2010). They find that "rational choices" seem to have taken place independently of the availability of report cards.[3]

Another important debated issue is the interplay between clinical quality (whether publicly disclosed or not), competition, and choice-based reforms. In addition to the large literature mainly related to the U.S. healthcare markets (see Gaynor and Town, 2012, for a survey), several recent papers have studied the impact of clinical quality in light of the reforms of the English NHS and have generally found a positive demand effect (e.g., Beckert et al. (2012), Gutaker et

[3] On the effects of CABG quality scores, more positive findings have been found by Chou et al. (2014) and Wang et al. (2011). The pitfalls of this policy, due to strategic behavior by surgeons aimed at avoiding most severe cases, are discussed by Dranove et al. (2003)

al. (2016) and Moscelli et al. (2016) on hip replacement hospitalizations; Santos et al., 2016, on the choice of family doctor).

Though recognizing the existence of statistically significant effects of clinical quality indicators, some studies have raised some doubts about the overall relevance of these effects with respect to different quality measures and structure and process factors. Goldman and Romley (2008) have challenged the overall role of outcome factors by using an aggregate measure for a series of services defined as “amenities” available at hospitals in greater Los Angeles. They find that an increase of one standard deviation in amenities leads to an increase in hospital demand (pneumonia patients) of approximately 38.5 per cent, whereas analogous variations in clinical quality lead do much smaller variations.[4] Gutacker et al., 2016 find that self-reported outcome measures play a prominent role in patient choice for hip replacement, whereas hospital demand is less responsive to clinical quality indicators.[5] The point is that the available measures of hospital quality used in the extant empirical works only partially capture true quality of care because of the existence of unobserved quality. This can be seen as classical measurement error or as a potential endogeneity bias due to individual unobservable heterogeneity in perception of quality. Attention on this issue is given by Dardanoni et al. (2018) who, starting from a set of observed quality indicators, focus on recovering an estimate of unobserved quality for each hospital. The latter captures also amenities and other hospital features which are valued by patients at the moment of choice.

Independently of the specific research deepening, in all previous studies the impact of quality is compared to the (repulsive) effect of distance. In part this is due to the fact that empirical analyses are based on a discrete choice econometric framework, which identifies effects up to a

[4] A limited role of outcome factors is found also by Rademakers et al. (2011). By means of a survey administered to a sample of Dutch patients who were hospitalized for several types of pathologies, they find that outcome quality can only explain up to 13% of the variance of overall ratings given to hospitals by patients, vis-à-vis much higher impacts of structure and process factors.

[5] Their conclusion is that, especially for some treatments such as hip replacement, “patients’ choice of hospital is influenced by the health gain from treatment, not just by the likelihood of extreme, rare events such as death or an emergency readmission” (Gutacker et al., 2016, p. 243).

factor scale, consequently requiring an interpretation of the results in terms of marginal rates of substitution (MRS) (which measures the patient's willingness to travel to get better care); in part, this also depends on the fact that in an industry where the "good" can only be purchased in the place of production, differently from most primary and manufactured goods, geographical distance is crucial in the consumers' decision process. The disutility of travelling is valued to be so strong, that focusing only on alternative choices among close hospitals is usually considered sufficiently informative.

The shared evidence from previous works is that the MRS between distance and quality is quite low, meaning that patients are not very willing to travel far distances to be treated in higher quality hospitals. In Romley and Goldman (2011) the willingness to travel for pneumonia (Medicare) patients ranges from 2.41 to 3.94 miles for being treated in a hospital with quality at 75th percentile of distribution rather than in a hospital at the 25th percentile. In Chandra et al. (2016), AMI (Medicare) patients are willing to travel from 1.1 to 1.8 miles to get better quality care as measured by an increase of 1 percentage point in risk-adjusted survival and readmission rates. Gutacker et al. (2016) find that the estimated MRS for hip replacement surgery in the English NHS, evaluated for one standard deviation increase in quality and at the average distance to the chosen provider, ranges from 0.1 to 0.9 km, depending on the quality measure used. According to estimates reported in the study of Moscelli et al. (2016) on choice of hospitals for hip replacement surgery after the introduction of the patient choice reform in 2008, patients are willing to cover a longer distance of up to 0.5 km to avoid a deterioration of one standard deviation in quality. In Raval and Rosenbaum (2017) choosing a hospital at the 75th percentile of the quality distribution instead of one at the 25th percentile leads is worth travelling up to 17 minutes more (which is an increase of 98.7% in travelling time). In this latter work, the effect of distance is separated from unobserved tastes for hospitals by estimating model for women who had multiple pregnancies and who moved residence and switched hospital, so that hospital proximity varies independently from persistent preferences.

3 Empirical approach

The decision about whether and where be hospitalised is a complex process in which both the patient, her family and her GP are likely to play a role. Henceforth, for simplicity we will talk of patient's choice, though, as in most existing studies, we cannot observe who actually "chooses" the hospital.

We model the demand for elective hospital care of patients with digestive system cancers by considering that each hospital admission episode can be seen as the result of a "choice" by $i = 1, 2, \ldots, N$ 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:

$$U(\text{choice } h \text{ by patient } i) \equiv U_{ih} = \boldsymbol{\beta}'\boldsymbol{v}_h + \varepsilon_{ih} \qquad (1)$$

where $\boldsymbol{v}_h$ denotes observable hospital characteristics and ε_{ih} is a stochastic component that captures the unobservable determinants leading to the choice of hospital *h* by patient *i*. In the baseline specification of equation (1), $\boldsymbol{v}_h$ includes the hospital's distance from the patient's place of residence d_h, a measure of hospital quality of care q_h and other hospital characteristics $\boldsymbol{x}_h$ (described in detailed in the next section):

$$U_{ih} = \gamma d_h + \delta q_h + \boldsymbol{\lambda}'\boldsymbol{x}_h + \varepsilon_{ih} \qquad (2)$$

By assuming that the individual random components ε_{ih} are independently and identically distributed (IID), with an extreme value type 1 (Gumbel) distribution, the model in (1) is the "conditional logit" model, where the likelihood that patient *i* is admitted to hospital *h* is expressed as:

$$P_{ih} = \frac{\exp(\beta'\boldsymbol{v}_h)}{\sum_{l=1}^{H}\exp(\beta'\boldsymbol{v}_l)} \qquad (3)$$

The IID assumption leads to the independence of irrelevant alternatives (IIA) property, which implies that the relative probabilities depend solely on the characteristics of those two k and l alternatives. The IIA property also implies that the probability to choose between two alternatives is independent from the presence of additional alternatives other than k and l (e.g., Hausmann and McFadden, 1984). In the presence of subsets of similar alternatives, the IIA condition may prove very strong and therefore it must be tested.

Among the several alternative models that can overcome this limitation, we consider the *mixed logit* model, also known as *"random parameter logit"* or *"mixed multinomial logit" (e.g.* McFadden and Train, 2000). As outlined by Train (2009), this model obviates the main limitations of standard logit models by allowing for random taste variation and unrestricted substitution patterns. In formal terms, equation (1) becomes:

$$U_{ih} = \boldsymbol{\beta}_i' \boldsymbol{v}_h + \varepsilon_{ih} \tag{4}$$

where the parameter β_i are allowed to vary randomly across individuals according to the following specification and are distributed as a normal with mean γ and variance σ^2, $\beta_i \sim N(\gamma, \sigma^2)$. Equation (3) is now conditional on β_i, which is unknown. Therefore, by integrating out the parameters β, the unconditional likelihood to be estimated is:

$$P_{ih} = \int \left(\frac{exp(\beta_i' \boldsymbol{v}_h)}{\sum_{l=1}^{H} exp(\beta_i' \boldsymbol{v}_l)} \right) f(\beta) d\beta \tag{5}$$

In practice, the random parameters are decomposed as $\beta_i = \gamma + \eta_i$ where, from an error-component perspective (see Train, 2009), the deviations η_i add to the unobserved random component of the utility function, thus helping to capture the unobservable patients' effects.

In many applications the random specification is assumed, especially in the case of an ample number of covariates, only for a subset of parameters. In the present study we use the mixed logit model to address unobserved patient heterogeneity in preferences over quality and distance. As for quality, unobservable patients' effects might capture differences in perceived quality. Those differences might be due to individuals' diverse ability to get and process information about clinical quality of care and to individual-specific tastes for other non-clinical aspects of quality. In the case of distance, unobservable patients' effects are assumed to capture differences in preferences for travelling for care which are related to the presence of a support network (family or friends) close to the hospital. In the Italian case, inter-regional migration dynamics are characterized by large flows of persons from the southern regions, particularly the two main islands, towards the northern-central regions. The source of knowledge provided by similar support networks can lessen the disutility of distance by reducing the costs of getting information about the hospital and the costs of accommodation.

The mixed logit model can gain additional flexibility by allowing the parameters of the chosen covariates to vary with some individual observable characteristics $\boldsymbol{z}_i$. On this vein, we allow the parameters of quality and distance to vary with individual characteristics (we consider dummy variables for gender, education and age).[6] Thus, by making explicit distance and quality in v_{h}, the utility for patient *i* associated with each alternative hospital *h* can be written as:

$$U_{ih} = \beta_i^{\boldsymbol{d}} d_h + \boldsymbol{\theta}_d{}'\boldsymbol{z}_i \otimes d_h + \beta_i^{\boldsymbol{q}} q_h + \boldsymbol{\theta}_q{}'\boldsymbol{z}_i \otimes q_h + \boldsymbol{\lambda}'\boldsymbol{x}_h + \varepsilon_{ih} \tag{6}$$

[6] From a practical point of view, the estimation of the effects of patient-level factors can be obtained by adding to the baseline specification the interactions between patient's level characteristics and the subset of hospital attributes whose parameters are allowed to vary randomly.

where $\boldsymbol{\theta}_d$ and $\boldsymbol{\theta}_q$ are the matrixes of parameters associated with the interaction of quality and distance with the individual characteristics.

Because we aim to assess whether patients' utility is differently affected by hospital characteristics depending on the hospitals' location being in the local area of residence or at very long distances, we include separate parameters for the two groups of alternatives represented by local hospitals in the two islands and distant hospitals in the Centre-North of Italy.

$$U_{ih} = \beta_i^{\boldsymbol{d}} d_h + \beta^{\boldsymbol{Ld}}(d_h L) + \boldsymbol{\theta}_d(\boldsymbol{z}_i \otimes d_h) + \beta_i^{\boldsymbol{q}} q_h + \beta^{\boldsymbol{Lq}}(q_h L) + \boldsymbol{\theta}_q(\boldsymbol{z}_i \otimes q_h) + \boldsymbol{\lambda}'\boldsymbol{x}_h + \varepsilon_{ih} \qquad (7)$$

The estimation of model (7) is carried out by adding to equation (6) the interaction terms of distance and quality, as well as other hospital attributes, with the dummy variable L taking value 1 if the hospital is located in the patient's region of residence. For the reference patient, β_i^d and β_i^q represent respectively the marginal utilities of distance and clinical quality. For local hospitals the same marginal utilities are obtained as the algebraic sums $\left(\beta_i^d + \beta^{Ld}\right)$ and $\left(\beta_i^q + \beta^{Lq}\right)$, and the standard error can be recovered by means of the delta method.

4 Data and variables

We use patient-level data from the Italian hospital discharge cards (SDO – *Schede di dimissione ospedaliera*) on all admissions for treatments for digestive system cancers of patients enrolled in Sardinia and Sicily, the two main Italian islands located in the south of the country, occurring in year 2013.[7] The SDO data, released by the Ministry of Health, register each admission episode occurred in every public and private licensed hospital of the NHS, and contain information about the hospital type, the local health authority (LHA) and region where the

[7] Digestive system cancers include all malignant neoplasm of digestive organs and peritoneum (ICD9 code 150-159), all benign neoplasm of other parts of digestive system (ICD9 code 211), all secondary malignant neoplasm of digestive system (ICD9 code 197.4-197.8), carcinoma in situ of digestive organs (ICD9 code 230), neoplasm of uncertain behavior of digestive system (ICD9 code 235), neoplasm of unspecified behavior of digestive system (ICD9 code 239.0).

admission occurred, as well as the patient's LHA and region of enrollment. Each hospitalization is classified using the ICD-9-CM international classification of diseases and procedures. The SDO data also provide information on a restricted set of patients' socio-demographic characteristics: gender, age class and education level.

We exclude from the analysis emergency admissions and inter-hospitals patients transfers. The remaining selected admissions refer to elective treatments only. This allows us to focus on actual patient choice for this specific group of cancer treatments. In order to ensure a proper representativeness of outflows and avoid volatility of very sparse admission episodes, we only consider hospitals that have a minimum of 5 discharges of Sardinian and Sicilian residents and for which our risk-adjusted quality measure is available. Our sample is 4,508 elective admission episodes of patients treated in 46 different public and private Italian hospitals during the year 2013.[8] While most of these hospitalisations obviously occurred in the region of residence, about 16.9 per cent of them occurred in (28) hospitals located in northern or central Italian regions. This figure is very large if compared to overall patients' mobility from the south to the north of the country, as highlighted in Section 1.

Because we want to estimate a model for hospital choice where patients choose the preferred hospital on the basis of quality, specific hospital characteristics and distance, we link the SDO data with data derived from other administrative sources. We associate an indicator of geographical distance to each admission record in the SDO database. Distance is calculated as the (Euclidean) distance in kilometres (km) between the centroid of the LHA of enrolment of patients i and the hospital h. Hospitals in the choice set can be located within the region of residence (within the LHA of enrolment or in one of the others) or in any region of the North-Centre of Italy. Distance is expected to negatively affect patient choice. It should capture the disincentive effect of seeking hospital care out of own LHA, or even of own region, generated by

[8] Without imposing any further selection on the data, our sample does not contain admission episodes of Sardinian (Sicilian) residents in Sicilian (Sardinian) hospitals. The original SDO data record only 3 admissions of the first type and 2 of the second type.

the cost of mobility. The longer the distance is, the higher the travel costs and the disutility of distance. An accurate specification of the relationship between distance and the probability of choosing from a large choice set of hospitals is crucial to get reasonable estimates of the marginal rates of substitution between distance and hospital quality. Non-linear specifications of the distance effect have been detected in the existing studies: either quadratic specifications (e.g., Ho, 2006 and Beckert et al., 2012) or cubic specifications (as in Santos et al., 2017; Moscelli et al, 2016; Gutacker et al., 2016). As shown later, in this work we detect a statistically significant third-order polynomial of distance also for the long-distance hospitalizations.

We use a measure of clinical quality in the hospital care for digestive system cancers calculated and released by the National Agency for Regional Health services within the Outcomes Evaluation National Programme (*Programma Nazionale Esiti*, PNE).[9] One issue that we encounter using the PNE data is that the coverage of this recent source of public information is not always accurate because it relies on the availability of a minimum number of cases for all hospitals and each specific specialty within each hospital in order to provide risk-adjusted statistics. Because a synthetic clinical outcome indicator in the area of cancers of the digestive system does not exist, and because of the absence of the hospital-level information needed to adjust the single row mortality (or readmission) rates that are potentially available, we proxy outcome clinical quality with the risk–adjusted mortality rate (within 30 days) after a malignant neoplasm colon surgery. This indicator is published for most of the hospitals.[10] This mortality rate is calculated on admissions occurred between the 1st of January 2007 and the 30th of

[9] The PNE is similar to other international monitoring programmes such as the "NHS Outcomes Framework Indicators" in the UK. By delivering "objective" indicators at the hospital, LHA or regional level, the PNE is believed to empower patients with new and precise information about health outcomes, and therefore quality of care, which should help them to make more informed decisions about their healthcare. At the same time, public reporting of outcomes should create incentive, at the hospital level, to improve the performance and the overall quality of care.
[10] The statistical procedure for risk-adjustment is described in Agenas, 2013. Programma Nazionale Valutazione Esiti (PNE) Ed. 2013, SDO 2005-2012 Metodi Statistici (hiip://95.110.213.190/PNEed13/).

November 2012.[11] The timing is particularly convenient for the purpose of our analysis because it guarantees that current choices (i.e., hospitalisation occurred in 2013) cannot affect health outcomes and hence the level of quality, thus ruling out the risk of endogeneity of quality in the hospital choice model. The clinical quality indicator that we use in the analysis was released at the end of year 2013, therefore we reasonably assume that it was not available to patients to make informed choice. However, we expect that, because information about quality differences among hospitals is to some extent spread among the population at least by means of informal networks, the lower the value of the quality indicator, the lower the probability of an hospital of being chosen.

We control for potential hospital size effects by using information on the number of beds. This is a commonly used hospital attribute in the hospital choice literature. We also distinguish between teaching and research hospitals (either public or private) and private licensed hospitals. With respect to all the other hospitals, teaching and research hospitals might attract more patients because their mission and their commitment in research makes them more likely to provide state-of-the-art treatments using advanced technologies. Private ownership might influence hospital attractiveness through a more flexible management of waiting lists, the availability of more personalized care plans, the provision of more and better amenities. Private hospitals are also known to have strategic incentives to attract extra-regional patients (e.g. Brenna and Spandonaro, 2015).

We finally expect that patients are attracted by hospitals specialized in complex cases, particularly if their health condition is severe. For this reason, we make use of the case mix index (CMI), which is a publicly available indicator at the hospital level that reflects clinical complexity (measured in terms of the financial and physical resources allocated to treat all

[11]We are aware that perceived hospital's quality, which effectively shapes patient's decisions, takes the form of a latent variable that does not appear in the data. Nevertheless, the use of (risk-adjusted) post-discharge mortality indicators is generally supported in the literature.

hospital admitted patients) of the treated cases. A value greater than 1 indicates a mix of cases being more resource-intensive than average and identifies more specialised hospitals.

4.1 Summary statistics

Table 1 shows some summary statistics for admissions that occurred in the set of hospitals included in the analysis and distinguishes between admissions in close and distant hospitals. The former are located in the region of residence, while the latter are located in northern and central regions. About 44 per cent of patients are women, and this gender composition is very similar comparing "close" and "distant" admissions. Most of the admissions are of individuals aged 65-74 years old (45.6 per cent) and this age class is larger (52.9 per cent) in the group of "distant" admissions. The latter, however, are characterised by a larger presence of individuals younger than 64 (33.7 per cent) and of oldest old individuals (13.4) with respect to "close" admissions. Unsurprisingly, in line with the well-known socioeconomic gradient in health, most of the admissions are of low educated (none to lower secondary education) individuals. The fraction of low educated individuals is much larger in the group of "close" admissions, while the fraction of high educated individuals (those with tertiary education) is almost double in the group of "distant" admissions. The proportion of admissions in distant hospitals clearly decreases with age and increases with education, as shown in Table 2. The oldest old and the low educated appear the less likely to travel for care.

Table 1 allows us to see how patients moved for their hospital care. The fraction of patients who chose a "close" hospital, that is they decided to stay in their own region and chose an hospital belonging to an LHA different from that of enrolment, is about 22.1 per cent. We have measured the fraction of patients who bypassed the closest hospitals by using a broader definition of closeness which implies to increase of 3, 5, 10, 30 and 50 km the distance from the closest hospital. We find, as expected, that this fraction of patients decreases with distance and that it is still very high for longer distances: 41.3 per cent of patients bypassed the hospitals located at 10 km from the closest one, 29.4 per cent bypassed the hospitals located at 30 km from the closest one and 26.2 per cent bypassed the hospitals located at 50 km from the closest one. These figures clarify that restricting the choice set at a specific threshold distance (say 30 or 50 km) would impose an arbitrary selection to the data. The fraction of patients choosing one of the "distant" hospitals is indeed quite high (about 16.9 per cent). If we look at actual patients' choices, the average distance to close hospitals is 42.3 km; the closest hospital is about 3 km distant and the most distant is located 212.4 km away. Distant hospitals are at an average distance of 759.9 km, and are located at a minimum of 285.7 km[12] from the LHA of enrolment up to a maximum of 1099.1 km.

Table 1 shows that admissions in "close" and "distant" hospitals also differ in terms of quality and other hospital characteristics. For all admissions, the average 30-days mortality rate in the chosen hospital is about 5.7%. With respect to this rate, average quality is 0.32 percentage points lower (the mortality rate is higher) in close hospitals and approximately 1.6 points higher (the mortality rate is lower) in distant hospitals of the choice set. Hospital size is (1.57 times) larger, on average, in the group of "distant" admissions. The average ICM is higher in latter type of hospitals, meaning that patients who travel more for care end up in hospitals that are more specialized in complex cases. Only 31.1 per cent of "close" admissions occurred in teaching and research hospitals, while this share is 69.7 per cent in the group of "distant" admissions. Even the share of admission occurring in private licensed hospitals is higher in distant hospitals (42.7 per cent *versus* 0.04 per cent in close hospitals).

Table 1 and Table 2 about here

[12] This is the distance from the North-East part of Sardinia to the closest hospital in Lazio. It can be only covered by ferry or flight.

5 Results

Table 3 reports the results of the estimations carried out for the hospital choice model according to the empirical approach described in Section 3. The first regression (Model 1) is a conditional logit model for a baseline specification that includes only clinical quality, distance and the hospital attributes described in Section 4. In Model 1 all hospital characteristics have a significant explanatory power. As expected, the "gravitational pull" of a hospital is positively affected by its size (in terms of beds) and its specialization in complex cases (as summarised by the CMI). The coefficient for teaching and research hospitals as well as private hospitals are positive and significant, consistently with the arguments illustrated in Section 4. The disutility of distance is confirmed by the negative sign of the coefficients and it is significantly shaped by the cubic specification (as in Santos et al., 2017 and Moscelli et al., 2016).

Table 3 about here

In the baseline specification, where we do not distinguish between local and distant hospitals the 30-days mortality indicator does not show a repulsive effect. This counterintuitive result is confirmed when estimating the same specification using a mixed logit model (Model 2), where distance and clinical quality are allowed to vary randomly across observations. The use of this random parameter specification for the rest of the empirical analysis is motivated by the McFadden-Hausman test reported for Model 1, which strongly suggest to reject the IID hypothesis in the conditional logit model. Moreover, though the estimated standard deviations of the random parameters are small, the mixed logit outperforms the conditional logit analogous in terms of the Bayesian information criterion (BIC).

In Model 3 we augment the baseline specification by interacting all hospital attributes with a dummy indicator for hospital location and by including interaction terms of quality and distance with patients' characteristics.[13] Column 5 of Table 3 shows the estimated parameters for distant and local hospitals, while point estimates for all regressors are reported in the Appendix (Table A.1). The BIC clearly indicates a better fit of this specification.

All coefficients are interpretable (up to some adjustment) in terms of marginal utilities (or disutilities) of the reference patient, who is a very old (aged 75 years old and older) and low educated (up to primary education) male. The augmented specification shows a substantial change in the estimated coefficient of clinical quality. The 30-days post admission mortality rate displays a significant and negative effect in the case of distant hospitalizations: as the mortality rate increases (quality decreases) the probability that a distant hospital *j* is chosen by patient *i* decreases (hence the marginal utility of quality is positive). However, clinical quality does not exert the same effect in the group of local hospital where the coefficient is not statistically significant and can be interpreted as a null marginal utility of quality. Clinical quality plays a clear relevant role in the choice of very distant hospital (namely, those located in the central-northern regions), showing that the quality signal not only does not vanish with distance, but it seems to strengthen for long-distance mobility. The marginal utility of distance evaluated at the average distance is about fourteen times higher for local than distant hospitals. Table A.2 in the Appendix reports the estimated marginal utilities of distances evaluated at different percentiles of the distribution for both types of hospitals.

Table 3 shows other differences between distant and local hospitals. For distant hospitals the complexity of treated cases seems to be more important than for local ones (the coefficient is twice as large) in increasing the likelihood of an hospital to be chosen, while hospital size has a larger effect for local hospital (the coefficient is about 4 times that of distant hospitals). Teaching and research hospitals have a higher (almost double) probability of being chosen if they are located in the Central-Northern regions. Private ownership, instead, has a different

[13] The inclusion of these interactions allows us to take into account the fact that the marginal utility of clinical quality and the marginal disutility of distance might vary with patients' demographic and socioeconomic characteristics.

effect on hospital choice. Estimates show that private licensed hospitals in the region of residence tend to have a lower probability of being chosen with respect to public ones. On the contrary, when located in distant regions, this type of hospital seem to compete with local public providers in competing to attract extra-regional patients. This result can also be explained by the different role played by private providers in Northern Italy, where they are often at the forefront of medical research (many of them are universities), and in the two islands where patients are enrolled, where they simply top up the public sector in the supply of basic or standard services.

5.1 Willingness to travel

In order to appraise the size of the effect of clinical quality on hospital choice, estimates from discrete choice models are often used to measure the willingness to travel (WTT) of the reference patient. The WTT is the marginal rate of substitution between quality and distance and it is usually evaluated at the mean or median sample value of distance. Because the evaluation point matters when dealing with a nonlinear specification of distance, in this section we show estimates of WTT calculated at each percentile of the distribution of distances both for distant and local hospitals: $WTT = -\beta_i^q \,/MUD$, where MDD is the marginal disutility of distance $MDD = \beta_i^d + \frac{2}{100}\beta_i^{d^2} d_{perc} + \frac{3}{1000}\beta_i^{d^3} d_{perc}$. The expression above calculates the WTT as the number of kilometers a patient is willing to travel for a one-unit change in quality. As in Romley and Goldman (2011), Chandra et al (2016) and Raval and Rosenbaum (2017), we consider the effects of a hypothetical shift of clinical quality from the 75th to the 25th percentile. This approach allows us to simulate the WTT (and the MDD) as if hospital moves from the third quartile of the distribution of the risk-adjusted mortality rate to the first one.

Figure 1 reports the disutility of distance (top graph), the MDD (central graph) and the WTT (bottom graph) along the support of distance for hospitals located in the Central-Northern regions (285.7 – 1099.1 km) for two types of patients, the reference individual (aged 75 or older and poorly educated) and a young individual (0-49 years old) with tertiary education. The shape of the MDD is in line with the existing literature (e.g., Moscelli et al, 2016). The MDD curve is characterized by a no-significance area between the 18th and the 46th centile of the distribution of distance, in the neighborhood of the inflection point of the cubic function (as shown in the top graph) which corresponds to the local maximum of the MDD function. The central graph shows that the marginal disutility decreases (in absolute value) with distance at the left of the non-significance area (that is, for relatively shorter distances), while it increases at the right (for relatively longer distances) for both the reference patient and the young and highly educated individual. However, for each distance the younger and higher educated patient always has a smaller disutility of distance, meaning that her utility decreases less if she has to cover longer distances to get hospital care. This result should also be reflected on the WTT of the two types of patients.

Figure 1 about here

The bottom graph of Figure 1 illustrates the range of our estimates of the WTT, statistically different from zero outside the no-significance area (which goes from the 17th and the 48th centile of the distribution of distance). Because of the different sign of the slope of the MDD curve at the left and right of the no-significance area, the WTT curve increases with distance at the left part and decreases at the right part. At the 10th distance centile, the reference patient is willing to travel 86 km more to be cured in a hospital whose quality moves from the 75th to the 25th percentile. This WTT decreases with distance as it is 77 km at the median distance, 36 km at the 75th distance centile, and 22 km at the 95th centile. The WTT of the comparison patient is always higher, following the smaller MDD commented above.

6 Conclusions

In this paper, we have investigated hospital choice using Italian data on elective admissions for neoplasms of the digestive system occurred in 2013 in private licensed and public hospitals of the NHS. Focusing on admissions of patients enrolled in the LHAs of insular regions, we have exploited the geographical location of the two main Italian islands to model long-distant mobility, towards hospitals located in the Central-Northern regions, as a phenomenon potentially different from short-distant mobility. The empirical approach has followed a discrete choice framework and it has addressed both unobservable and observable heterogeneity in individual preferences. We present results from a mixed logit regression models where coefficients of clinical quality and distance are random parameters and where patient tastes for distance and quality vary with individual socioeconomic characteristics.

The distinction between close and distant hospitalization shows that, at least for cancer treatments, patients choices are very sensitive to variations in clinical quality of hospital located at several hundred kilometers from home. Notwithstanding the lack of public release of information at the time of our analysis, patients seem to have been able to look outside their neighborhoods in order to get a better care. This result could be at least in part determined by the need of getting the best available treatments and services for cancer – by definition a very serious pathology - despite the distance from home, whereas for more ordinary medical and surgical treatments patients have a lower incentive to seek for better services outside their region of residence. Another important finding is that clinical quality does not seem to be relevant in the choice of local hospitals. We would have expected that (even in the absence of public information about hospital quality) proximity to hospitals, interaction with people who have been previously cured in local hospitals and family doctors' referral should have increased the probability of choosing higher quality hospitals. Though, patient choices of local hospitals are not correlated to clinical quality indicators. Coupled with the much stronger effect (with respect to distant hospitalizations) of hospital size on choice probability, this result seems to reflect an uncritical adhesion of a significant part of the population (arguably mediated by family doctor's recommendations) to the regional hospital network organization which is not necessarily defined on the basis of true quality.

We find that, for distant hospitals, a hump-shaped curve for patients' marginal disutility of distance. This entails that patients are initially less concerned by additional traveling distance, then the effect becomes stronger when very long distances (600 hundred km or more) are involved.

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.

References

Aggarwal A., Lewis D., Mason, M., Sullivan, R. and van der Meulen J. (2017a). Patient Mobility for Elective Secondary Health Care Services in Response to Patient Choice Policies: A Systematic Review. Medical Care Research and Review, 74(4), 379–403.

Beckert W., Christensen M., Collyer K. (2012). Choice of NHS-funded hospital services in England. The Economic Journal, 122(560), 400-417.

Berta P., Martini G., Moscone F., Vittadini G. (2016). The association between asymmetric information, hospital competition and quality of healthcare: evidence from Italy. Journal of the Royal Statistical Society: Series A (Statistics in Society), 179:907–26.

Beukers PDC, Kemp RGM, Varkevisser M. (2014). Patient hospital choice for hip replacement: empirical evidence from Netherlands. European Journal of Health Economics, 15:927-936

Birkmeyer JD, Siewers AE, Finlayson EV, et al. (2002). Hospital volume and surgical mortality in the United States. New England Journal of Medicine, 346:1128-1137.

Brekke, K., Gravelle, H., Siciliani, L., Straume, O.R. (2014). Patient Choice, Mobility and Competition among Health Care Providers. In: Montefiori, M., Levaggi, R. (Eds.), Health Care Provision and Patient Mobility. Springer.

Brenna, E., Spandonaro, F. (2015) Regional incentives and patient cross-border mobility: evidence from the Italian experience. International journal of health policy and management 4 (6), 363

Chandra, A., Finkselstein, A., Sacarny, A., Syverson, C. (2016). Health Care Exceptionalism? Performance and Allocation in the US Health Care Sector." American Economic Review, 106(8): 2110-44

Chou, S.-Y., Deily, M.E., Li, S., Lu, Y. (2014). Competition and the impact of online hospital report cards. Journal of Health Economics 34, 42–58.

Donabedian, A. (2003). *An Introduction to Quality Assurance in Health Care*, Rashid Bashshur (ed.). New York: Oxford University Press.

Dranove, D., Kessler, D., McLellan, M., Satterthwaite, M. (2003). Is more information better? The effects of 'report cards' on health care providers. The Journal of Political Economy, 111 (3), 555–588.

Epstein, A. (2010). Effects of report cards on referral patterns to cardiac surgeons. Journal of Health Economics 29 (5), 718–731.

Gaynor, M., Seider H. and Vogt W.B (2005). The Volume–Outcome Effect, Scale Economies, and Learning-by-Doing. American Economic Review, 95 (2): 243-247

Gaynor, M., Moreno-Serra, R., Propper, C. (2013). Death by market power: reform, competition, and patient outcomes in the National Health Service. American Economic Journal: Economic Policy, 5(4), 134-166.

Gaynor M. and Town R. (2012). Competition in health care markets. In M. V. Pauly, T.G. McGuire, P.P. Barros (Eds.), Handbook of Health Economics. Volume 2. Elsevier, Amsterdam.

Goldman D, Romley J. (2008). Hospitals as Hotels: The Role of Patient Amenities in Hospital Demand. Vol. 2008. Cambridge, MA: National Bureau of Economic Research, n. 14619.

Gutacker, N., Siciliani, L., Moscelli, G., Gravelle, H. (2016). Choice of hospital: Which type of quality matters? Journal of Health Economics, 50, 230-246.

Hausman, J., McFadden D. (1984). "Specification Tests for the Multinomial Logit Model". Econometrica, 52(5), 1219–1240.

Learn P.A. and Bach P.B. (2010). A Decade of Mortality Reductions in Major Oncologic Surgery: The Impact of Centralization and quality Improvement. Medical Care, 48(12): 1041-1049.

Lu Y and Slusky D.J.G. (2016). The Impact of Women's Health Clinic Closures on Preventive Care. American Economic Journal: Applied Economics 2016, 8(3): 100–124.

Luft, H.S., Garnick, D., Mark, D., Peltzman, D., Phibbs, C., Lichtenberg, E., McPhee, S. (1990). Does quality improve choice of hospital. JAMA: The Journal of the American Medical Association 263, 2899–2906.

McFadden, D.L., Train, K.E. (2000). Mixed MNL models for discrete response. Journal of Applied Econometrics, 15:447-470.

Ministry of Health (2014). Rapporto annuale sull’attività di ricovero ospedaliero. Dati SDO 2013.

Ministry of Health (2017). Rapporto annuale sull’attività di ricovero ospedaliero. Dati SDO 2016

Moscelli, G., Siciliani, L., Gutacker, N., Gravelle, H. (2016). Location, quality and choice of hospital: Evidence from England 2002–2013. Regional Science and Urban Economics, 60, 112-124.

Pope DG., (2009). Reacting to rankings: evidence from America’s Best Hospitals. Journal of Health Economics 28 (6), 1154–1165.

Romano P.S. and Mutter R. (2004). The evolving science of quality measurement for hospitals: implications for studies of competition and consolidation. Int. J. of Hlth Care Finan. Econ. 28: 1154-1165.

Romley, J. A., Goldman D. P. (2011). How Costly Is Hospital Quality? A Revealed-Preference Approach. Journal of Industrial Economics, 59 (4): 578–608.

Raval D., Rosenbaum T. (2017). How Strong is Gravity? Separating Home Bias from Transport Costs Using Hospital Choice, Working Paper, 2017.

Santos R., Gravelle H., Propper C., (2017). Does quality affect patients’ choice of doctor? Evidence from UK. The economic Journal, 127, 445-494.

Spilsbury K, Rosman D., Alan J.,Boyd, J.H., Ferrante A-M. and Semmens J.B (2015). Cross-border hospital use: analysis using data linkage across four Australian states. The Medical journal of Australia, 102 (11), 582-586

Tay A. (2003). Assessing Competition in Hospital Care Markets: The Importance of Accounting for Quality Differentiation. The RAND Journal of Economics. 34(4), 786-814.

Train K. (2009). Discrete choice models with simulation, 2nd ed. Cambridge university press.

Varkevisser M., van der Geest SA, Shut FT. (2012). Do patients choose hospitals with high quality ratings? Empirical evidence from the market for angioplasty in the Netherlands. Journal of Health Economics. 31(2), 371-378

Wang, J., Hockenberry, J., Chou, S.-Y., Yang, M. (2011). Do bad report cards have consequences? Impact of publicly reported provider quality information on the CABG market in Pennsylvania. Journal of Health Economics 30 (2), 392–407.

Tables and figures

Table 1: Descriptive statistics

	All admissions (N=4508)		"Close" admissions (N=3746)		"Distant" admissions (N=762)	
	mean	s.d.	mean	s.d.	mean	s.d.
Patient characteristics						
Gender (=1 if the patient is female)	0.440	0.496	0.442	0.497	0.429	0.495
Age classes						
0-49	0.116	0.320	0.110	0.313	0.144	0.352
50-64	0.161	0.367	0.154	0.361	0.193	0.395
65-74	0.456	0.498	0.441	0.497	0.529	0.499
75 and older	0.268	0.443	0.295	0.456	0.134	0.341
Education level (isced classification)						
none or primary	0.415	0.493	0.438	0.496	0.302	0.459
lower secondary	0.294	0.456	0.302	0.459	0.253	0.435
upper secondary	0.206	0.405	0.187	0.390	0.302	0.459
tertiary education	0.085	0.279	0.073	0.261	0.143	0.350
Choice						
Distance to chosen hospital (km)	163.624	282.386	42.330	28.573	759.905	199.530
Distance to potential hospitals in choice set (km)	585.203	37.422	230.195	56.629	813.423	87.789
% patients choosing a "close" hospital bypassing the LHA of enrolment	0.221	0.415				
% patients choosing a hospital located at more than:						
3 km away from the closest hospital	0.595	0.491	0.513	0.500		
5 km away from the closest hospital	0.555	0.497	0.464	0.499		
10 km away from the closest hospital	0.413	0.493	0.294	0.456		
30 km away from the closest hospital	0.294	0.456	0.150	0.357		
50 km away from the closest hospital	0.262	0.440	0.112	0.316		
% patients choosing a "close" hospital	0.831	0.375				
Hospital characteristics						
Clinical quality (risk adjusted mortality rate)	5.718	3.049	6.037	3.124	4.145	2.012
Hospital size (number of beds)	623.738	346.021	568.286	269.022	896.343	513.221
Case mix index (CMI)	1.076	0.077	1.062	0.064	1.147	0.092
Teaching and research hospitals	0.376	0.484	0.311	0.463	0.697	0.460
Private licensed hospitals	0.106	0.307	0.040	0.197	0.427	0.495

Note. "Close" admissions might occur in any hospital located in the region of residence (whether Sardinia or Sicily); "Distant" admissions might occur in any hospital located in a northern or central region.

Table 2: Patient characteristics by location of the chosen hospital

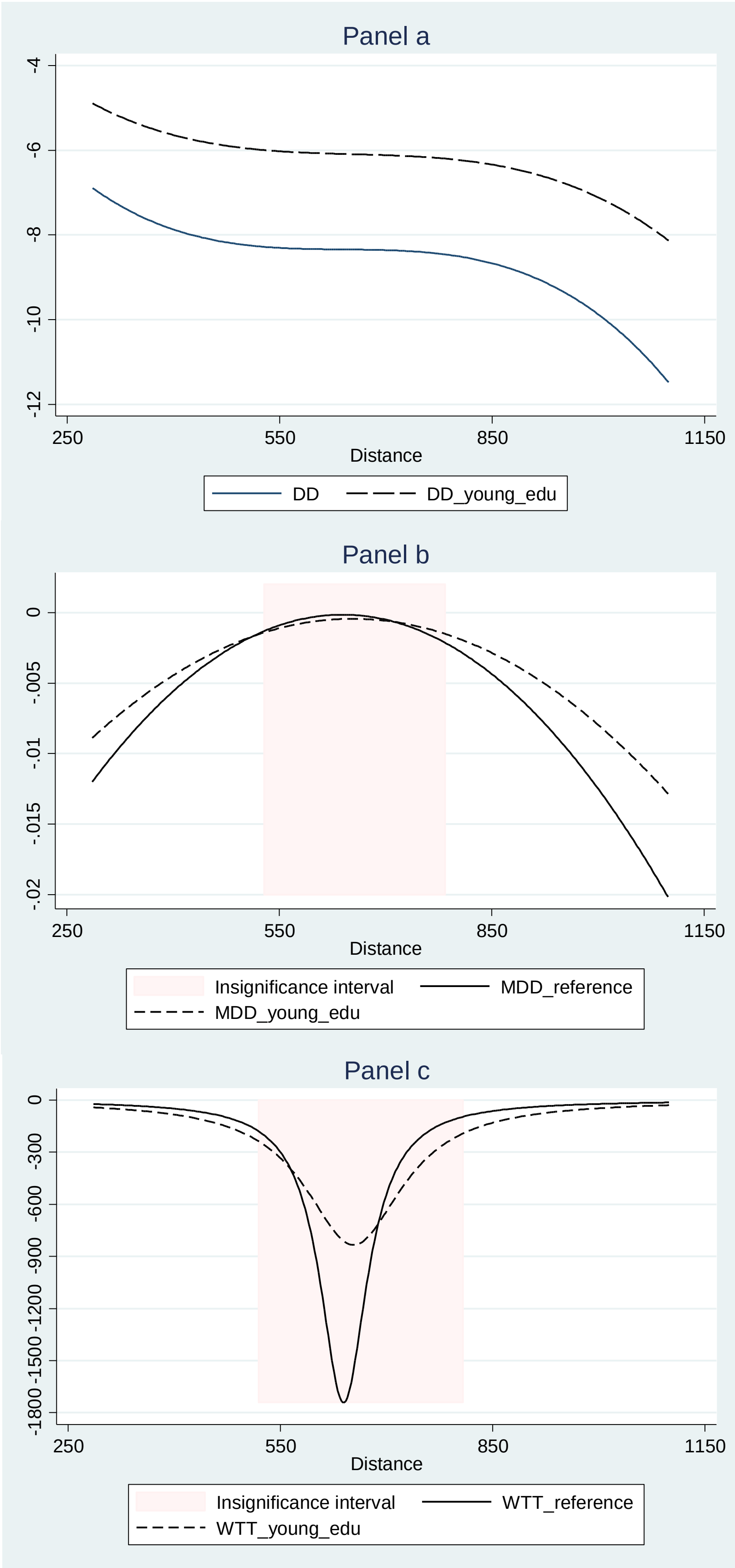
	chosen hospital is local	**chosen hospital is distant**
Age classes		
0-49	78.970	21.030
50-64	79.700	20.300
65-74	80.380	19.620
75 and older	91.550	8.450
Education level		
none or primary	87.690	12.310
lower secondary	85.430	14.570
upper secondary	75.270	24.730
tertiary education	71.610	28.390

Table 3: Hospital choice models for elective digestive system cancer admissions

	Conditional logit model			**Mixed logit models**					
	Model 1			Model 2			Model 3		
Hospital characteristics	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
							Distant hospitals		
Quality	0.034	***	0.005	0.035	***	0.005	-0.096	***	0.024
Distance	-0.041	***	0.001	-0.048	***	0.001	-0.039	***	0.003
Squared distance (/100)	0.008	***	0.0002	0.010	***	0.0003	0.006	***	0.001
Cubic distance (/1000)	-0.00004	***	0.000001	-0.00008	***	0.000004	-0.00003	***	0.000005
Case mix index	2.969	***	0.217	2.868	***	0.219	4.125	***	0.460
Hospital size	0.001	***	0.0001	0.001	***	0.0001	0.0004	***	0.0001
Teaching and research hospitals	0.526	***	0.039	0.506	***	0.039	0.500	***	0.092
Private licensed hospitals	0.583	***	0.060	0.510	***	0.060	0.939	***	0.096
							Local hospitals		
Quality							0.016		0.012
Distance							-0.046	***	0.005
Squared distance (/100)							-0.004		0.005
Cubic distance (/1000)							0.0005	***	0.0002
Case mix index							2.000	***	0.2554
Hospital size							0.001	***	0.0001
Teaching and research hospitals							0.280	***	0.047
Private licensed hospitals							-0.162	*	0.095
St.dev. of random parameters									
Quality				0.002		0.013	0.001		0.013
Distance				0.004	***	0.001	-0.0003		0.0004
Squared distance (/100)				-0.00004		0.0001	-0.00002		0.0001
Cubic distance (/1000)				0.0000130		0.000001	0.000001	***	0.000001
Log likelihood	-11084.8			-10990.582			-10631.9		
BIC	21391.4			22126.5			21845.2		
McFadden-Hausman IIA test									
Chi-square	22.550								
prob.	0.004								
Number of observations	4,508			4,508			4,508		
Number of hospitals	46			46			46		

Note. Model 3 includes interactions of quality and distance with patients characteristics (gender, age and education dummies). Parameters for local hospitals are obtained by including in the model interactions of all hospital characteristics with a location dummy L (=1 if hospital is located in the patient's region of residence); standard errors are calculated using the delta method.

Figure 1: Absolute disutility, marginal disutility of distance (MDD) and willingness to travel (wtt) for reference (old and poorly educated) individual and comparison (young and higly educated) individual for a clinical quality change [from the 75th to the 25th centile]



Appendix

Table A.1: Regression results for the mixed logit model with interactions

	Coef.		Std. Err.
Hospital characteristics			
Quality	-0.096	***	0.024
Distance	-0.039	***	0.003
Squared distance (/100)	0.006	***	0.001
Cubic distance (/1000)	-0.00003	***	0.000005
Case mix index	4.125	***	0.460
Hospital size	0.0004	***	0.0001
Teaching and research hospitals	0.500	***	0.092
Private licensed hospitals	0.939	***	0.096
Interactions with L (=1 if hospital is located in the patient's region of residence)			
Quality	0.113	***	0.021
Distance	-0.007		0.005
Squared distance (/100)	-0.010	*	0.005
Cubic distance (/1000)	0.0005	***	0.0002
Case mix index	-2.125	***	0.513
Hospital size	0.001	***	0.0001
Teaching and research hospitals	-0.220	**	0.103
Private licensed hospitals	-1.101	***	0.135
St.dev. of random parameters			
Quality	0.001		0.013
Distance	-0.0003		0.0004
Squared distance (/100)	-0.00002		0.0001
Cubic distance (/1000)	0.000001	***	0.000001
Interactions with patients characteristics			
Quality			
female	-0.008		0.011
age class 0-49	-0.050	**	0.021
age class 50-64	-0.005		0.017
age class 65-74	0.015		0.013
lower secondary education	0.008		0.013
upper secondary education	0.016		0.015
tertiary education	0.015		0.020
Distance			
female	-0.002		0.002
age class 0-49	0.001		0.003
age class 50-64	0.00001		0.003
age class 65-74	-0.0005		0.002
lower secondary education	0.009	***	0.002
upper secondary education	0.012	***	0.002
tertiary education	0.010	***	0.003
Squared distance			
female	0.0005		0.0004
age class 0-49	0.0004		0.001
age class 50-64	0.001		0.001
age class 65-74	0.001		0.001
lower secondary education	-0.002	***	0.0005
upper secondary education	-0.003	***	0.001
tertiary education	-0.002	***	0.001
Cubic distance			
female	-0.000003		0.000003
age class 0-49	-0.000005		0.000005
age class 50-64	-0.000006		0.000004
age class 65-74	-0.000007	***	0.000003
lower secondary education	0.00002	***	0.000003
upper secondary education	0.00002	***	0.000004
tertiary education	0.00002	***	0.000005
Number of observations	4,508		
Number of hospitals	46		

Table A.2: Estimated marginal utility of distance evaluated at the different percentile of the distribution of distance for distant and local hospitals

Percentiles	Distance (km)	Marginal Utility		S.E.
Distant hospitals				
1	318.9	-0.010	***	0.001
5	431.6	-0.004	***	0.001
10	460.8	-0.003	***	0.001
25	590.6	-0.0004		0.001
50	829.2	-0.004	**	0.002
75	919.1	-0.008	***	0.003
90	983.1	-0.011	***	0.004
95	1008.5	-0.013	***	0.004
99	1080.1	-0.019	***	0.005
Local hospitals				
1	10.2	-0.046	***	0.004
5	15.5	-0.046	***	0.003
10	15.5	-0.046	***	0.003
25	22.1	-0.047	***	0.003
50	36.8	-0.047	***	0.002
75	54.3	-0.046	***	0.001
90	80.6	-0.043	***	0.002
95	91.4	-0.041	***	0.002
99	139.2	-0.029	***	0.002