REIMBURSEMENT SYSTEMS AND QUALITY OF HOSPITAL CARE: AN EMPIRICAL ANALYSIS FOR ITALY

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Reimbursement systems and quality of hospital care: an empirical analysis for Italy.

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Abstract

There is an ongoing debate about the effect of different reimbursement systems on hospital performance and quality of care provided. Given that quality cannot be observed directly and defined through only one indicator, in the literature several aspects and outcome measures are proposed, such as Acute Myocardial Infarction (AMI) mortality, Congestive Heart Failure (CHF) mortality, 30 days readmissions for some diagnosis. Despite the many empirical studies investigating the issue of quality measurement, many are the questions that still remain open, mainly concerning the most appropriate indicator.

The widespread adoption of different hospital prospective payment systems (PPSs) has also provoked an intense theoretical debate on their effects, since the level of competition in the system and, above all, the quality of care provided could be influenced. The trade-offs between incentives for efficiency and risks of opportunistic behavior by providers, that erode quality of care, have been especially analyzed.

In this paper, we aim at contributing to the literature on the effect of different hospital payment schemes on patient outcomes. The paper focuses on the Italian National Health Service (Servizio Sanitario Nazionale, SSN), which seems to be a particularly interesting case, when hospital reimbursement mechanisms are considered. The Italian SSN has been subject to a considerable decentralization process, characterized by the devolution of responsibility to regional governments: therefore, Regions have introduced different organizational and financing models. Great variability exists in the way tariffs are used at a regional level, as Regions have chosen their tariff schemes in accordance with the specificities of health care providers.

The paper investigates the variability of quality outcome data across Italian hospitals and the role played by the prevailing payment systems. An empirical analysis of the Italian hospital system is carried out using administrative regional data on mortality rates and hospitalization (and readmissions) for AMI, CHF, stroke, and Chronic Obstructive Pulmonary Diseases (COPD) in the years 2009-2010.

The results confirm a significant impact of the methods of financing hospitals (national vs. regional DRG) on the selected health outcomes and highlight the opportunity to proceed to more detailed analyses (for example, considering quality variability at either the provincial or local health unit level).

Keywords: quality of hospital care, prospective payment systems, competition, decentralization.

JEL Codes: I11, I18, L20

1. Introduction

There is an ongoing debate about the effect of different reimbursement systems on hospital performance. Assessment of hospital performance refers mainly to efficiency, effectiveness and quality of care provided to patients. While efficiency and effectiveness are the basis for productivity analyses, the most critical dimension is quality: it has been increasingly recognised that output measures should consider quality aspects, though there is no general consensus on which indicators to employ.

During the last years, several research projects carried out at an international level have focused on quality assessment (PATH, 2004). Given that quality cannot be observed directly and defined through only one indicator, several aspects and outcome measures have been proposed, such as Acute Myocardial Infarction (AMI) mortality, Congestive Heart Failure (CHF) mortality, 30 days readmissions for some diagnosis.

However, despite the many empirical studies investigating the issue of quality measurement, many are the questions about quality of care that still remain open, especially on the opportunity to select one or more indicators for quality.

The widespread adoption of hospital prospective payment systems in European countries and US has also provoked an intense theoretical debate on their advantages and adverse effects. The potential trade-offs between efficiency and risks of opportunistic behaviour by providers, that may erode quality of care, have been especially analysed.

In this paper, we aim at contributing to the literature on the effect of different hospital payment schemes on patient outcomes, carrying out an analysis for Italy, at a regional level. The Italian National Health Service (Servizio Sanitario Nazionale - SSN) seems to be a particularly interesting case, when considering the effect of hospital reimbursement mechanisms. The Italian SSN has been subject to a considerable decentralization process, characterized by devolution of responsibility to regional governments, as far as the overall organization of health care provision is concerned. As a consequence, Regions have used their autonomy to introduce different organizational and financing models.

In particular, in hospital sector a great variability exists in the way tariffs are used at a regional level, as Regions have chosen their tariff schemes in accordance with the specificities of their health care context. Moreover, other differences across regional

health care systems, in terms of health care supply mix, demand characteristics and ability to manage the overall system, have evolved over time.

The present paper investigates the variability of quality outcome data across hospitals and the role played by the prevailing regional payment systems in explaining it, once controlling for other relevant providers' characteristics. An empirical analysis of the Italian hospital system is carried out using administrative regional data on mortality rates and hospitalization (and readmissions) for AMI, CHF, stroke, and Chronic Obstructive Pulmonary Diseases (COPD) in the years 2009-2010.

The remainder of this paper is organized as follows. Section 2 briefly reviews the existing literature on the effects of hospital payment systems on quality and effectiveness of care. The Italian SSN and the devolution of responsibility to regional governments for the organization and the financing of health care provision is briefly reviewed in section 3. Section 4 presents the dataset and discusses the empirical strategy. Finally, empirical results are discussed in section 5 and some conclusions and policy implications are drawn.

2. Literature review

Literature studies have dealt with quality of hospital care, adopting several perspectives: quality has to be appraised first by patients and providers. Analyses that are focused mainly on patients' satisfaction rather than only on hospitals' performances have been spreading during the last five years.

Other incentives for quality may come from the reimbursement scheme. The majority of OECD countries finance hospital activity by employing DRG-based prospective payment systems (PPS) (Busse *et al.*, 2011), that should provide incentives to increase the quality of services, comparing to other mechanisms, as global budget systems. This assumption can be verified by identifying appropriate indicators for quality and its variations. Effects on quality might result by looking at health outcomes (such as morbidity and mortality), adherence to guidelines and quality standards established at a national level, equity issues, or, according to the main stream of literature focused on patients' assessment, patient experience.

A first indication coming from some reviews of the literature on payment schemes and quality outcomes is that there is little or no significant correlation between these aspects.

Rather, payment systems appear to impact more on costs and levels of utilization. Case payment reduces costs by approximately 6-10% relative to fee for service (Mc Cue and Thompson, 2006), although it may take many years for this effect on costs to become visible, depending on how high payment levels are initially set under a newly-introduced case payment system (Rosko and Mutter, 2010).

The first analyses based on the correlation between quality and reimbursement schemes used, as quality indicator, variations in mortality rate.

Mortality was studied especially in some US studies since the end of '80s. Payment methods and systems compared included fee for service, case payments, global budgets, capitation, pay for performance, all-payer rate setting, and competitive bidding. The datasets ranged in sample size from hundreds to millions of patients. The largest sample sizes were from analyses in which national discharge or outcome rates were collected.

Mayer-Oakes *et al.* (1988), for example, analysed outcomes for patients in the medical intensive care units of three hospitals in California, USA, after the payment change from fee-for-service to case payments. The study concerned 400 patients; 200 were admitted before the PPS (Oct 1981 to Aug 1982) and 200 were admitted after the PPS (Oct 1984 to Aug 1985). While both groups experienced a decreased hospital length of stay, there were no significant changes in in-hospital or six-months mortality.

A wide analysis has been done by Moreno-Serra and Wagstaff (2009), who compared the effect on mortality of payment system changes in 28 Central and Eastern European and Central Asian nations. The authors considered 28 countries during a 15-year period (1990-2004), when many former Soviet republics and satellites changed from global budgets to case payments or fee for service, and found that switching from global budgets to case payments resulted in national standardized death rates (not inpatient mortality). This effect was due to heart disease mortality rate, decreasing approximately 4%, and to stroke mortality, decreasing 5% over the study period. Moving from global budgets to case payments, there was no significant impact on mortality (as measured by national standardized death rates) for five other causes of death: diabetes, breast cancer, appendicitis, intestinal disease, and adverse events.

A significant effect on mortality rate was, instead, identified in Volpp *et al.* (2003), although their analysis was limited to payment system changes in only one US state, New Jersey, during the 1990s. The change in the payment system was related to competitive bidding for per diem rates instead of to a subsidy for care of uninsured patients. It was observed an increase in inpatient heart attack mortality from 3,7% to

5,2% for uninsured patients. Another later study on the same dataset, carried out by the same authors (Volpp *et al.*, 2005) measured differences in inpatient mortality for more conditions (heart attack, heart failure, stroke, hip fracture, pulmonary embolism, or pneumonia) and found no significant changes in mortality due to the change in payment methods.

The measurement of quality through mortality measures is often combined with morbidity measures, such as hospitalization for specific events (heart attack, pneumonia, stroke), emergency readmission rate after inpatient treatment for hip fracture. Although some readmissions cannot be avoided, low readmission rates are often used as a proxy measure for good inpatient care quality (Ashton *et al.*, 1997).

Measurement of quality based on mortality and morbidity data has been the object of the US Medicare – Premiere Inc. pay for performance demonstration, implemented in 2003. Premiere Inc. is a U.S. nationwide organization of non-profit hospitals; more than 200 hospitals adherent to Premiere Inc. agreed to participate in the demonstration, which involved sharing quality data, mostly on process measures, and an incentive/disincentive program for Medicare patients. The baseline payment method for these patients was Medicare's DRG case payment system[1].

Findings from studies of the Medicare-Premiere demonstration are that pay for performance's overall impact on quality was little to modest.

Glickman *et al.* (2007) studied heart attack care processes in 54 hospitals from 2003 to 2006, without finding significant incremental improvement in quality of care or outcomes for acute myocardial infarction attributable to the pay for performance program. In both intervention, hospitals and control hospitals, processes improved and mortality decreased, but the amount of change did not differ between the two groups. Grossbart (2006) observed only 10 hospitals and a one-year post-intervention period, detecting 8% improvement in heart failure care quality processes, but no improvement in pneumonia or heart attack care. However, the positive effect could be due to the very small sample size and the short time period of this study.

Jha *et al.* (2010) concentrated their attention on 251 control hospitals that collected data on 33 quality measures (3 conditions). The hospitals included in the sample served a disproportionate share of poor or uninsured patients: improvements in mortality rates

[1] The demonstration rewarded top performing hospitals with 1 to 2% bonuses during the first years of the demonstration and took away 1 to 2% of revenues from low performing hospitals that failed to improve by the third year of the demonstration.

due to a pay for performance program were less than 1% for heart attack and pneumonia care and there was no significant change for heart failure care.

Farrar *et al.* (2009) studied the effects on mortality and morbidity of English hospitals' change from global budgets to case payments with the objective to examine whether the introduction of payment by results (a fixed tariff case mix based payment system) was associated with changes in key outcome variables measuring volume, costs, and quality of care between 2003/20044 and 2005/2006. All patients admitted to hospitals in England and Scotland during the study period (10,4 million admissions to 248 hospitals), with Scottish hospitals being used as the control group (1,06 million admissions to 49 hospitals), were considered in the study. The authors examined proxy measures for output and quality. Concerning quality of care: inpatient hospital mortality, 30 day post-surgical mortality and Emergency Room (ER) admissions after hip fractures did not change significantly over the study period.

Ljunggren and Sjoden (2001 and2003) considered morbidity as parameter to measure quality outcomes: they compare outcomes from two surgical clinics (that is, two hospital orthopaedic surgery departments) in Sweden, one of which was paid by DRGs and the other one operating under a global budget. They studied the impact of the payment system differences on self-reported quality of life after surgery. Both studies did not found any effect, although, with only one intervention hospital and one control hospital, generalization of findings is questionable.

Quality as reported by patients' experience is considered by Hagen *et al.* (2006), who analysed the effects of a reimbursement reform in Norway, aimed at replacing a capitation-based block grant system with an activity-based system. Efficiency and quality measures are derived by surveys focusing on four dimensions of patient experiences: - general satisfaction (the patient's overall confidence and satisfaction with hospital stays); - information provided by hospital staff and communication with physicians; - nursing services (experiences with nurses' care and professional competence); - doctor services (patient experiences with doctors' care and competence). Local and county hospitals have been considered in the analysis: a higher efficiency was monitored for county hospitals, probably explained by differences in teaching load and research carried out at that hospital, or by the volume of acute episode.

In a recent work, Peabody *et al.* (2011) considered an experiment in the Phillipines to improve child health: randomly selected districts were assigned to one of three categories, "Expanded Insurance intervention", where hospitals were eligible for 100%

of the cost of covering common infections, such as pneumonia and diarrhea, "Bonus intervention", where physician salary increased by 5% for reaching quality benchmarks and a "control group".

Rather than the usual pay for performance model of making bonus payments afterwards, o recompense performance achieved, this was an arrangement characterized by an anticipated payment, aimed at improving performance on the basis of increased funding. The measurement of doctors' performance was done through on standardized clinical vignettes, although this was a very indirect measure of hospital quality. It was found a 3,5% improvement in scores attributable to the intervention at three year follow up.

Our analysis is focused on Italy. The institutional framework is fragmented, because of Regional differences, that should be taken into account. There are no many studies for Italy investigating the role that payment systems might have on hospital outcomes (Louis *et al.*, 1999).

Berta *et al.* (2010) carried out a study for the Lombardy Region. The authors started from the consideration that case payment systems often have pairs of DRGs differing only in the circumstances that one DRG of the pair is for patients with complications or co-morbidities, and that the payment for that DRG is higher. This situation might lead to an "upcoding", in which hospitals record all complications and co-morbidities and obtain the higher payment rate for many patients who should not be included in the DRG "with complications". The Lombardy Region in Italy addressed this problem by adding a condition to its DRG system and admitting higher payments for patients with a length of stay of at least a specified minimum duration. Hospital stays affected by the minimum length of stay rule decreased by 4%: this result demonstrates that patterns of discharges are affected by financial incentives.

Overall, this short review of literature studies on quality indicators and payment schemes shows how there is not a significant correlation between the two variables. This does not exclude the existence of such a correlation, that should be investigated by considering indicators related to more dimensions (such as mortality and morbidity).

Results might obviously change from country to country and according to the diagnosis considered. Moreover, the payment scheme might vary even within the same country, as it is in Italy.

3. Payment mechanisms for hospital providers in Italy

The Italian National Health Service (SSN – *Servizio Sanitario Nazionale*) has the nature of a complex multi-tier system, involving three different levels of government: central (Ministry of Health), regional (*Assessorati alla Salute*) and local (*Aziende Sanitarie Locali* – ASLs)[2]. The actual organizational structure of the SSN is the result of a set of reforms undertaken since the early 1990s. Among other things, the reform process aimed at introducing a more managerial culture and quasi-market mechanisms into the health care system as well as to devolve regions new responsibilities and powers for both the financing and delivering of health care.

As concerns hospital care, the reforms asked regions to transform major public hospitals into entities formally independent from the ASLs (*Aziende Ospedaliere* - AOs), thus implementing *de facto* the separation between purchasing and providing functions. As a result, public provision of hospital care ranges from independent AOs, to hospitals that are still directly controlled by the ASLs (*Presidi Ospedalieri* - POs) and private accredited[3] hospitals that compete with the public ones for supplying services. Within this legislative framework, regions were, however, free to decide the number of hospitals to hive off, the extent to which the commissioning power has to be attributed to ASLs[4] and the nature of providers with which to negotiate. All these choices result in a highly differentiated composition of hospital care supply across regions, in terms of both public-private mix and status of public providers, which lastly affects the degree of competition within the hospital care market.

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[2] The Ministry of Health is responsible for the national planning and for the coordination of regional activities, in order to guarantee the same essential levels of care (*Livelli Essenziali di Assistenza* – LEA) in all the areas of the country, Regions are competent to define their own health plans so as to organize services delivery within their own territory in accordance to central government's planning. The local healthcare authorities (ASLs) enjoy administrative and financial autonomy and are directly involved in producing and commissioning services (mainly LEA) in the geographical area under their responsibility.

[3] In Italy, the accreditation process of public and private providers has been systematically addressed with the Legislative Decree 299/1999. The issue is ultimately a regional responsibility and requires two standard top-down procedures: 1) an authorization for delivering health care services which is granted by the regional departments of health once a minimum set of structural, technological and organizational requirements has been satisfied; 2) an institutional accreditation for accessing the market of publicly funded services which requires the compliance with quality standards and the objectives of the regional plan.

[4] The Legislative Decree 229/99 does not specifies clearly what should be the ASL's involvement in the negotiation process. Therefore, regions have differently interpreted the role played by ASLs and their interrelations with regional authorities and providers. At one extreme, ASLs can carry out the purchasing activity autonomously (ASL-based model). At another extreme, regional authorities are directly involved in purchasing services and no role is delegated to ASLs. Sometimes, ASLs do not play any negotiation role but are only required to remunerate providers according to regional tariffs and to comply with regional budget constrains (third-party payer model). (See, Cantù and Carbone, 2004; France *et al.*, 2005)

Another key element of the SSN reform launched in 1992 was the switch from cost-reimbursement mechanisms (bed-day rates and *ex-post* payments) in the financing of hospital care to prospective payment systems (PPSs) for both inpatient procedures and outpatient ambulatory care. Under the new arrangements, hospitals were no longer secured the full reimbursement of all the actual costs for providing health services but they received a pre-determined fixed amount which did not necessarily reflect true production costs. This change did not however affect hospitals directly managed by local health authorities which continue to be mainly remunerated on the basis of historical spending.

For inpatient care provided by public independent hospitals and private accredited ones, the reimbursement is made up of two components: 1) activity based payments where patients are classified according to the DRG classification of discharges[5]; 2) block assignments based on average production costs, for specific health services. The latter include integrated care and management of chronic illnesses, prevention activities, programs for rare diseases, emergencies and accidents and, more generally, care activities with high waiting costs, ,experimental programs and organ transplants[6]. The rational for the use of a *forfeit* component lies in the fact that all these services are deemed inadequate to be properly funded through a per case payment system[7]. Within the general category listed above, regions have, however, the power to autonomously decide the specific areas of hospital activity which should be remunerated through non-tariff allocations, the type of hospitals that are entitled to receive this source of funds (only public hospitals or also private ones) and the related funding levels. By altering the overall hospital funding and its composition, regional decision-making on the utilization of block assignments have the potential to weaken the incentives provided by the PPS.

Several aspects of the adoption of the tariff-based system vary extensively among regions too. First of all, tariffs can play different roles towards hospital care providers. While for private hospitals they represent the "real price" paid by regions for the services provided on behalf of the SSN, for public hospitals regions can decide to use tariffs just as a device to assess hospital activity and to determine the global hospital

[5] Starting from January 1st 2009, Italy has adopted the version 24.0 of the Diagnosis Related Group system and the corresponding International Classification of Diseases ICD-9-CM (2007 version).
[6] Legislative Decree 502/1992, Article 8-sexies.
[7] For further details, see Morandi (2009) and Finocchiaro Castro *et al.* (2011).

budget (Morandi *et al*., 2008)[8]. In the latter case, losing their original character of per case payment, tariffs are no more expected to generate those positive incentives (mainly, in terms of improved efficiency) that the literature recognizes them.

As for the way tariffs are determined, some regions have decided to apply national tariffs[9] (with or without the allowed abatement), set in accordance with either the decree D.M. 30.06.1997 (Piedmont, Valle d'Aosta, Trento and Bolzano) or the decree D.M. 12.09.2006 - Lazio, Campania, Molise, Puglia, Sicily and partly Abruzzi and Sardinia[10] - (Morandi, 2009). In contrast, only 5 of the 21 Italian regions (Lombardy, Veneto, Emilia Romagna, Tuscany and Umbria) have developed their own fee schedules on the basis of some kind of cost assessment.

Irrespective of whether national or regional tariffs are adopted, all regions are free to discriminate tariffs across providers in an attempt to make them closer to their actual costs and the specificities of their regional context. In general, a more generous financial treatment is applied to public hospitals[11], as well as those hospitals with more complex case-mix indices, providing highly specialized services (e.g. emergency, blood banks, etc.) or carrying out teaching and research activities[12]. As shown by Morandi and Arcangeli (2009), the range of variation in regional hospital tariff classes is quite large, moving from a minimum of 3% in Sicily and a maximum of 25% in the Province of Trento, with the only exception of Campania where it reaches 57%.

Regions may also decide to modulate tariff fees not just to secure adequate funding to hospitals but also to orient hospital activity towards the achievement of the regional planning objectives. In this case, tariffs of single activities are used as leverage to encourage or discourage certain delivery patterns (Cantù and Carbone, 2007)[13]. High

[8] Legislative Decree 229/1999, Article 8-sexies.

[9] According to the criteria laid out by the Ministry of Health Decree April 15th 1994, tariffs were to be set using a full costing approach. The same year the first list of national tariffs was determined (Ministry of Health Decree December 14th, 1994) based on data collected from eight hospitals located in the northern and central regions of the country (Fattore and Torbica, 2006). Since then, national tariffs were updated in 1997 (Ministry of Health Decree June 30th, 1997) and, more recently, in the 2006 (Ministry of Health Decree September 12th, 2006). National tariffs are not differentiated by hospital categories, nor do they entail additional reimbursements for costly items such as drugs and medical devices (Morandi, 2009).

[10] In Sardinia some tariffs are defined in accordance with the uniform tariff (TUC - *Tariffa Unica Convenzionale*) which applied to hospital treatments provided outside the region of residence. The same mechanism is adopted also by Calabria, Liguria and Basilicata.

[11] Public hospitals are entitled to higher resources than private ones under the assumption that these structures provide more complex services and treat patients in worse health conditions.

[12] According to the legislative Decree 517/99, teaching hospitals are also entitled of additional financial resources, regionally defined in an amount between 3% and 8% of the overall budget allocated through the DRG system.

[13] In general, regions aimed at shifting health care treatments towards settings more efficient but equally effective - e.g. day cases against inpatient admissions - (Morandi, 2009).

tariffs may encourage providers to increase the production of the related services while low tariffs may induce to restrain health care provision.

Last but not least, Italian regions show marked differences with regards to the implementation of expenditure control measures. Under a PPS, these are used to tackle the opportunistic behaviours by providers to increase volume of services. Two main approaches can be distinguished (Annessi-Pessina, Cantù and Jommi, 2004). Some regions (e.g. Lombardy) have centrally set caps, ceilings or targets at either regional, ASL or hospital level. Thresholds can be defined in terms of either expenditure or volume of care. Under the second decentralized approach, regions (e.g. Tuscany) control volumes using bilateral contracts, rather than targets and ceilings. ASLs negotiate with hospitals to define the volume, mix and price in accordance with regional planning. Independently from the chosen control method, departures from the assigned budgets imply either a reduction of the per case tariff or a cut of the global DRG-based funding[14].

To sum up, analysing the impact of tariffs on hospital care is not an easy task. Tariff systems are markedly regionally differentiated in Italy. National legislation allows regions to autonomously decide the main characteristics of their own tariff rates (level, classes of providers, tariff reductions, etc.), the role to attribute to the tariff system, the extent to which the overall hospital funding should be tariff-based as well as various other aspects of the hospital care market structure (public-private mix; relationships among regional authorities, ASLs and providers; etc.). All these regulatory arrangements, both separately and jointly, are expected to have an effect on the incentives provided by the PPS but are not easily representable and quantifiable in the empirical analysis. When assessing the effects of tariffs on hospital performance, at least the following two points must be kept in mind: 1) incentives, typically related to tariffs, act differently according to the hospital typology, with no role for those run by ASLs and maximum effect for the private accredited hospitals; 2) the overall hospital funding, and not just the tariff component, should be considered since non PPS-related assignments (which are often very discretionary in nature) may offset PPS incentives.

[14] Alike tariff reimbursement, a more favorable treatment is generally provided to public hospitals and to those with a more complex case mix.

4. Data and empirical strategy

4.1 Dataset

As highlighted in the previous section, due to the regionalization process, the Italian SSN may represent an interesting case study to test the impact of different financing mechanisms on the quality of hospital care. An empirical analysis is carried out to examine the hypothesis that quality outcome data of Italian hospitals are affected by different reimbursement systems adopted at regional level.

The main source of data for this study is the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – PNE) run by the National Agency for Regional Health Services (Agenzia Nazionale per i Servizi Sanitari Regionali – AGE.NA.S) together with the Italian Ministry of Health. The program is intended to assess the health care activity of all Italian hospitals, either public or private accredited, which provide services on behalf of the SSN. The outcome assessment is based on discharge data collected in the time span 2005-2010 and the study population is represented by all the Italian residents at the date of January 1st, 2010. The observation units are both hospitals and local health authorities. Data are gathered from the Informative Hospital System (Sistema Informativo Ospedaliero - SIO) and, where available, from the Informative Systems for Regional Mortality (Sistemi Informativi di Mortalità Regionali).

The following outcome measures are considered by the program: short-term mortality, short-term readmissions, hospitalization for specific clinic conditions, surgical procedures, short-term complications after specific treatments, waiting lists. Overall, 45 performance indicators (32 related to hospital services and 13 to hospitalization) are computed [15].

We were able to gain access only to few indicators among the several developed by the PNE Program: 30-day mortality rates in patients with AMI, CHF and stroke. In addition, 30-day in-hospital readmission rates after stroke and COPD are used. All these five indicators are examined at a hospital level and are related to the period 2009-2010.

The rationale behind the choice of these indicators for quality of care lies in the fact that they are among the most frequently factors employed in international studies, as seen in the previous literature review. Notwithstanding, data on these indicators are not

[15] Further details on the PNE Program are available at AGE.NA.S website (http://151.1.149.72/pne10/index.php).

available for all the hospitals providing health care services on behalf of the SSN but only for specific subsets of them. In particular, risk adjusted mortality and readmission rates are reported by the PNE Program only for high-volume hospitals[16] while gross rates are provided for almost all hospital structures.

Summary statistics for the five indices are presented in Tab. 1. Gross indices reveal great variability among Italian hospitals; the same variability decreases markedly whenever risk adjusted indicators are used.

Moreover, though the number of hospitals in the sample for which risk adjusted indices are provided is limited, these cover almost the whole body of hospital cases. As for AMI, risk adjusted mortality rates in 2009 are provided for 393 hospitals (about 38% of all the hospitals dealing with this diagnosis). However, they have treated 91% of the overall cases (85,742 patients out of a total of 94,221).

Similar conclusions can be drawn also with regard to the other indicators, thus showing that a high degree of hospitals' specialization exists for those medical conditions selected in this paper.

Table 1 – Summary statistics for selected indices by year

		AMI	CHF	STROKE	STROKE readmission	COPD readmission
Year 2009	Gross index % [a]	16.16 (20.53)	9.39 (10.60)	13.00 (14.96)	13.29 (16.23)	14.78 (12.85)
	Number of cases	*94,221*	*169,046*	*80,231*	*70,532*	*104,400*
	Number of hospitals	*1,021*	*1,127*	*1,018*	*1,007*	*1,108*
	Risk adj. index % [a]	11.16 (4.05)	9.00 (4.71)	13.36 (6.03)	11.46 (4.15)	14.34 (4.82)
	Number of cases	*85,742*	*151,892*	*71,080*	*60,713*	*94,159*
	Number of hospitals	*393*	*650*	*435*	*395*	*605*
Year 2010	Gross index % [a]	16.96 (22.11)	9.44 (11.61)	10.92 (13.77)	11.88 (14.08)	13.65 (10.83)
	Number of cases	*95,187*	*166,413*	*66,446*	*60,320*	*97,954*
	Number of hospitals	*1,015*	*1,102*	*931*	*922*	*1,081*
	Risk adj. index % [a]	10.80 (3.92)	8.87 (4.64)	10.17 (4.61)	10.96 (4.01)	14.33(4.76)
	Number of cases	*86,171*	*153,799*	*56,652*	*50,463*	*87,010*
	Number of hospitals	*382*	*640*	*381*	*356*	*564*

Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS)

[a] Mean value (SDs)

[16] Risk adjusted indicators are computed by the AGE.NA.S only for those hospitals with a high number of cases in the referred year. In general, the threshold is set equal to 75 cases per year. The risk adjustment methodology used within the PNE Program is very complex and based on multivariate regressions: odds ratios have been calculated to adjust for higher risks that certain groups of patients might present. A predictive model has been implemented by considering all factors (patients' age, sex, seriousness of clinical conditions, presence of chronic co-morbidity factors, etc) which could be potentially associated to the outcome considered: logistic regression models, survival analyses and Poisson regressions have been also used.

The specific object of our analysis strongly suggest to exclusively employ risk adjusted indicators, so as to correct for the effect of certain confounding factors on hospital outcome. Indeed, as to the use of these indicators at a hospital level, it can be expected that the residual variability among hospitals is reasonably associated with a different level of quality of care.

4.2 Empirical strategy

Consistently with the scope of this preliminary analysis, only those variables which are expected to capture the existing regional differences in the adoption of financing mechanisms as well as the role played by them within the regional health systems, are employed.

As highlighted in section 3, regional divergences are very pronounced in Italy and each hospital financing system presents its own peculiarities. Different approaches are suggested in the literature to capture regularities across regions in the prevailing hospital financing model.

Finocchiaro *et al*. (2011) proposed to consider, for each region, the share of total hospital beds owned by public independent and private accredited hospitals (the two classes of hospitals for which this financing mechanism is actually in use, even if at different degrees). This variable is used as a proxy for quantifying the extent to which the DRG payment system is adopted in each region. We decided to use the same variable, though latest available data on hospital beds provided by the Ministry of Health refer to the year 2008 (DRG_EXTENT).

A simpler approach is proposed by Francese *et al.* (2012) in their paper on the inappropriateness of caesarean deliveries across Italian regions. The authors separate, through a dummy variable, those Regions that have established their own DRG tariffs from those ones that have opted for the national DRG rates, though with some modifications. By splitting Regions into two groups, this variables is intended to disentangle regional decision-making over the use of the DRG system. In particular, regions that implemented their own tariff system are expected to be more active in managing their health care market and this would result in a better ability to control expenditure levels. Similarly to Francese *et al.* (2012), in order to identify the two groups of regions, we use data on national tariffs as established by the ministerial decree

30/06/1997 and more recently as published on the AGE.NA.S website (DRG_REGIONAL).

A preliminary explorative analysis of the selected hospital outcome indicators is reported in the appendix. Scatter plot analyses show some common trends. For all indicators, the higher the value of the DRG_EXTENT variable, the better the results of the outcome indicators, though there are small increases. This tendency seems to persist even when grouping hospitals according to the DRG implementation choices (DRG_REGIONAL).

On the contrary, boxplots for the hospital outcome indicators by the variable "DRG_REGIONAL" reveal less marked regularities even though, for most of them, hospitals of Regions adopting their own tariffs show greater variability in their performances than hospitals of Regions implementing national DRG rates.

As a further step of this preliminary analysis, we simply regress hospital performance indexes on a set of control variables. Provided that our dependent variables are truncated from below (by construction), we decided to use truncated regression models.

Besides the variables "DRG_EXTENT" and "DRG_REGIONAL", the number of hospital cases ($CASE_j$) for each selected indicator is also employed to evaluate whether hospitals treating a higher number of cases show better outcomes. The relationship between volume and outcome has been studied by a large empirical literature (see Gaynor *et al.*, 2005, for a review). Two leading explanations are provided for the positive correlation which however imply a different direction of causality: the so-called "practice makes perfect" and "selective referral" hypotheses. Under the first hypothesis, either learning-by-doing or quality-enhancing scale economies cause large hospitals to provide better quality care and thus to improve outcomes. The alternative explanation, selective referral, postulates that hospitals with higher quality attract a greater volume of patients. Although both explanations are plausible, the literature has largely relied on the learning-by-doing interpretation.

Another factor that could in theory influence hospital performance is the different size of the regional hospital systems. To control for the effects of differences in the regional supply of hospital beds, we therefore use the total number (in thousands) of regional hospital beds in 2008 (BEDS). The data source is the Italian Ministry of Health.

Several studies have indicated that the performance of the Italian regional health systems across different country areas are marked by relevant efficiency differentials. To control for these peculiarities, two macro-area dummies (NORTH and CENTRE) are

considered. Finally, time fixed effects are used to account for the impact of annual changes in the computation method of the risk adjusted indices.

Therefore, the estimated models have this general formulation:

$$Index_{ijt} = \beta_1 + \beta_2 CASE_{ijt} + \beta_3 DRG\_REGIONAL + \beta_4 DRG\_EXTENT + \beta_5 BEDS + \beta_6 NORTH + \beta_7 CENTRE + \mu + \varepsilon_{ijt} \quad [1]$$

where the subscript *jit* refers to quality index *j* in hospital *i* in year *t* (with *t* = 2009, 2010), μ is time fixed effects, ε_{ijt} is the disturbance term and the variables are those listed in Table 2.

Tables 3 and 4 provide summary statistics for the risk adjusted indices of mortality and readmissions, respectively.

Table 2 – Description of variables used in estimation

Variable	Meaning
DEPENDENT VARIABLES	
AMI	30-day risk adjusted mortality rate for acute myocardial infarction
CHF	30-day risk adjusted mortality rate for congestive heart failure
STROKE	30-day risk adjusted mortality rate for stroke
STROKE_R	30-day risk adjusted readmission rate after stroke
COPD_R	30-day risk adjusted readmission rate after chronic obstructive pulmonary diseases
INDEPENDENT VARIABLES	
$CASE_j$	Number of cases with the j condition (j = AMI, CHF, STROKE, STROKE_R, COPD_R)
DRG_REGIONAL	Dummy for regional tariff system
DRG_EXTENT	Proportion of total beds owned by public independent and private accredited hospitals
BEDS	number of regional hospital beds per 1,000 inhabitants
NORTH	Dummy for north area of the country
CENTRE	Dummy for centre area of the country

Table 3 – Summary statistics for risk adjusted mortality rates (different hospital samples)

Variable	Obs	Mean	Std. Dev.	Min	Max
SAMPLE FOR AMI					
AMI	775	10.984	3.987	0.740	41.540
$CASE_{AMI}$	775	221.823	128.144	76.000	917.000
DRG_REGIONAL	775	0.632	0.483	0.000	1.000
DRG_EXTENT	775	0.442	0.207	0.000	0.765
BEDS	775	18.2168	10.2379	0.4150	37.4060
NORTH	775	0.439	0.497	0.000	1.000
CENTRE	775	0.225	0.418	0.000	1.000
SOUTH	775	0.337	0.473	0.000	1.000
SAMPLE FOR CHF					

CHF	1290	8.932	4.675	0.160	31.720
$CASE_{CHF}$	1290	240.158	162.204	76.000	1080.000
DRG_REGIONAL	1290	0.632	0.483	0.000	1.000
DRG_EXTENT	1290	0.441	0.204	0.000	0.765
BEDS	1290	17.886	10.227	0.415	37.406
NORTH	1290	0.424	0.494	0.000	1.000
CENTRE	1290	0.228	0.420	0.000	1.000
SOUTH	1290	0.348	0.477	0.000	1.000
SAMPLE FOR STROKE					
STROKE	816	11.869	5.641	1.170	35.020
$CASE_{STROKE}$	816	156.534	101.695	51.000	632.000
DRG_REGIONAL	816	0.672	0.470	0.000	1.000
DRG_EXTENT	816	0.431	0.203	0.000	0.765
BEDS	816	17.710	10.042	0.415	37.406
NORTH	816	0.444	0.497	0.000	1.000
CENTRE	816	0.260	0.439	0.000	1.000
SOUTH	816	0.297	0.457	0.000	1.000

Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table 4 – Summary statistics for risk adjusted readmission rates (different hospital samples)

Variable	Obs	Mean	Std. Dev.	Min	Max
SAMPLE FOR STROKE_R					
STROKE_R	751	11.221	4.094	1.550	35.640
$CASE_{STROKE\_R}$	751	148.037	91.234	51.000	584.000
DRG_REGIONAL	751	0.668	0.471	0.000	1.000
DRG_EXTENT	751	0.433	0.204	0.000	0.765
BEDS	751	17.617	10.091	0.415	37.406
NORTH	751	0.450	0.498	0.000	1.000
CENTRE	751	0.250	0.433	0.000	1.000
SOUTH	751	0.300	0.458	0.000	1.000
SAMPLE FOR COPD_R					
COPD_R	1169	14.339	4.790	2.360	32.510
$CASE_{COPD\_R}$	1169	154.978	131.311	51.000	1186.000
DRG_REGIONAL	1169	0.587	0.493	0.000	1.000
DRG_EXTENT	1169	0.437	0.206	0.000	0.765
BEDS	1169	17.557	9.906	0.415	37.406
NORTH	1169	0.405	0.491	0.000	1.000
CENTRE	1169	0.207	0.405	0.000	1.000
SOUTH	1169	0.388	0.487	0.000	1.000

Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

5. Results and discussion

Estimation results from the described regression models of the five selected risk adjusted indices are reported in Tables 5 and 6.

Table 5 – Estimation results for risk adjusted mortality rates - truncated regression models

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	AMI			**CHF**			**STROKE**		
Intercept	10.4672***	11.4881***	11.4265***	7.1588***	7.7472***	7.7870***	13.0819***	13.8881***	14.0553***
	(0.4395)	(0.5125)	(0.5110)	(0.4681)	(0.5765)	(0.5754)	(0.6354)	(0.7805)	(0.7698)
CASE$_j$	-0.0004	-0.0009	-0.0006	-0.0003	-0.0004	-0.0005	-0.0051**	-0.0056***	-0.0054**
	(0.0012)	(0.0012)	(0.0012)	(0.0010)	(0.0010)	(0.0010)	(0.0021)	(0.0021)	(0.0021)
DRG_REGIONAL	-0.9120**		-0.9758**	-0.4950		-0.5764	-2.1206***		-2.2479***
	(0.4144)		(0.4121)	(0.4500)		(0.4524)	(0.5872)		(0.5899)
DRG_EXTENT		-3.4344***	-3.5356***		-1.9051*	-2.0433*		-2.7601*	-3.3064**
		(0.9945)	(0.9925)		(1.1150)	(1.1189)		(1.5092)	(1.5020)
BEDS	0.0163	0.0441**	0.0669***	0.0003	0.0147	0.0308	0.0566**	0.0433	0.1050***
	(0.0182)	(0.0210)	(0.0230)	(0.0202)	(0.0230)	(0.0262)	(0.0267)	(0.0310)	(0.0347)
NORTH	1.0514***	0.3949	0.7519*	2.3410***	1.9364***	2.0942***	1.2223**	0.2646	0.8834
	(0.3992)	(0.3770)	(0.4050)	(0.4289)	(0.4311)	(0.4484)	(0.5697)	(0.5725)	(0.5887)
CENTRE	0.9120**	0.0225	0.4432	2.7460***	2.2620***	2.4358***	3.2118***	1.9924***	2.6968***
	(0.4413)	(0.4228)	(0.4573)	(0.4605)	(0.4701)	(0.4893)	(0.6000)	(0.6207)	(0.6418)
Observations	775	775	775	1290	1290	1290	816	816	816
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	Yes	yes
Log likelihood	-2163.240	-2159.731	-2156.931	-3746.085	-3745.233	-3744.419	-2496.483	-2501.327	-2494.061
Wald (Prob > chi2)	0.1027	0.0071	0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.
Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6 – Estimation results for risk adjusted readmission rates - truncated regression models

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	STROKE_R			**COPD_R**		
Intercept	12.9147***	13.9024***	13.9613***	14.4217***	15.7691***	15.7669***
	(0.4586)	(0.5611)	(0.5602)	(0.3881)	(0.4831)	(0.4831)
CASE$_j$	-0.0023	-0.0028*	-0.0028*	-0.0007	-0.0017	-0.0016
	(0.0017)	(0.0017)	(0.0017)	(0.0011)	(0.0011)	(0.0011)
DRG_REGIONAL	-0.6878*		-0.8055*	0.3764		0.2668
	(0.4133)		(0.4124)	(0.3925)		(0.3898)
DRG_EXTENT		-3.2037***	-3.3885***		-4.3950***	-4.3552***
		(1.0557)	(1.0580)		(0.9474)	(0.9490)
BEDS	0.0078	0.0350	0.0567**	-0.0646***	0.0051	-0.0017
	(0.0191)	(0.0218)	(0.0244)	(0.0181)	(0.0203)	(0.0226)
NORTH	-1.5374***	-2.1323***	-1.9165***	1.6678***	1.2892***	1.1895***
	(0.3985)	(0.3996)	(0.4133)	(0.3740)	(0.3564)	(0.3849)
CENTRE	-0.5229	-1.3158***	-1.0636**	1.1388***	0.5675	0.4574
	(0.4293)	(0.4415)	(0.4587)	(0.4188)	(0.4104)	(0.4407)
Observations	751	751	751	1169	1169	1169
Year fixed effects	yes	yes	yes	yes	yes	yes
Log likelihood	-2103.113	-2099.913	-2098.009	-3459.646	-3459.646	-3459.412
Wald (Prob > chi2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.
Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Despite the limited number of control variables employed at a hospital level, some interesting conclusions can be drafted. Overall, the regression results are satisfactory and quite consistent with our expectations. The number of hospital cases ($CASE_j$) does not show a significant impact on hospital performance for AMI, CHF and COPD but the coefficients present the expected negative signs and are significant when considering stroke mortality and readmission. The number of beds (BEDS), instead, is positively and significantly correlated with mortality for stroke and in some regressions for AMI.

The dummy variable accounting for regional tariffs (DRG_REGIONAL) is significant almost in all regressions, indicating how improvements in quality indicators can be achieved by setting tariffs at a regional level. A possible explanation is that, by setting their own tariffs, Regions could keep into account some peculiarities and local differences. However, it would be interesting to check whether the same correlation with quality indicators is confirmed when data about not only mortality but also morbidity are included in the analysis or when other diagnoses are considered.

The variable "DRG_EXTENT" is always significant and inversely correlated with mortality and readmission rates, showing once again how financing systems do have a role in determining a higher level of hospital performance.

There is a marked positive effect of the geographical variables: the highest values are associated with the coefficients related to Central Regions for CHF and stroke mortality rates. As for readmissions rates, geographical dummies presents significant and negative coefficients for stroke readmissions.

In conclusion, the main findings of this preliminary analysis are that, whenever significant, variables related to the regional financing systems show always positive effects on hospital outcomes. This is true independently of the quality outcome indicators and the number of hospitals in the sample. Hence, the need to proceed to more detailed analyses (for example, considering quality variability at either the provincial or local health unit level or grouping hospitals according to similar characteristics – dimension, number of cases treated per year, etc.).

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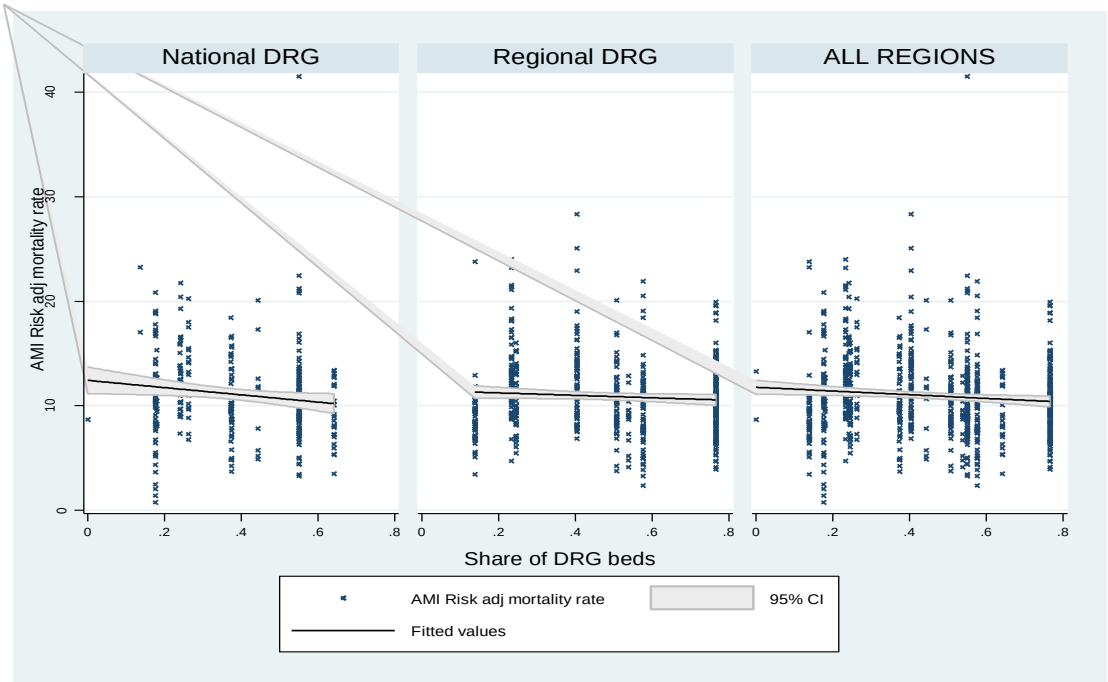
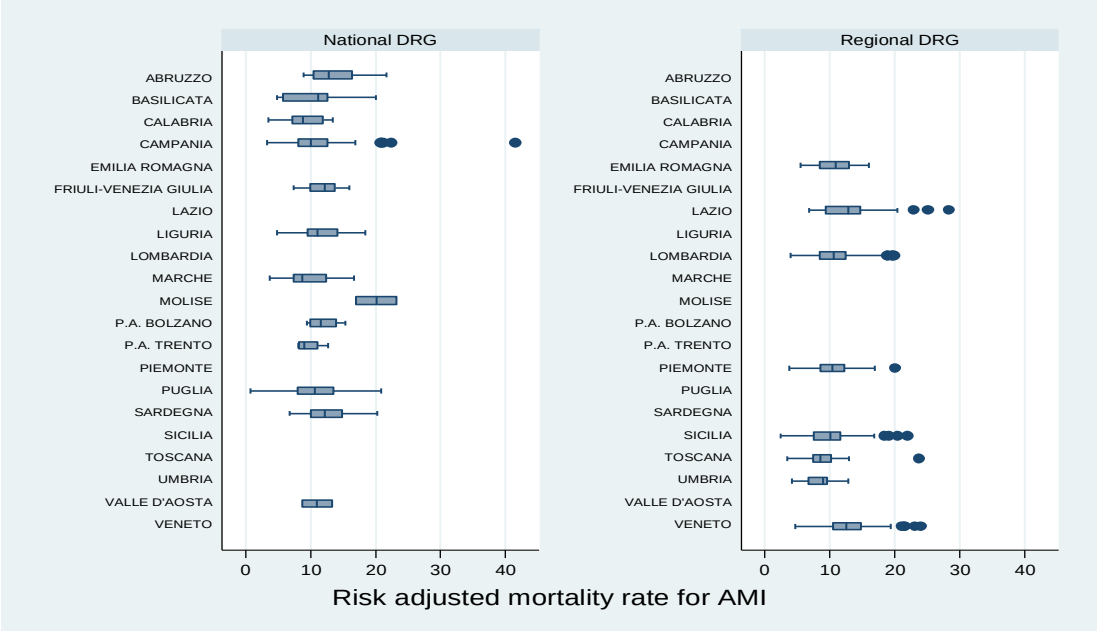
APPENDIX

Table A.1 - Scatter plots of hospital risk adjusted mortality rates for AMI by DRG system



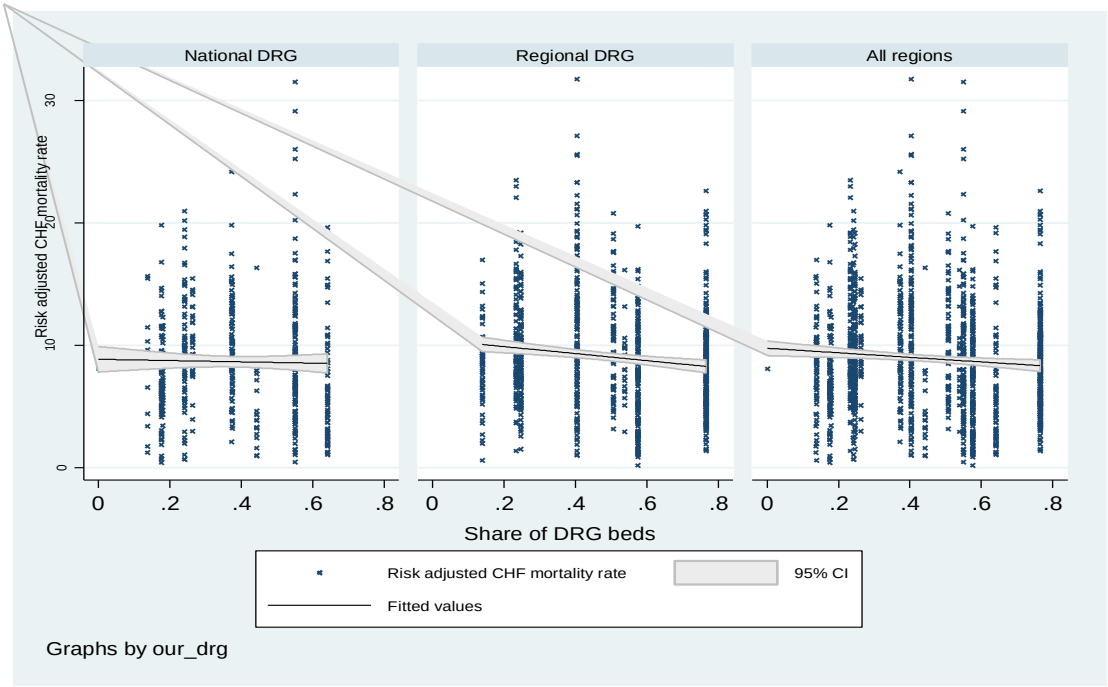
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.2 - Box plots of hospital risk adjusted mortality rates for AMI by DRG system



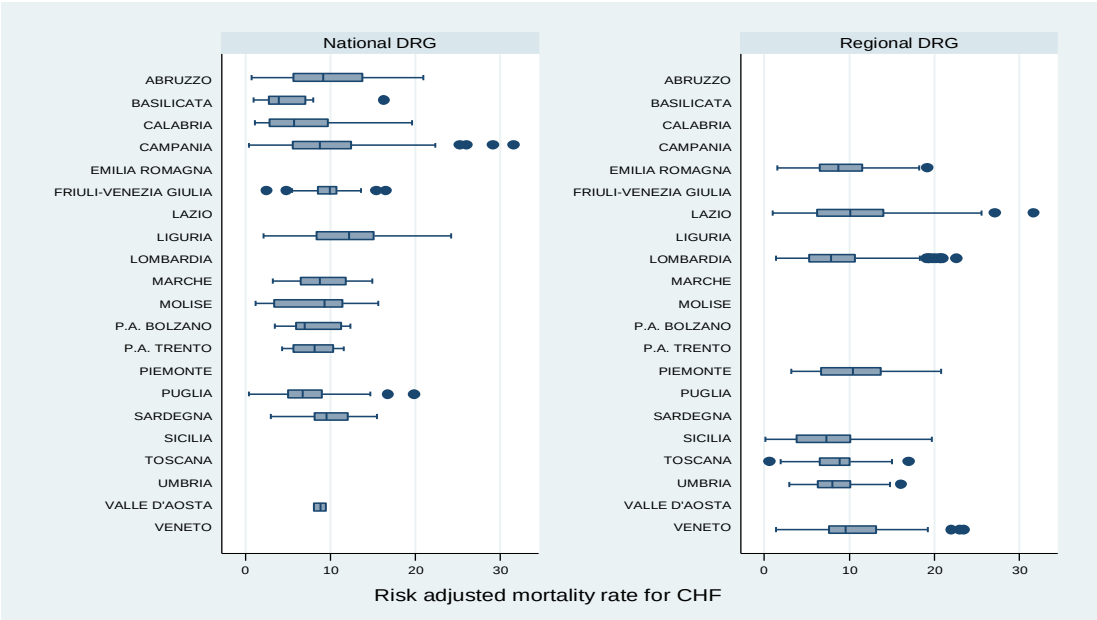
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.3 - Scatter plots of hospital risk adjusted mortality rates for CHF by DRG system



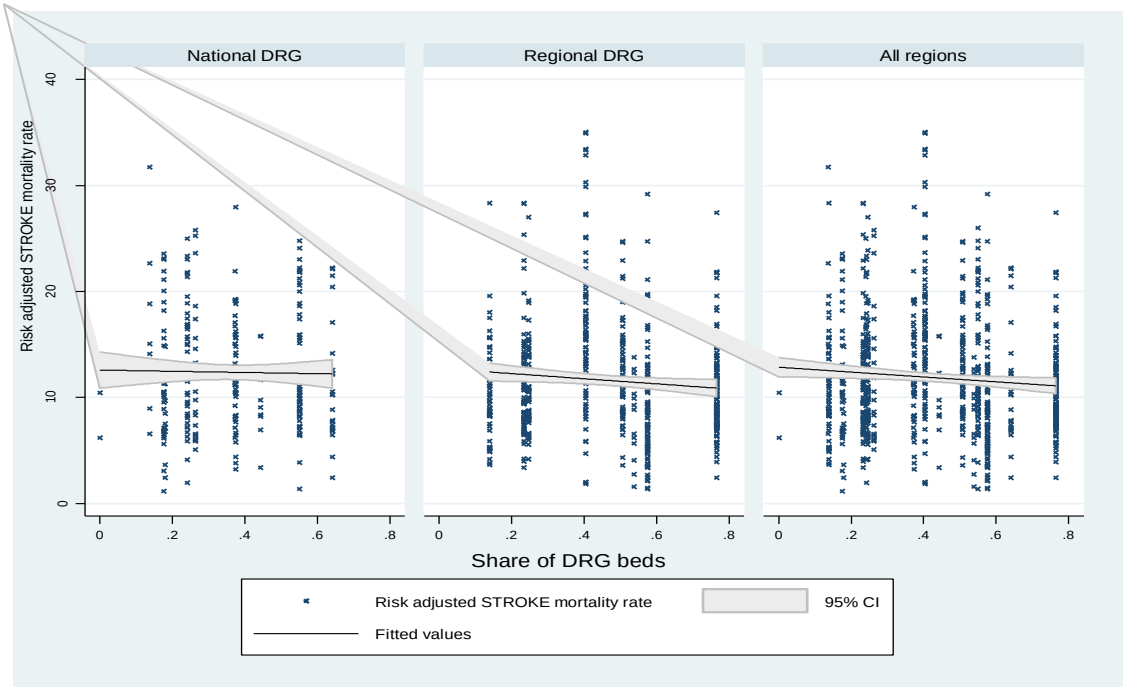
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.4 - Box plots of hospital risk adjusted mortality rates for CHF by DRG system



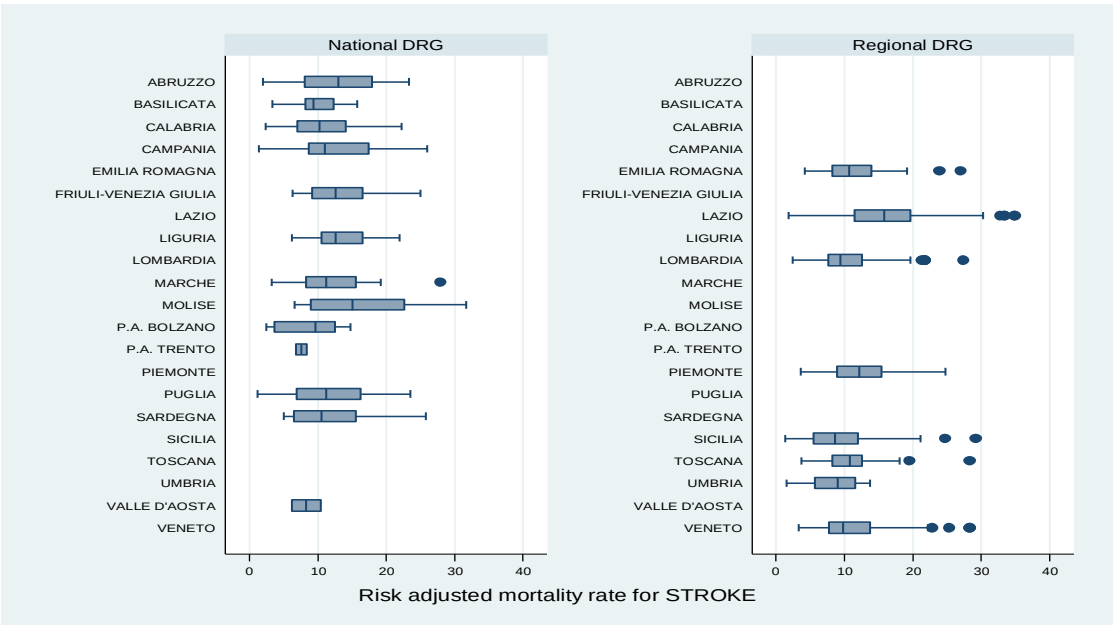
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.5 - Scatter plots of hospital risk adjusted mortality rates for STROKE by DRG system



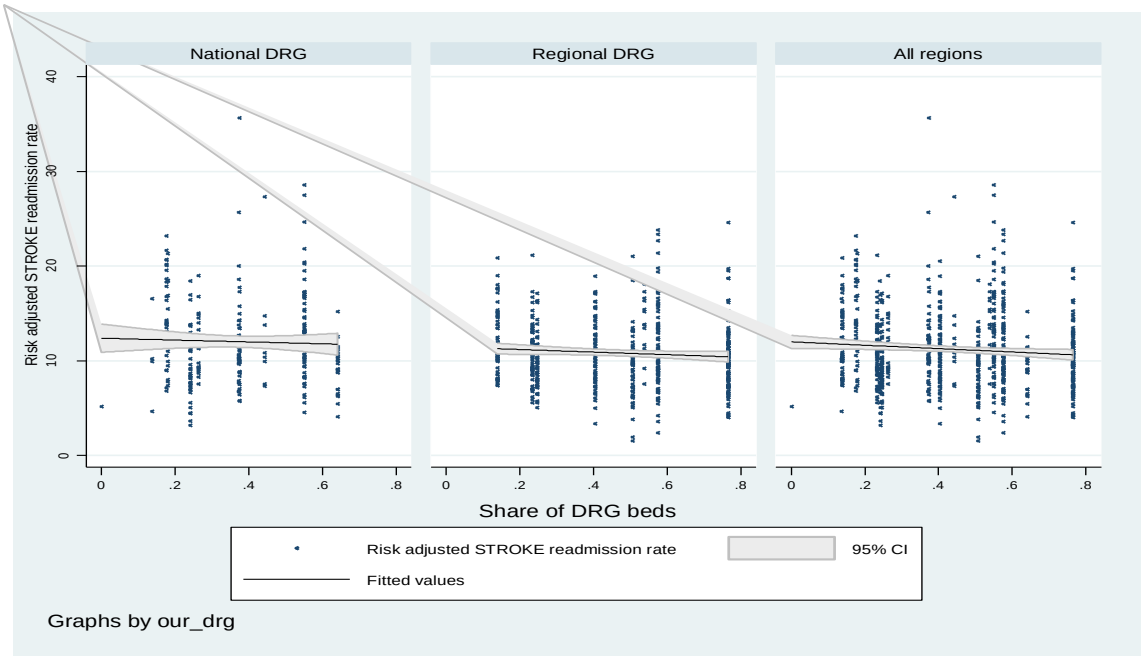
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.6 - Box plots of risk adjusted mortality rates for STROKE by DRG system



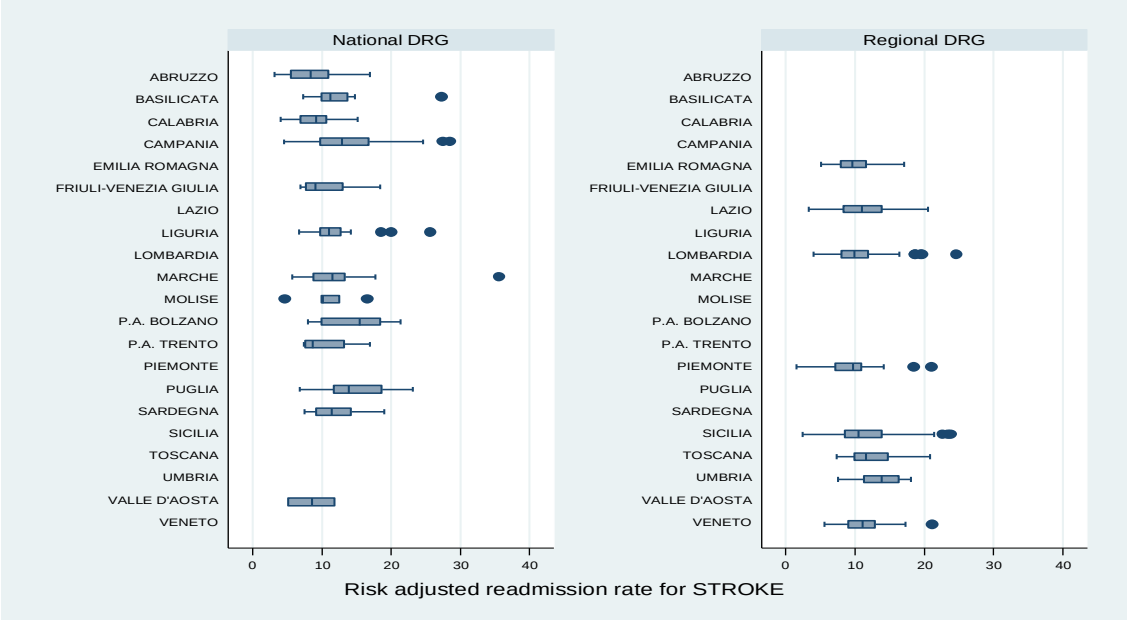
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.7 - Scatter plots of hospital risk adjusted readmission rates for STROKE by DRG system



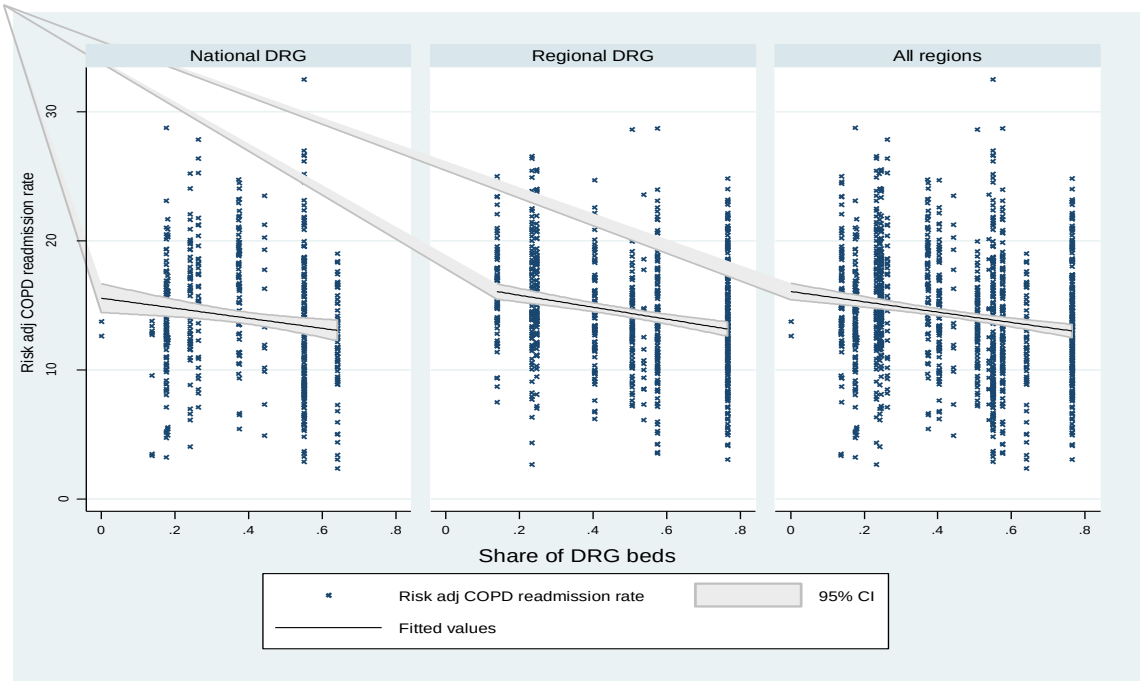
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.8 - Box plots of hospital risk adjusted readmission rates for STROKE by DRG system



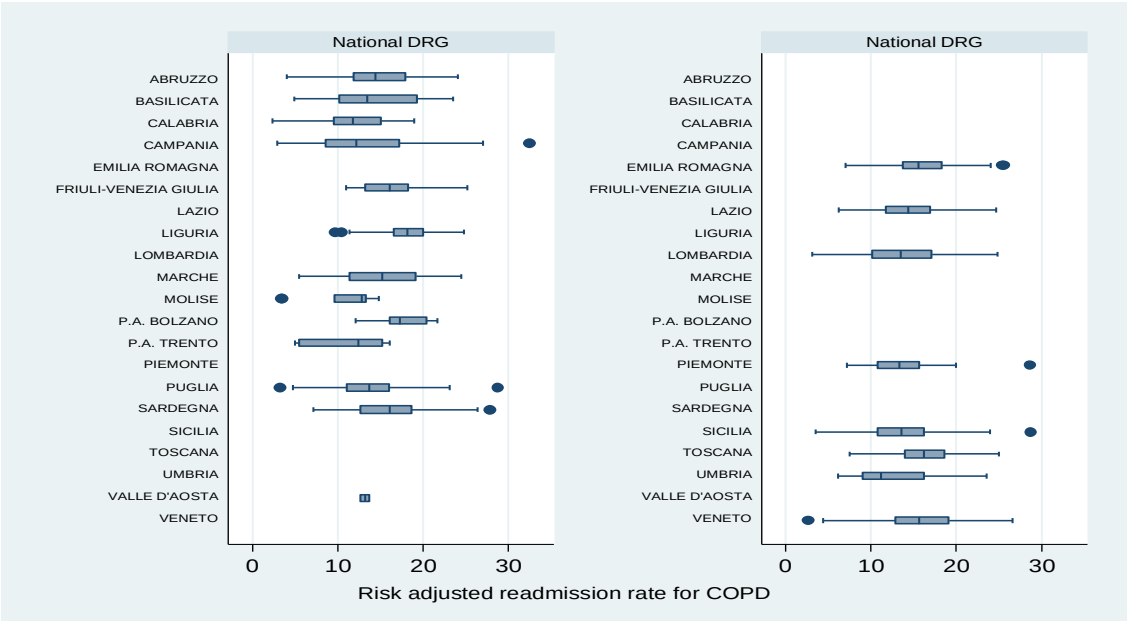
Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.9 - Scatter plots of risk adjusted readmission rates for COPD by DRG system



Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.

Table A.10 - Box plot of risk adjusted readmission rates for COPD by DRG system



Source: our elaboration on data provided by the National Program for Outcome Assessment (Programma Nazionale Valutazione Esiti – AGENAS) and Ministero della Salute.