

# Understanding hospital performance: The role of network ties and patterns of competition

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**Background:** To improve efficiency and quality, a number of policies have recently been implemented to increase competition and cooperation within the health systems of many countries. We theorize how hospital performance, measured as productivity, is contingent upon network embeddedness, the extent to which a hospital is involved in a network of interconnected interorganizational relationships.

**Purpose:** The aim of this study was to explore the effects on hospital productivity resulting from both collaborative network ties and competitive relationships between providers.

**Methodology:** We used panel data collected between 2003 and 2007 from 35 hospitals in Abruzzo, one of the most populated regions of central Italy. We used secondary data of hospital activities regarding both clinical and administrative aspects. For each year, we examined the intensity of interhospital competition and the unique position each provider has within a larger network of relationships with other hospitals. Other idiosyncratic organizational characteristics were examined as well.

**Findings:** Our results show that hospital productivity is negatively related to the degree of competition that a hospital faces and positively related to the degree with which hospitals establish collaborative relationships. We also found that the negative impact on hospital productivity due to competition was lessened when hospitals were more likely to create cooperative network ties.

**Practice Implications:** Because interhospital collaboration and competition are related to hospital productivity, they should constitute a core element in the strategic planning of a hospital's operation. Health administrators should implement policies that favor collaborative network ties at the regional level and mitigate interorganizational rivalries when establishing collaborative relationships with local competitors.

The current environment in which health care providers operate and perform is characterized by the simultaneous influences of cooperation and

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competition among themselves. In the early 1990s, many national governments took initial steps toward introducing market forces into the provision of health care services while simultaneously emphasizing the need for closer collaboration between different health care providers (e.g., Cabiedes & Guillén, 2001; Light, 2001).

Literature on health care management has widely investigated the impact of hospital competition on cost, access, and quality of services (e.g., Dranove, Shanley, & Simon, 1992; Dranove & White, 1994) as well as a number of benefits that interhospital collaboration might produce (Bazzoli, Chan, Shortell, & D'Aunno, 2000; Chukmaitov et al, 2009). Despite this extensive prior research, a number of limitations are observed. First, few empirical studies analyzed how interhospital competition influences hospital performance in countries that practice universalistic health care. Most studies focused on the health care system of the

United States. Secondly, whereas previous literature does account for the impact of interhospital competition and collaboration on organizational performance (Barretta, 2008), the simultaneous effects of competition and collaboration have not been widely investigated. Finally, the theoretical framework and underpinning concepts adopted in prior literature have mainly relied on neoclassical economic views and economic concepts of industrial organization. Neoclassical economics provides a product-centric view of markets, whereas industrial economics suggests that the behaviors and performance of individual organizations are strongly related to the number of competitors, the level of concentration, and other factors.

This study adopts an “embeddedness perspective,” which focuses on the interactional nature of competition and collaboration rather than viewing markets as stable economic structures (Granovetter, 1985; Uzzi, 1996). Organizations within markets do not act independently but are highly interdependent, and they influence each other by making provisions and decisions that modify expectations, behaviors, and actions within the market. These continual and mutual adjustments are based on patterns of interdependent influences among actors and allow markets to be considered social structures (White, 2002). Consequently, a wide range of organizational behaviors and outcomes can be understood by analyzing interorganizational relationships. In context of this relational view, the purpose of this study was to explore the impact on organizational performance stemming from the collaborative and competitive interdependence observed between hospitals.

## Background

At the international level, health care organizations have currently increased their level of interdependence within their competitive and institutional environment. In pluralistic systems, the demand for wider health care coverage increasingly requires that health care organizations integrate their resources by creating interorganizational linkages with one another (Gittell & Weiss, 2004).

Health care restructuring in universalistic systems have recently introduced a “quasi-market” framework, claiming to stimulate efficiency by increasing competition between providers (Smith, Preker, Light, & Richard, 2005). In light of some fundamental changes introduced, such as the financial and technical autonomy given to hospitals, the freedom for patients to choose health care providers, and the introduction of a financing system characterized by prospective payment mechanisms, hospitals represent competing economic units that must increase the number of admitted patients to increase revenues (Smith et al., 2005).

If collaborative and competitive interdependences between health care organizations are so relevant, what is their impact on performance? Performance is a multi-dimensional concept that is difficult to quantify by a single

measure (Li & Benton, 1996). In this study, we focus on a particular internal dimension of hospital performance referred to as hospital productivity. Productivity, which reflects the relationship between production and resource utilization within hospital organizations (Wang, Wan, Clement, & Begun, 2001), is one of the key performance indicators within health systems where market forces are publicly regulated (Arah, Klazinga, Delnoij, Ten Asbroek, & Custers, 2003).

In managed competition contexts, such as Italy or the United Kingdom, hospitals must respect their budget limitations by balancing costs and revenues and, given the prospective payment system instituted, they are reimbursed for each admission regardless of its duration or cost (Lo Scalzo et al., 2009). Hospitals bear the costs of additional lengths of stay or resource utilization and largely cannot pass them on to the payer, like with fee-for-service payment systems. To increase revenues, the hospital must increase admissions while decreasing the cost of each. With the number of beds fixed by the national or regional systems, increasing admissions, and subsequently economic performance, means increasing discharges. In particular, hospitals must increase the utilization of hospital capacity (or occupancy rate) by continuously attracting new patients and reducing their average length of stay.

## Hypotheses Development

Organizational and strategic management research highlight that greater competition usually leads to lower performance because organizations must expend resources to compete (Baum & Shipilov, 2006).

Organizational ecologists have argued that competitive constraints on organizations depend on the level of their codependence on the same resources (Hannan & Freeman, 1989). Because all organizations rely on their environment for resources that provide sustainability, the more two organizations depend on similar resources, the more intense their rivalry is (Baum & Shipilov, 2006). Specifically, the concept of organizational niche, or market domain, is used to describe how opportunities and constraints vary as a function of patterns of environmental dependencies (Ingram & Yue, 2008). Prior studies have found that crowding within organizational niches is more likely to stimulate competition by rivals and is positively related to the aggressiveness that organizations face in their competitive environment (Podolny, Stuart, & Hannan, 1996).

A multitude of health care management studies have reported that interhospital rivalry does not benefit hospital organizations because competition causes hospitals to produce high-tech medical services in excess of demand and what can be effectively managed (e.g., Dranove et al., 1992). Especially in countries with universalistic systems where health care providers do not compete on prices, hospital organizations survive competitive pressures by creating

high-tech images through spending on the latest medical technologies (Robone & Zanardi, 2006).

Although better technologies can increase hospital productivity by attracting new patients and reducing lengths of stay, providers often do not achieve such benefits because unforeseen risks often accompany novel technologies. Hospitals may acquire new technologies without regarding that their adoption might pose problems for professionals who are also unlikely to change their practice (Danjoux et al., 2007). It also causes the additional use of different technologies within hospitals, increasing problems such as ambiguity for staff to adopt different technologies (Blank & Van Hulst, 2009), complexity for administrators managing technologies, and additional obstacles to ordinary hospital operations in the short run (Chaudhry et al., 2006).

Based on the previous discussion, we assert that it is likely for hospitals in highly competitive markets to have lower levels of productivity as they must expend additional resources in the face of competition and often do not take advantage of the expenditures.

*Hypothesis 1:* Hospitals in more competitive environments have lower levels of organizational productivity.

Within this framework, hospitals can employ strategies that mitigate some of this pressure on profits, such as entering into agreements with other organizations. There is ample evidence that cooperative relationships between hospitals increase efficient utilization of resources and facilitate access to new information and clinical expertise (Provan & Milward, 1995), increasing a hospital's financial performance, quality of care, and operational efficiency (Bazzoli et al., 2000; Chukmaitov et al., 2009).

Hospital productivity is positively influenced by interhospital collaboration. The advent of managed care and the introduction of prospective payment systems have increasingly required that hospitals collaborate to shorten the length of stay. The higher the propensity of hospitals to collaborate, the higher the possibility that discharged patients will receive the necessary follow-up in other settings, such as rehabilitation hospitals or other specialized hospitals (Gittell & Weiss, 2004). Collaborative hospitals also have better knowledge of partners' clinical capabilities, increasing the likelihood that patients are referred to providers that have the optimal capabilities for treatment. This reduces the length of stay because of the possibility for hospitals to focus on specific clinical pathologies that they are best able to treat (Carey, 2003). Finally, collaborative providers can allocate hospital beds for optimal patient care (Thaldorf & Lieberman, 2007). Based on the previous discussion, we formulate the following hypothesis.

*Hypothesis 2:* The more collaborative a hospital is with other health care organizations in its competitive environment, the higher the level of its organizational productivity.

Although the effects of competition and collaboration on hospital performance have been discussed mainly considering interhospital collaborative and competitive interdependences as distinct from each other, it is also important to consider whether these two aspects interact. Despite considering cooperation and competition as opposite models, recent studies have claimed that interorganizational collaborative and competitive relationships are instead likely to coexist (Oliver, 2004).

According to Ingram & Yue (2008), this happens because collaboration has the same basis of competition. Organizational ecologists identify the condition of "niche overlap" as the basis of competition, meaning that competitive interdependences between organizations can be identified based on the extent that they rely on the same resources (Hannan & Freeman, 1989). By occupying the same market segments and depending on similar resources, organizations tend to be similar in their structure, behavioral focus, and strategic posture (Podolny et al., 1996). This similarity increases the likelihood to form interorganizational collaboration because it reduces the "cognitive distance" between partnering organizations in search of mutual benefits (Wuyts, Colombo, Dutta, & Nooteboom, 2005) and provides identity for competitors in search of exchange partners (Lazega, 2009).

The interaction between competition and collaboration can mitigate the extent that competition between hospitals influences hospital performance. Organizations competing and, at the same time, collaborating are likely to reduce the degree of reciprocal aggressiveness (Ingram & Yue, 2008). Network ties might serve as signals that organizations emanate to signal their generic intention to pursue collaboration (Lazega, 2009). If perceived correctly, network ties could reduce the propensity of other organizations to challenge competitors, which reduces the likelihood for organizations to behave aggressively. Although organizations must compete to maintain their market position, increased cooperation is likely to reduce aggressiveness that organizations face and positively impact performance.

From our perspective, the formation of relationships between hospital organizations is viewed as a deterrent to competition rather than as a mechanism for interhospital coordination. In addition to facilitating exchange of information and general advice, collaborations also reduce competitive actions and reactions by fostering trust and reciprocity. Hospitals may benefit from interorganizational relationships that counterbalance the level of aggressiveness in competitive environments, and as a result, we expect that this should mitigate waste stemming from potential competitive actions that rivals may undertake.

*Hypothesis 3:* The impact of competition on hospital productivity is significantly lessened when the propensity of hospital organizations to collaborate is high.

## Methods

### Data and Data Sources

The empirical analysis is carried out with reference to 35 hospital organizations located within the health care service of Abruzzo, a central region of Italy. Extended over approximately 11,000 square kilometers, the Abruzzo region has a population of ~1,300,000, more than 10% of which lives in Pescara, its largest city.

The health care system of Abruzzo is part of the larger Italian National Health Service, a publicly funded universalistic health system that provides universal coverage through a single payer. The Italian regions are similar to states in the United States and allocate resources to approximately 200 local health authorities (LHAs). Each LHA is responsible for administering community health care services to its population. The majority of hospitals in Italy are publicly owned, but a significant number of investor-owned and not-for-profit organizations also receive public funds through contract-based agreements with the National Health Service. The central Italian government defines the core benefit packages and oversees basic coverage being provided to the entire population, whereas each region is responsible for the organization and delivery of health services.

The regional health system of Abruzzo is entrusted to six LHAs, and health care is provided by 35 hospital organizations of which 22 are public and 13 are private (Table 1). Of the 22 public providers, 2 are teaching hospitals. In this regional health care service, public hospitals provide highly specialized hospital care and are characterized by technical, economic, and financial autonomy. Private hospitals are investor-owned organizations providing ambulatory, hospital care, and diagnostic services that are partially financed by the regional health care service. Teaching hospitals are regional hospitals linked to universities. They provide education, research, and tertiary care.

The current health system of Abruzzo is characterized by a mixed market and is defined as the public character of the system being accompanied by market forces. Within Abruzzo, universal access and public financing are guaranteed by regional coordination and intense planning for service provision. Regional policies have encouraged competition among providers to control health expenditures and increase efficiency. The implemented measures we note include separation between purchasers (LHA) and providers (hospitals), freedom for patients to choose providers, greater responsibility for hospital organizations to manage budgets, and creating a general manager position to which the ultimate responsibility for hospital balanced budgets is assigned (Lo Scalzo et al., 2009). In Abruzzo, coordination of efforts to meet the needs of local patient pools is mediated by the considerable financial and managerial independence and the full responsibility for bud-

**Table 1**

### Key demographics of hospitals (2006)

	Abruzzo	Italy	All regions in Central Italy
Hospitals, <i>n</i>	35	1166	302
Average number of beds per hospital	170.93	193.60	172.13
Average number of discharges per hospital	7110.23	7097.40	6007.52
Average length of stay, hospital days	9.186	9.018	8.707
Case mix index	0.909	0.982	0.982
Occupancy rate (for acute patients)			
Public hospitals	81.5	79.1	81.26
Private hospitals	74.7	60.5	57.62
Hospitalization rate (for acute patients)	175.32	135.61	137.938
Population			
Average age, years	42.6	42	43.56
>65 years old, %	20.5	18.6	20.98
No. of staffed beds per inhabitants	0.0042	0.0037	0.0039
No. of discharges per staffed beds	44.100	36.660	34.901

geting, financing, management, and technical functioning given to providers. Hospitals essentially have managerial autonomy within broad institutional constraints imposed by the public interest that they serve. The hybrid nature of this arrangement makes institutional and competitive processes equally important to understand the forces that shape the structure of the interorganizational field in which hospitals operate.

We collected secondary data from the hospital information database managed by the regional health agency of Abruzzo, which regularly collects data and annually reports on activities and performance of each provider in the region. The data include annual reports from 2003 to 2007 for all hospital organizations in Abruzzo. Because the data used in this study were collected for administrative purposes, we were able to obtain information from all the hospitals in the region.

### Measures: Dependent Variable

Our dependent variable is hospital productivity, measured as the (natural log of the) number of hospital admissions adjusted for case mix divided by the number of beds staffed for use in the hospital (Wang et al., 2001). Although other financial performance measures such as expenditure per bed, growth in revenue, net profit margin, and others are

relevant for the long-term survival, growth, and profitability of health care organizations, we chose hospital productivity because many hospitals in the sample were not-for-profit and public institutions, which lacked the performance measures commonly used by for-profit organizations. The data needed to calculate the productivity measure were obtained from archival entries in the information database managed by the health agency of Abruzzo.

### Measures: Explanatory Variables

**Competition (Niche Crowding).** Although there is no generally accepted approach to measuring and defining hospital markets and competition, hospitals do compete within a limited geographical region (Dranove & White, 1994). We measured interhospital rivalry by considering the competitive aggressiveness exerted on a given hospital by other regional providers. The organizational population ecology paradigm has conceptualized competitive aggressiveness among organizations based on their niche overlap (Hannan & Freeman, 1989). Niches represent spaces of fundamental resources that are vital for the survival of a given organizational population.

Following previous studies (Podolny et al., 1996), we define the competitive pressure that a hospital faces in its regional area as the sum of its niche overlaps. Levels of crowding within organizational niches are more likely to stimulate competitive actions by rivals and thus, are positively related to the aggressiveness that organizations face in their competitive environment (Podolny et al., 1996). Niche crowding ( $r_i$ ) for every hospital in the sample is specified using the formula

$$r_i = \sum_{i \neq j} C_{ij}; i = 1, 2, \dots, 35.$$

This expression measures the intensity of competition that a hospital ( $i$ ) faces. This is determined using the sum of the proportion of its niches that are also occupied by other hospitals  $j$  ( $C_{ij}$ ).  $C_{ij}$  defines the intensity of competitive interdependencies between organizations, and is based on the amount of overlap that any two hospitals exhibit within their niche of relevant resources.

We computed niche overlap by adopting the approach developed by Sohn (2002), according to which the general level overlap is high when hospitals compete for patients in the same geographical area and low when they do not. The calculation of niche overlap considers a rectangular array of dimension  $n \times m$  as a starting point, where rows contain hospitals and columns contain geographical areas where incoming patients live. Row vectors give the aggregate number of patients that individual organizations receive from the various geographical segments of its reference markets. The overlap between pairs of hospitals may be calculated by comparing vectors for the level of similarity with regard to patterns of patient admissions.

To identify hospital market domains, we used discharge files of the regional health agency between 2003 and 2007 and constructed origin (patient resident) and destination (hospital location) data by zip code. We created five  $n \times m$  matrices where the dimension  $n$  contains the 35 hospitals in the region and  $m$  contains the 305 like zip codes that partition the region. Each cell contains the number of patients from a given zip code who were admitted to one of the hospitals in a given year. To calculate hospital rivalry with more accuracy, we utilized data from 25 hospital service categories (so-called major diagnostic categories) to distinguish the major diagnoses of patients admitted to each hospital. This allowed us to determine the type of services provided to patients from each region who were treated at any particular hospital. After computing the competition coefficients as described previously, we produced five different adjacent matrices, one for each of the 5 years. Cells contain the competitive interdependence measured as the extent of niche overlap between hospital pairings. Niche overlap was scaled by multiplying the Sohn's competitive coefficients by 100.

**Collaboration (Network Ties).** The propensity of hospitals to collaborate with other providers is measured by the eigenvector centrality, which is used to measure the importance of members in a social network in terms of "well connectedness" (Wasserman & Faust, 1994). It assigns relative scores to all nodes of a network and assumes that connections to a highly connected node have greater contributions to the centrality of that node than do connections to less-connected nodes. Thus, a highly centralized node is more likely to collaborate, due to the fact it is strongly tied to other nodes.

For the computation of the eigenvector centrality indicator, we built a relational matrix containing information on the interorganizational patient flow between all hospitals in Abruzzo. The matrix contains hospitals sending and receiving patients in each row and column respectively. The intersecting cells contain the number of patients transferred from the "row hospital" to the "column hospital." Patient flow between hospitals is relevant because it indicates coordination between the sending and receiving organizations (Iwashyna et al., 2009). Patients are often sent to and received from other hospitals or wards to integrate their internal resources. In this way coordination occurs between different organizations that work with the same patients. Hospitals integrate their workload when patients flow between them. They achieve common understanding and agreement on cases and avoid conflicting goals or treatment. In addition, patient exchange is viewed as a source of learning that might represent an early stage development of more structured interorganizational arrangements.

We decided to support our claim that patient flow represents a salient form of cooperation by integrating archival data with qualitative information. Specifically, we

**Table 2**  
Descriptive statistics and correlations (N = 175)

Variable	M	SD	1	2	3	4	5
1 Productivity	3.04	0.57	1.00	–			
2 Hospital size <sup>a</sup>	170.94	148.58	.35	1.00	–		
3 For-profit hospital <sup>b</sup>	0.37	0.48	–.06	.06	1.00	–	
4 Teaching hospital <sup>c</sup>	0.06	0.23	.14	.48	.01	1.00	–
5 LHA 2 membership	0.14	0.35	.26	.14	.02	0.25	1.00
6 LHA 3 membership	0.17	0.38	–.10	–.11	.12	–.11	–.19
7 LHA 4 membership	0.09	0.28	.06	.02	–.07	.36	–.13
8 LHA 5 membership	0.17	0.38	–.06	.24	–.04	–.11	–.19
9 LHA 6 membership	0.11	0.32	.05	.21	–.05	–.09	–.15
10 Task complexity <sup>d</sup>	2850.39	1443.73	–.01	.00	.29	.11	.13
11 Secondary care <sup>e</sup>	0.89	0.32	.64	.35	–.06	.09	.15
12 Task variety <sup>f</sup>	11.22	7.72	.15	–.08	–.43	–.06	–.05
13 Uncertainty <sup>g</sup>	33.18	26.71	.03	–.09	–.47	–.07	–.03
14 Niche crowding	12.79	10.69	–.11	–.39	.03	–.20	–.10
15 Network ties <sup>h</sup>	18.77	14.85	.32	.63	.13	.42	.16

Note. LHA = local health authority.

<sup>a</sup>Number of staffed beds.

<sup>b</sup>For-profit hospital = 1, not-for-profit = 0.

<sup>c</sup>Teaching hospital = 1, otherwise = 0.

<sup>d</sup>Average revenue per discharged patient.

<sup>e</sup>Secondary care = 1, Rehabilitation and long-term care = 0.

<sup>f</sup>Number of medical specialties.

<sup>g</sup>Number of emergency admissions on the total admissions;

<sup>h</sup>Eigenvector centrality score.

interviewed hospital managers and medical directors within five of the hospital organizations surveyed. The respondents explained specific procedures for patient flow. The decision of a hospital to refer a patient to another hospital is complex and involves both single individuals and the organizations as a whole. Being those who receive and treat patients, the physicians make the decision about patients' transfer. Such a decision, accurately motivated, is then forwarded to the medical directorate of the hospital that keeps on by selecting and asking a specific request to potential regional receivers. Patient flow requires deliberate adjustment between the sending and receiving hospitals because the transfer takes place once the receiving organization has accepted to receive clients. In the light of the previous discussion, we can confirm that the analysis of patient flows represents a proper proxy for the measurement of interhospital cooperation in the regional health system at hand.

Data regarding patient flow between hospitals were obtained from the health agency of Abruzzo for a 5-year period (2003 through 2007). We gathered five different adjacent matrices and computed the eigenvector centrality for each using Ucinet 6 (Borgatti, Everett, & Freeman, 2002).

### Measures: Control Variables

Organizational size and ownership status are considered two significant predictors of hospital performance (Graeff, 1980). We controlled for these characteristics by measuring *hospital size* as the total number of staffed beds and by distinguishing between for-profit and not-for-profit hospitals using a binary variable (*for-profit hospital*). Organizational performance is also potentially influenced by the dual mission of academic hospitals to provide graduate education and patient care (Blumenthal, Campbell, Weissman, 1997). We used a binary variable (*teaching hospital*) to distinguish academic hospitals. Lastly, location-specific factors could affect hospital performance. Membership in a particular LHA is a categorical variable (*LHA membership*) assigning hospitals to their reference geographical area. We used six binary variables (one of which was adopted as reference category in our statistical analysis) to identify whether each hospital takes part to one of the six LHAs.

Hospital performance may also be the result of inherent differences in the complexity of the clinical procedures that are performed (Argote, 1982). The need for organizational

	6	7	8	9	10	11	12	13	14	15
1.00	–									
–.14	1.00	–								
–.21	–.14	1.00	–							
–.16	–.11	–.16	1.00	–						
.02	.02	.01	.03	1.00	–					
–.07	.11	–.07	.13	–.11	1.00	–				
–.10	–.01	.06	–.05	–.33	.06	1.00	–			
–.09	.03	.07	.00	–.36	.09	.52	1.00	–		
–.19	.24	.12	–.24	–.04	–.14	–.03	–.03	1.00	–	
.16	–.08	.08	–.03	–.03	.34	–.04	–.11	–.53	1.00	

and medical expertise and capability increases as the complexity, specialization, and variety of tasks performed increases. For this reason, we incorporate four variables that reflect aspects related to the supply of hospital services such as (1) complexity of diseases treated or task complexity, (2) level of specialization or intensity of care, (3) services mix or task variety, and (4) uncertainty. In light of the diagnostic-related groups' price mechanism for reimbursement of hospital services, we used the average revenue (in Euros) per discharged patient to represent the *task complexity* of services. The intensity of care that each hospital can provide is represented by a dummy variable (*secondary care*), using 0 for rehabilitation and long-term care and 1 for secondary care, which relates to highly specialized inpatient and outpatient hospital services. *Task variety* represents the number of medical disciplines or specialties in each hospital. It is a discrete variable representing the spectrum of services that each hospital offers in each year. *Uncertainty* represents unplanned emergency admissions as a percentage on the total admitted patients as in previous studies (Gittel, 2002).

Table 2 summarizes the descriptive statistics and correlations among the variables included in the study.

### Analyses

Our data represent 5 years (2003–2007) of 35 cross-sectional records. In each cross-section, the variables were measured at the hospital level. To test the hypotheses concerning hospital productivity, we used a panel regression model. The data were arranged with the hospital–year as the unit of analysis so that the total number of observations was 175. We selected this technique because hospital productivity is an organizational feature and might be subject of variation over time. Pooling data offers the opportunity to exploit both cross-sectional (between hospitals) and time-series variation for parameter estimation.

This technique requires that a number of statistical concerns must be addressed. Unobserved heterogeneity arises from differences among hospitals in omitted variables that are constant over time and may cause changes in both independent and dependent variables. To eliminate any spurious effects due to unobserved differences among hospitals, we included fixed hospital effects by entering a dummy variable for each hospital. In addition, pooling repeated observations might violate the assumption of observation independence, leading to autocorrelation in a model's

residuals and incorrect variance estimates. In this situation, conclusions about statistical significance could be unclear because the estimations of variance are biased despite the coefficients generated by the ordinary least squares approach not being distorted.

Generalized least squares (GLS) allows reliable statistical estimations when autocorrelation within panels and heteroscedasticity across panels is present. We generated our model using a GLS approach with random effects after verifying its robustness and adequacy against other available approaches such the fixed-effects panel model and the pooled ordinary least squares.

## Results

Table 3 summarizes the regression results. Model 1 reflects the inclusion of only the control variables; Models 2 and 3 test Hypotheses 1 and 2 respectively, and Model 4 tests Hypothesis 3.

Results from Model 1 show that most of the control variables included are significant. First, we observed that for-profit hospitals outperformed public, not-for-profit hospitals. This could stem from differences in the overall mission of the hospitals to fulfill financial versus social objectives. A positive and significant coefficient characterizes the

**Table 3**

### Generalized least squares regression with random effects (RE)—Effects of cooperation and competition on hospital performance

	Model 1	Model 2	Model 3	Model 4
Constant	1.58** (.09)	1.60** (.09)	1.71** (.09)	1.69** (.09)
Hospital size <sup>a</sup>	0.00 (.00)	0.00 (.00)	0.00 (.00)	0.00 (.00)
For-profit hospital <sup>b</sup>	0.34** (.05)	0.34** (.05)	0.35** (.05)	0.37** (.05)
Teaching hospital <sup>c</sup>	0.12 (.10)	0.15 (.10)	0.16 (.10)	0.17 (.10)
LHA 1 (comparison group)	–	–	–	–
LHA 2 membership	–0.20** (.07)	–0.20** (.07)	–0.22** (.07)	–0.21** (.07)
LHA 3 membership	–0.20** (.05)	–0.21** (.05)	–0.19** (.05)	–0.18** (.05)
LHA 4 membership	–0.01 (.10)	0.00 (.10)	–0.01 (.10)	–0.03 (.10)
LHA 5 membership	–0.06 (.05)	–0.05 (.05)	–0.05 (.05)	–0.06 (.04)
LHA 6 membership	0.08 (.07)	0.07 (.07)	0.04 (.06)	0.05 (.06)
Task complexity <sup>d</sup>	0.00** (.00)	0.00** (.00)	0.00** (.00)	0.00** (.00)
Secondary care <sup>e</sup>	0.12* (.05)	0.13** (.05)	0.19** (.05)	0.20** (.05)
Task variety <sup>f</sup>	–0.01** (.00)	–0.01** (.00)	–0.01** (.00)	–0.01** (.00)
Uncertainty <sup>g</sup>	0.00** (.00)	0.00** (.00)	0.00** (.00)	0.00** (.00)
Competition (niche crowding)	–	–0.18** (.01)	–0.13* (.06)	–0.13** (.06)
Collaboration (network ties <sup>h</sup> )	–	–	0.07* (.03)	0.07* (.03)
Competition × collaboration	–	–	–	0.03** (.00)
$\sigma_u^2$	0.08	0.08	0.06	0.06
$\sigma_e^2$	0.14	0.14	0.15	0.15
$\rho$	0.24	0.24	0.15	0.14
N° of observations	175	175	175	175
N° of groups	35	35	35	35
R squared (overall)	0.56	0.60	0.63	0.67
Wald $\chi^2$	355.04	367.36	386.49	416.98
Hausman test (RE vs. FE) $\chi^2_i$ ; $P > \chi^2$	12.38; 0.25	15.28; 0.18	15.59; 0.29	15.98; 0.18
B-P LM test (RE vs. POLS) $\chi^2_i$ ; $P > \chi^2$	8.64; 0.00	8.48; 0.00	7.20; 0.01	8.30; 0.00

Note. Robust standard error in parentheses. LHA = local health authority; FE = fixed-effects panel model; B-P LM = Breusch–Pagan lagrange multiplier; POLS = pooled ordinary least squares.

\* =  $p < .05$ ; \*\* =  $p < .01$ .

<sup>a</sup>Number of staffed beds. <sup>b</sup>For-profit = 1, not-for-profit = 0.

<sup>c</sup>Teaching hospital = 1, otherwise = 0.

<sup>d</sup>Average revenue per discharged patient.

<sup>e</sup>Secondary care = 1, rehabilitation and long-term care = 0.

<sup>f</sup>Number of medical specialties.

<sup>g</sup>Number of emergency admissions on the total admissions.

<sup>h</sup>Eigenvector centrality score.



association between hospital productivity and the intensity of care variable, which distinguishes hospitals providing mostly *secondary care* services from those that mainly provide rehabilitation services. This finding is expected since hospital productivity is negatively affected by longer lengths of stay. The variable *teaching hospital* appears to be nonsignificant.

The nature of clinical and organizational tasks significantly affects the level of hospital performance. Whereas *task variety* is negatively related to hospital productivity, the variable *task uncertainty*, surprisingly, is positively and significantly related to hospital productivity. One possible explanation is that higher task uncertainty results in a greater ability to allocate resources for routine treatment of elective patients (Argote, 1982). *Task complexity* is positively associated to productivity. Because this variable represents the average payment per patient, this suggests that the absorption of resources and the level of cost associated with the range and type of cases that hospitals treat is positively associated to hospital productivity. As such, hospitals treating more acute cases are also better able to allocate organizational resources. We find the association between organizational size and hospital performance is positive, although not significant. Finally, Model 1 finds that the membership of hospitals to LHA numbers 2 and 3 are significant with respect to productivity, LHA 1 being the omitted category.

Models 2, 3, and 4 report the estimates of models that predict hospital performance introducing the explanatory variables. Hypothesis 1 asserts that higher levels of competition that hospitals face at the regional level will result in lower levels of organizational performance; that is, greater niche crowding results in lower productivity. As the results in Table 2 show, the level of a hospitals' niche crowding is negatively related to productivity ( $\beta = -.18$ ;  $p < .01$ ). Hypothesis 2 states that collaborative exchange-based relationships enable hospitals to combine internal and external organizational resources, resulting in greater coordination and productivity. The results shown in Model 2 indicate a positive and significant relationship between coordination and productivity ( $\beta = .07$ ;  $p < .05$ ). All control variables included in Model 1 continued to remain significant.

Hypothesis 3 asserts that the effect of competition on productivity is lower when the propensity of hospital organizations to collaborate through exchange-based relationships is higher. This means that hospitals can interact with other organizations by establishing collaborative linkages to lessen negative effects on organizational performance. As Model 4 shows, the relationship between niche crowding and productivity is less negative when hospitals are more prone to create collaborations (interaction  $\beta = 0.03$ ;  $p < 0.01$ ). All control variables included in Model 3 continue to be significant.

Finally, the results of the Hausman test and the Breusch-Pagan Lagrange Multiplier Test are presented at the bottom of Table 3. These were conducted to test the

robustness of the GLS model. The two tests indicate that the random-effects method is appropriate to analyze our data.

## Discussion

In an effort to control the rising costs of health care, universalistic systems have progressively increased competition among providers. In sharp contrast, pluralistic systems have increasingly favored higher levels of collaboration between hospitals. To examine the effects of the increased interdependence of hospitals in their relevant market domains, this study examines the effect of interorganizational competition and collaborative network ties on hospital performance. The results of this study suggest that competition is negatively associated with organizational performance and the forming interorganizational collaborations are positively associated with hospital productivity. Specifically, when hospitals face greater competition at the local level, their performance is lowered. Rather than competing, hospitals also form collaborative agreements with other hospitals to provide care at the local level. In the context of a national health system, these agreements are in the form of patient transfers rather than alliances or other formal affiliations. Patient flow between hospitals increases productivity by facilitating greater coordination of internal and external capabilities. We also found the negative effect competition has on organizational performance is significantly lower when the likelihood of collaboration between hospitals is high.

Our results shed new light on several aspects of health care management. First, instead of assuming that cooperation between competitors is illegitimate (Burt, 1992), we showed that both collaboration and competition do coexist between health care organizations. Although strategic management literature has recognized the importance of such "co-opetition" (e.g., Brandenburger & Nalebuff, 1996; Oliver, 2004), our study is the first that empirically documented the role co-opetition plays for organizational performance in the health care sector.

A second contribution is our approach to analyzing interhospital collaboration and especially competition. The new economic sociology views economic actions as structurally embedded (Granovetter, 1985). Studies have examined the effects of collaborative ties (formal and informal) on organizational performance and decision making (e.g., Uzzi, 1996), but little exists on the structural embeddedness of organizations in competitive ties. Much of it can be attributed to the lack of theoretical framework that allows a sociological conceptualization of competition. The embeddedness arguments proposed in this study can fill this void by allowing hospital performance to be understood in a more complete way than previously possible.

Third, we took the first step toward developing theory on the role of competition and collaboration among providers in those settings where managed competition has been introduced to ensure higher levels of hospital performance.

In theory, greater competition among providers should have changed their behaviors. However, whether and how the introduced competition has effectively produced changes for actors whose behaviors were previously inspired to collaboration largely remains unexplored. We began investigating how interhospital competition in managed competition relates to hospital productivity; we hope that future research further investigates the impact of competition in health systems where markets are created, fostered, or even dictated by governments (Light, 2001).

The findings presented here highlight areas that are in need of future research. The paired concepts of niche and niche overlap are really multidimensional because resource spaces that are vital for organizations are multidimensional as well. By projecting these into a single dimension defined in terms of codependence on patients, the environment of health care organizations becomes oversimplified. Future studies can expand on these results and further refine the niche overlap measure adopted to measure competitive interdependences between hospitals.

We measured hospital performance in terms of productivity. We anticipated that hospital performance is a multidimensional concept that is difficult to quantify by a single measure. Although service-related performance indicators might have been used to measure hospital performance, the adoption of quality indicators is more likely to be suitable when the analysis is developed at a departmental level rather than at an organizational level. Using quality performance criteria here would have been difficult because complex hospitals have different subunits that are characterized by different goals, objectives, outputs, and performance standards. Our measure of hospital productivity is one that is routinely reported (e.g., Wang et al., 2001), although several may be used (Li & Benton, 1996). Formulating better measures of performance to reflect the complex nature of hospital performance remains an important area of research.

Lastly, there are compromises between managerial principles of financial equilibrium and institutionalized principles of universal coverage and free access to health care. Although our findings are based on data from hospitals in a single region of Italy, assessing productivity as a function of collaborative and competitive relationships is of general relevance. In this respect, our analysis should have broad applications on the effects of network ties and patterns of competition for hospitals operating in different types of health systems. For example, in our study, we found that the (negative) impact of competition on hospital productivity is greater than that of (positive) collaboration. This might be due to hospitals operating in a universalistic health system, where technical and managerial forms of legitimacy are mediated by significant institutional constraints, and market forces are distinctive because of the high degree of governmental oversight. Hospitals in these contexts can exercise their managerial autonomy within broad institutional constraints imposed by the public interest that they are expected

to serve. The effects of competition and collaboration on hospital productivity would be expected to be different in health care systems that predominantly must satisfy financial, economic, and technical expectations. The analysis that we have proposed in this article provides a general framework for future comparative studies, which will help clarify the general applicability of our findings.

## Practice Implications

Understanding the determinants of hospital performance is one of the most important issues for policy makers and managers of hospital organizations. Concerning health policy, governments could predict how policies affecting hospital competition alter the productivity of single providers. Our findings provide insights on how hospital performance is positively related to the formation of collaborative relationships and suggest that organizations would benefit from governmental initiatives that facilitate cooperation. Policy makers can provide incentives for interhospital collaboration through new regulation such as introducing innovative financial models or redefining assessment criteria of provider performance. The form of interhospital collaboration we studied represents an early stage in the development of more formal interorganizational arrangements. Therefore, it is likely that by tracing interorganizational patient flow, policymakers may accelerate the formation of structured agreements between hospitals allowing frequent and proper patient flow. In the short term, more efficient procedures and guidelines could also increase productivity by increasing patient flow between hospitals.

The implications also appear relevant for the management of hospital organizations. In countries or areas adopting a Beveridge-like health system, hospital managers have recently begun analyzing the competitive positioning of their organizations. Competition motivates managers to strengthen the quality and efficiency of their hospital. When a hospital faces high levels of crowding in its market domain, it is likely to result in lower organizational productivity. Optimizing the strategic positioning to improve hospital performance implies that managers pay close attention to the overall market structure in which their organizations are embedded and might benefit from viewing health care markets as social structures and apply social network analyses to hospital competition.

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