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The Competition Effect of a French Reform on Hospital Quality

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Abstract

We study the effect on hospital quality of a pro-competition reform gradually introduced in France over the 2004-2008 period. Whereas before the reform public and non-profit hospitals were subject to a global budget system and private hospitals to a fee-for-service system, they are all subject to a Diagnostic Related Group (DRG) based payment system after the reform. We evaluate to what extent the incentives for hospital competition created by the reform affect mortality for the different types of hospitals using a difference-in-differences approach. Estimates are based on an exhaustive dataset of heart attack patients over the 1999-2011 period. We provide suggestive evidence that patients admitted in non-profit hospitals are less likely to die in less concentrated markets after the reform. For patients admitted in a public or a for-profit hospital, we do not find clear-cut results on the competition effect of the reform on mortality.

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Introduction

The market structure of the healthcare system is a major concern in most countries, as it has an impact on the quality of care as well as costs. Whereas healthcare has long been market-oriented in the US, several European countries—including the UK and France—have only recently changed to a market-oriented system from a non-market or strongly regulated market structure. These changes are part of a debate on the effect of reimbursement rules on hospital quality (Gaynor and Town, 2013).

In this chapter, we study the effect on hospital quality of a pro-competition reform gradually introduced in France over the 2004-2008 period. French hospitals can be in the private sector (for-profit) or in the public sector (non-profit or state-owned). Reimbursement rules differed in the two sectors before the reform. Whereas private hospitals were paid fees for services, non-profit and public hospitals were subject to a global budget system. The purpose of the reform was to homogenize the reimbursement rules for the two sectors into a Diagnostic Related Group (DRG) payment system. The transition was more consequential to the public sector and intended to encourage competitive behaviour. As prices are fixed in France, competition can only occur in quality. France is unique in that both public and private sectors provide a high level of quality.

Our study contributes to the growing empirical literature on competition and quality. This literature mostly evaluates the impact of local market concentration on heart attack mortality, which is considered to be a good indicator of quality.[1] Studies on the US provide empirical evidence based on cross-section variations in local competition. Results are mostly on Medicare patients and, although they are mixed, tilt somewhat toward lower

1. A recent exception is Colla *et al.* in this volume who study the effect of hospital competition not only for heart attack but also for hip and knee replacement, and dementia.

mortality in competitive markets. Kessler and McClellan (2000) and Kessler and Geppert (2005) find that local competition leads to lower mortality. Gowrisakaran and Town (2003) find the opposite for patients in California. In fact, the effect of competition on mortality is likely to depend on the reimbursement rate (Shen, 2003). If hospitals are underpaid for patients with a given insurance, such as Medicare, they have little or no incentive to compete for them by improving quality. In France, there is no selection of patients for whom hospitals compete based on insurance, since all patients are within the same insurance system.

There is also literature emerging in the UK which evaluates the effect of local competition on quality and which uses time variations in the intensity of local competition caused by a pro-competition reform introduced over the 2002-2006 period. This reform shares some elements with the one implemented in the public sector in France. Indeed, UK hospitals are public. The reform gave them some autonomy and changed the reimbursement system to a DRG payment system. It intensified local competition for patients in places where the healthcare structure was deconcentrated. Cooper *et al.* (2011) find that the reform led to a decrease in mortality trend in more competitive local markets. Gaynor *et al.* (2013) obtain similar results when studying mortality in level and additionally show that the reform saved lives without raising costs. In fact, most prominent scholars consider that the UK reform had positive effects on hospital quality (Bloom *et al.*, 2011).

We evaluate the impact of the pro-competition French reform using an exhaustive dataset of in-hospital patients over the 1999-2011 period. We focus on patients aged 35 and over with an acute myocardial infarction (AMI). We consider separate specific effects for hospitals in the private sector and those in the public sector, and then distinguish non-profit, university and non-teaching hospitals in the public sector. We assess to what extent the intensification of local competition has a negative effect on mortality for the different types of hospitals using linear probability

models for in-hospital mortality within 30 days. Additional regressions using a Cox duration model stratified by hospitals are provided in Gobillon and Milcent (2017).

In our main set of regressions, we use a measure of local competition centred on the hospital and defined as the average of Herfindahl-Hirschman Indices (HHI) computed for every patient taking into account establishments in a 30 km radius around her place of residence. We exploit the variations in market structure across hospitals and examine whether mortality decreases more for hospitals in less concentrated markets than for those in more concentrated markets after the reform. This is a difference-in-differences approach dealing with the fact that the reform applied to all hospitals in France. We then compare the difference-in-differences estimators obtained for hospitals in the private sector and those in the public sector as the effect of the pro-competition reform varies across hospital statuses, and this amount to making triple differences.

We provide suggestive evidence that patients admitted in non-profit hospitals are less likely to die in less concentrated markets after the reform. For patients admitted in a public or a for-profit hospital, we do not find clear-cut results on the competition effect of the reform on mortality.

The rest of the chapter is organized as follows. The next part gives some information on the French healthcare system as well as the pro-competition reform. It also gives details on our quality indicator and our main measure of local competition. Our empirical strategy is presented on page 172 and we comment the results on page 180. We provide robustness checks on page 184 and finally make some concluding remarks on page 191.

Context

French Healthcare System

The French Reform

We now propose a brief description drawn from Gobillon and Milcent (2017) of the French Health Care System, and explain how the reform changed the funding of hospitals and may have affected their behaviour. In France, the hospital healthcare system is publicly funded. There are three hospital ownership statuses: state-owned, non-profit and for-profit, which characteristics are described in Figure 4.1. Teaching and research activities are assigned to specific state-owned facilities that we label "university hospitals" (the usual label in French is *Centre hospitalo-universitaire* or *CHU*). They differ in their size and use of high-tech equipment when compared to other state-owned facilities, which we label "non-teaching public hospitals".

Individuals can choose rather freely the hospital where they receive care, although there is a minor restriction to the region of residence. In fact, over the 1998-2003 period, 93% of AMI patients were treated in their region of residence (Gobillon and Milcent, 2013). There is a unique public health insurance system which covers almost all in-patient expenditures of the whole population, whatever the ownership status of the hospital. A large part of the population also has additional private health insurance that covers mainly dental care, optical care, and an additional part of medications for outpatients.[1]

The reform of the hospital healthcare system took place over the 2004-2008 period. Prior to the reform, hospitals in the public sector (which includes state-owned facilities and non-profit facilities) were funded under a global budget system. They did not have any specific reason to attract patients, and they could choose whether or not to work cooperatively,

1. More details on the French healthcare system and differences across hospitals depending on their ownership can be found in Dormont and Milcent (in this volume).

Type	University hospital	Non-teaching public hospitals	Non-profit hospitals	For-profit hospitals	
Public status	Yes		No		
Public sector	Yes			No	
Ownership	State-owned		Not-for-profit	For-profit	
Workers' status for non-doctors	Civil servants and salaried workers		Salaried workers		
Workers' status for doctors	Civil servants		Salaried workers and private practice		
Profit	No profit Surplus given to the state		Cannot make profit but surplus can be re-invested	Can make profit	
Before reform					
Funding	Budget global			Fee-for-service	Per diem
Medical devices	No additional budget			Reimbursed per unit, tariff defined at the local level	
Research activities	Additional budget[a]	No	No	No	
After reform					
Funding	DRGs based payment				
Medical devices	If on a restricted list, reimbursed per unit, tariff determined at the national level If not on the list, no additional payment				
Research activities	Additional budget[a]	No	No	No	

a. Part of the additional budget for research activities may have been used for medical devices such as stents for AMI patients.

Figure 4.1 – Description of Hospital Ownership Statuses in France.

depending on their own will and the incentives from local health authorities. In March 2004, the reform labelled "Tarification à l'activité"—T2A was introduced, and a funding system based on Diagnostic Related Groups (DRG) was gradually implemented. The proportion of hospitals under this new funding system was 10% in 2004, 25% in 2005, 35% in 2006, 50% in 2007 and 100% in 2008. Currently, all hospitals in the public sector are given money for each stay depending on the DRG, which is determined by taking into account the degree of pathological severity. A fixed payment is associated to each DRG and the total amount of money received by a hospital depends on the volume of patients with each DRG and the associated payment.[1] As funding depends on the volume of patients, hospitals have incentives to compete for patients.

In the private sector, hospitals are funded for each stay. Prior to the T2A reform, hospitals received a fee-for-service payment, which amount depended on local health authorities and the procedures implemented during the stay. In March 2005, the fee-for-service funding system was replaced by a DRG system. The reform homogenized payments received by hospitals for patients with the same pathologies and procedures. As in the public sector, the DRG system created some incentives for hospitals to compete for patients. Nevertheless, this was already the case with the fee-for-services system. However, it is important to note that, as the DRG system is now also implemented in the public sector, private hospitals do not compete only among themselves after the reform, but also with public and non-profit hospitals.

The payment for every DRG is set every year by the government so that the overall funding of hospitals complies with national budget constraint. DRG payments take into account the average costs of stays and the volume

1. An additional budget is allocated to some hospitals because they provide specific public services such as teaching.

of care at the national level. They thus depend on global healthcare activity: the more important the activity, the lower the payments for DRGs.

The result of the reform is a unique payment system for both the public and private sectors. It is believed by national authorities that after the reform, all care providers have an incentive to attract patients and compete with others on quality, as prices are fixed. Nevertheless, it is unlikely that patients in France have some precise information on all hospitals. Indeed, hospital choice depends mostly on reputation, which is determined by information from relatives or social networks. After the reform, reputation is also influenced by some newspapers, which have decided to establish a ranking of hospitals by pathology, but the information remains vague. This means that incentives for competitive quality remain limited, because quality improvements in some hospitals could remain undetected. A website[1] provides information on hospitals but it is hard to interpret to get a quick idea of hospital quality and nothing is said on mortality. As a consequence, this website is poorly used by the population.

Overall, we anticipate that the effect of the reform should vary depending on hospital ownership. Regarding for-profit hospitals, the reform mostly increases the number of providers to compete with. For hospitals in the public sector (non-profit and State-owned), the reform both changes significantly the reimbursement rules of a payment per stay—which can have a direct effect on the quality of treatment—and induces competition with other providers. We therefore anticipate a stronger effect of the reform on the public sector than on the private one.

Ultimately, the pro-competition effect of the reform depends on the extent to which the market is locally de-concentrated and hospital quality is observable by patients. In this chapter, we assess whether hospitals in less concentrated local markets propose better healthcare quality to attract AMI patients after the reform, especially when they are in the public sector.

1. *http://www.scopesante.fr/.*

Comparison with Reforms in Other Countries

The French pro-competition reform combines some changes in reimbursement rules for two different sectors, which can be compared to reforms in other countries. The transition from a fee-for-service system to a DRG-related system for private hospitals is similar to the reform that was implemented in the US in the eighties. The transition from a global budget system to a DRG-related system for hospitals in the public sector shares some elements with the reform that was implemented in the UK over the 2002-2006 period.

In the UK, healthcare is provided by the National Health System (NHS) and is free whatever the use. Just before the reform, from 1997 to 2002, the health care clients (local governmental organisations) coordinated clinical-care packages and negotiated with health care providers (NHS-owned facilities) for annual contracts based on price, quality and volume. Patients were referred to the local hospital that was able to provide the service they required, and they could usually not choose their healthcare facility.

After gradual changes over the 2002-2006 period, the NHS encourages hospital competition for volume based on non-price aspects of services and care. This was achieved by changing reimbursement rules to a prospective payment system based on DRGs. Hospitals are paid for each admission and the price is fixed for each DRG, as in France with T2A.[1] Hospitals are given greater fiscal and managerial autonomy, and they can reinvest surpluses over fiscal years. This makes them comparable to French non-profit hospitals but more independent than state-owned French hospitals. Patients are allowed to choose where they receive care and the government has introduced a new information system providing quality information to patients. A government-run website gives some details on various aspects of establishment performances including: risk-adjusted mortality rates, hospital

1. There are some DRG adjustments, depending on pathology severity, local wage rates and whether hospitals are academic centres.

activity levels, waiting times and infection rates, all of which are sorted by procedures. Patients are much better informed than in France, where there is no real dissemination of information by the government.

Overall, whereas the French reform is likely to encourage competition, hospital incentives are probably not as strong as those introduced by the UK reform.

Quality Indicator

The most commonly used measure of hospital quality in the health economics literature is the mortality rate of AMI patients within 30 days after admission. This measure has been used in papers assessing how hospital competition affects hospital quality (Kessler and McClellan, 2000; Kessler and Geppert, 2005; Gowrisakaran and Town, 2003; Bloom *et al.*, 2010; Cooper *et al.*, 2011; Gaynor *et al.*, 2013).

There are several reasons why this indicator is used extensively in studies on the UK and the US. First, the volume of AMI admissions is large enough and deaths frequent enough to obtain reliable statistical results. This is also true for France, where ischemic diseases are a major cause of mortality. Second, infrastructures for treating AMI patients are common to other hospital services, making AMI mortality a good general marker of hospital quality (Gaynor, 2007). Third, it is believed that AMI patients are usually taken to one of the hospitals closest to their place of residence, which means that there is very little room for selection bias when studying the effect on mortality of local factors, such as local competition (Gaynor *et al.*, 2013).

We also chose to study the mortality of AMI patients for these reasons, especially as results can be compared with those obtained for the UK and the US. An additional motivation is that we have data at a more disaggregated level than most studies, since we have data at the patient level rather than at the hospital level. Moreover, our data are exhaustive for all stays of patients admitted in an acute care unit for a heart attack in France. We are

able to study mortality at the individual level and we focus on in-hospital mortality at 30 days. Only deaths occurring within hospitals are taken into account as we cannot track patients when they are discharged. Our goal is to compare how mortality varies with local competition before and after the reform by hospital status.

There are some composition effects when studying mortality that can be taken into account with patient characteristics at the individual level. These characteristics include not only age and sex, but also secondary diagnoses and comorbidities. As information on secondary diagnoses and comorbidities is often not available, researchers prefer to use some indices such as the Charlson index. In our data, the detailed information on secondary diagnoses and comorbidities allows us to control for them in our regressions at the patient level. One may still argue that this information is not enough, but McClellan and Staiger (1999) show that when the main secondary diagnoses and comorbidities affecting mortality risk are considered, considerably more detailed medical data do not add much to capture heterogeneity among patients.

As Cooper *et al.* (2011) and Gaynor *et al.* (2013), we will also control for treatment with angioplasty, which is an innovative procedure used for AMI patient healthcare and which consists in inflating a balloon in a vein or artery to crush a blockage that caused the heart attack.

Our Indicator for Local Competition

A major challenge is to measure local competition with a proper index at the relevant geographic level. This issue is still debated in the literature with alternative proposals made by researchers. In this context, we will present results for a specific index already used by Cooper *et al.* (2011) and we will conduct extensive robustness checks using alternative indexes which results will be reported in a specific section.

Our main measure is an index of local concentration centred on the hospital and defined as the average of Herfindahl-Hirschman Indices (HHI)

computed for every patient taking into account establishments in a 30 km radius around her place of residence.

More precisely, consider a given patient i and denote d_{ik} the distance between its place of residence and hospital k. The HHI for individual i is given by:

$$HHI_i = \sum_{k|d_{ik} \leq 30km} \left(\frac{N_k}{\bar{N}^i} \right)^2$$

where N_k is the number of AMI patients in hospital k and $\bar{N}^i = \sum_{k|d_{ik} \leq 30km} N_k$ is the total number of AMI patients within 30 km of the patient's place of residence.[1] This index measures hospital concentration around the patient. The lower the index, the more competition there is for the patient. The concentration measure at the hospital level is obtained by averaging the indexes of all patients within the hospital:

$$HHI^j = \frac{1}{N_j} \sum_{i \in j} HHI_i$$

The larger this measure, the less the hospital is in competition with other establishments for its patients.

Empirical Strategy

We now present the approach we use to evaluate the competition effect of the reform on quality. Our final goal is to test the hypothesis that the reform improves hospital quality through an increase in local competition. We present results according to hospital status as the effect of the reform is likely to depend on the reimbursement rules. For-profit

1. Denote by n^i the number of hospitals within 30 km of patient i. The HHI_i index varies from $1/n^i$ to 1 as the concentration of patients occurs within fewer hospitals. When $HHI_i = 1/n^i$, patients around individual i are equi-distributed between the n^i hospitals. When $HHI_i = 1$, they are all treated within one hospital.

hospitals compete for patients both before and after the reform, albeit they are under different funding regimes. By contrast, hospitals in the public sector had no incentive to compete for patients before the reform, but have some incentives to do so to get some funding after the reform. We first contrast hospitals in the private sector with those in the public sector, before distinguishing non-profit, university and non-teaching public hospitals in the public sector.

We exploit the variation in local market structure across hospitals as we examine whether quality improves more in hospitals in less concentrated markets than in hospitals in concentrated markets after the reform. This is akin to difference-in-differences approaches usually used to estimate the effects of policy reforms. Nevertheless, in our case, there is no perfect control group as there is no hospital left unaffected by the reform. Identification is rather secured by the existence of spatial variations in the level of local concentration of hospitals, as in papers studying the UK reform (Cooper *et al.*, 2011; Gaynor *et al.*, 2013). However, there is an additional twist in our study. We compare the difference-in-differences estimators obtained for hospitals in the private sector and those in the public sector as the effect of the pro-competition reform varies across hospital statuses, and this amount to making triple differences.

We begin our analysis by assessing the effect of the reform in the long run keeping only two dates, 1999 and 2011, and studying how mortality has evolved over the period in the same spirit as Gaynor *et al.* (2013). Our specification is a linear probability model given by:

$$\begin{aligned} m_{iht} = {} & b_0 + b_1 \mathbb{I}_{\{t=2011\}} + b_2 FP_h * \mathbb{I}_{\{t=2011\}} + b_3\ HHI_{h,t} + b_4 HHI_{h,t} * FP_h \\ & + b_5\ HHI_{h,t} * FP_h * \mathbb{I}_{\{t=2011\}} + b_6\ HHI_{h,t} * Pub_h * \mathbb{I}_{\{t=2011\}} \\ & + X_i b_7 + v_h + u_{iht} \end{aligned} \tag{1}$$

where m_{iht} is a dummy for mortality for patient i admitted in hospital h during year t, $HHI_{h,t}$ is the concentration index, FP_h is a dummy equal to one if the hospital is for-profit and zero otherwise, Pub_h is a dummy equal

to one if the hospital is in the public sector and zero otherwise, $1_{\{t=2011\}}$ is a dummy for year 2011, X_i is a set of patient variables, v_h is a hospital fixed effect (included or not) and u_{iht} is random noise.

Our main coefficients of interest are b_5 and b_6 which measure the competition effect of the reform respectively for hospitals in the private sector and those in the public sector. Some other explanatory variables are used as controls. These include the concentration index, its interaction with a dummy for for-profit status as well as individual characteristics related to case-mix (interactions between sex and age brackets, detailed information on secondary diagnoses and comorbidities, average income in the municipality) and procedures (treatment with angioplasty). Endogeneity of the concentration index involved in several terms is a usual concern that arises because the hospital choice of patients itself can be endogenous (Bresnahan, 1989). Hospital fixed effects are used to take into account the unobserved hospital heterogeneity that may affect the hospital choice of patients and thus may be correlated with the concentration index. We also provide additional robustness checks in a specific section in which we resort to a concentration index constructed from predicted flows of patients in line with Kessler and McClellan (2000).

We also assess to what extent hospitals in the public sector are affected by the competition effect of the reform on mortality depending on whether they are non-profit, university or non-teaching. For that purpose, we re-estimate the specification by hospital status. By contrasting results for non-profit and state-owned hospitals, we capture the impact of managerial autonomy. Also, comparing results obtained for university and non-teaching hospitals makes it possible to isolate the impact of having teaching activities.[1]

1. Note that teaching hospitals are on average larger than non-teaching public ones and the difference in size and activity is also captured when comparing the two types of hospitals.

As a complement, we conduct estimations on all years over the 1999-2011 period to use all the information available in the data and estimate both the short-run and long-run competition effects of the reform. As the reform occurred in 2005 for for-profit hospitals, the post-reform period is considered to be from 2005 onwards. As the reform occurred gradually between 2004 and 2008 for hospitals in the public sector, we distinguish for them two periods: the transition over the 2004-2007 period and the period when the reform is fully implemented from 2008 onwards. More precisely, the specification is given by:

$$\begin{aligned} q_{iht} = {} & \beta_0 + \beta_1\, t + \beta_2 \mathbb{I}_{\{t\geq 2004\}} * Pub_h + \beta_3 \mathbb{I}_{\{t\geq 2008\}} * Pub_h \\ & + \beta_4 \mathbb{I}_{\{t\geq 2005\}} * FP_h \\ & + \beta_5\, HHI_{h,t} + \beta_6\, t * HHI_{h,t} + \beta_7 HHI_{h,t} * FP_h \\ & + \beta_8 HHI_{h,t} * FP_h * \mathbb{I}_{\{t\geq 2005\}} \\ & + \beta_9 HHI_{h,t} * Pub_h * \mathbb{I}_{\{t\geq 2004\}} + \beta_{10} HHI_{h,t} * Pub_h * \mathbb{I}_{\{t\geq 2008\}} \\ & + X_i \beta_{11} + u_{iht} \end{aligned} \tag{2}$$

where $\mathbb{I}_{\{.\}}$ is the indicator function and t is the time trend.

Our main coefficients of interest are β_8 which captures for for-profit hospitals the average competition effect of the reform from 2005 onwards, as well as β_9 and β_{10} which capture for hospitals in the public sector respectively the average competition effect of the reform since its start in 2004 and the additional effect once the reform is complete in 2008. For hospitals in the public sector, whereas the competition effect of the reform is β_9 over the 2004-2007 period, it becomes $\beta_9 + \beta_{10}$ from 2008 onwards.

As previously, other explanatory variables are used as controls. These include a time trend, a dummy for for-profit status, dummies capturing period effects interacted with dummies for hospital statuses, a concentration index, an interaction between the time trend and the concentration index, an interaction between the concentration index and the dummy for for-profit status, as well as the same individual variables as in specification (1)

capturing effects related to case-mix and treatment with an angioplasty. We also conduct separate regressions by hospital status to identify the effect of managerial autonomy and the effect of having teaching activities.

Data and Preliminary Statistics

Data

We use the exhaustive data on stays in French hospitals provided by the *Programme de médicalisation des systèmes d'information* over the 1999-2011 period as detailed in Gobillon and Milcent (2017). We restrict our attention to patients admitted to a hospital for an AMI. Because heart attacks before age 35 are usually related to a heart dysfunction, we consider only patients aged 35 and over, which is in line with the OMS definition. Stays with duration coded zero (4.6% of observations) are excluded.

The resulting sample includes 870,549 stays for mainland France with an average of 66,965 stays per year.[1] Hospital admissions occur for patients coming from home stays (80.5%), from another hospital (18.9%), or from another service of the same hospital (0.6%).

As we cannot keep track of patients when they are transferred to another hospital or service, we restrict our sample to patients who come from their place of residence. We thus discard 19.5% of observations, which makes the sample size drop to 704,509 stays with an average of 54,193 stays per year.

We have information on patients' age and sex, as well as detailed information on co-morbidities (i.e. pre-existing conditions), secondary diagnoses and treatment procedures. Detailed co-morbidities and diagnoses are related to the way of life (smoking, alcoholism, obesity, hypertension), chronic health problems (diabetes, conduction diseases, history of

1. We exclude from the analysis patients and hospitals from Dom-Tom and Corsica, as well as patients from foreign countries, as healthcare is very specific in that case.

coronary disease), disease complications (renal failure, heart failure), and site of heart attack (anterior, posterior, sub-endocardial, other). We know whether patients were treated or not with an angioplasty.

We also have the municipality code of residence and we use it to recover the municipality household median income in 2000 from fiscal data. This measure is used as a proxy for patients' social background that may influence their probability of death since we do not have any information on it in our main dataset.

Finally, our concentration index is computed on the whole sample of patients in mainland France. We have the municipality codes for both the patients' place of residence and the location of hospitals.[1] We match these codes with an additional dataset containing the coordinates of the town hall and compute the distance between patients and hospitals as crow flies using these coordinates.

We delete 4.12% of observations for which information is missing or miscoded, and end up with 675,469 stays with an average of 51,959 stays per year, with 20.4% of stays being in for-profit hospitals, 3.4% in non-profit hospitals, and 76.2% in public hospital (of those, 27.6% are in university hospitals and 48.6% in non-teaching public hospitals). We also know the type of discharge: death (7.2%), home return (61.0%), transfer to another service (2.0%) or transfer to another hospital (29.8%). As we cannot follow patients when they are discharged, we study patients during their stay within the hospital. We focus on discharge due to death and treat all other discharges as right censored.

1. There are around 36,000 municipalities in mainland France. There are two large groups of establishments, one in Paris (called *Assistance publique-Hôpitaux de Paris*) and the other one in Marseille (called *Assistance publique-Hôpitaux de Marseille*), for which we do not have a specific municipality code for each establishment. We therefore attribute them the municipality code of the first district in their respective city.

Preliminary Statistics

We first assess whether the distribution of patients across hospital statuses changes over the 1999-2011 period, especially after the implementation of the reform. Figure 4.2 shows that this distribution does not vary much over time. There are only slight changes in demographic characteristics. Whereas the proportion of male patients declines from 70% to 68%, the proportion of patients more than 85 years old increases from 8.2% to 9.2% for females and from 4.5% to 5.8% for males.

There is some heterogeneity in patients' composition across hospital statuses as shown by Table A.1 (p. 194). In particular, the proportion of patients aged 35-55 is about 22% in university hospitals but only 15.5% in non-teaching public hospitals. The length of stay is 7.9 days in non-teaching public hospitals but only 7.0 days in for-profit hospitals.

The mortality rate is around 7% over the period but once again, there is some heterogeneity across hospital statuses since it is as high as 8.6% in non-teaching public hospitals but only 5% in for-profit hospitals, 5.7% in university hospitals, and 7.8% in non-profit hospitals. Figure 4.3 shows that the mortality rate decreases over the whole period, especially after the beginning of the reform in 2004 with the trend becoming steeper. Table A.2 (p. 195) shows that the mortality rate decreases over time whatever the hospital status. This decrease can be explained by an increase over time in the use of innovative technologies (in particular, angioplasty and stent) for every hospital status.

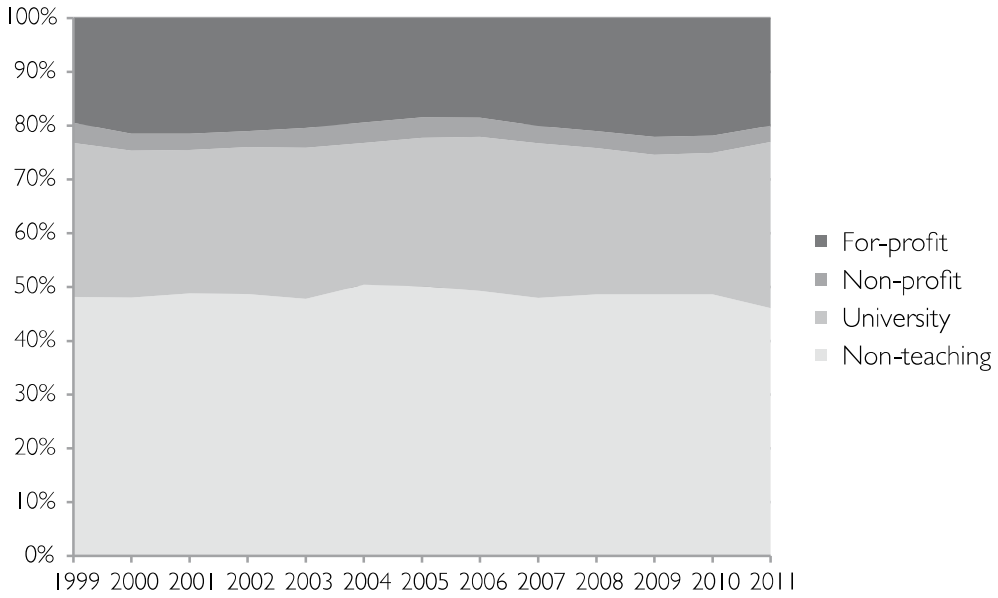

Figure 4.2 – Distribution of Patients across Hospital Statuses over the 1999-2011 Period.

Note: for a given year, each color represents a status and the height the percentage of patients in hospital of such status. Percentages sum to 100%.

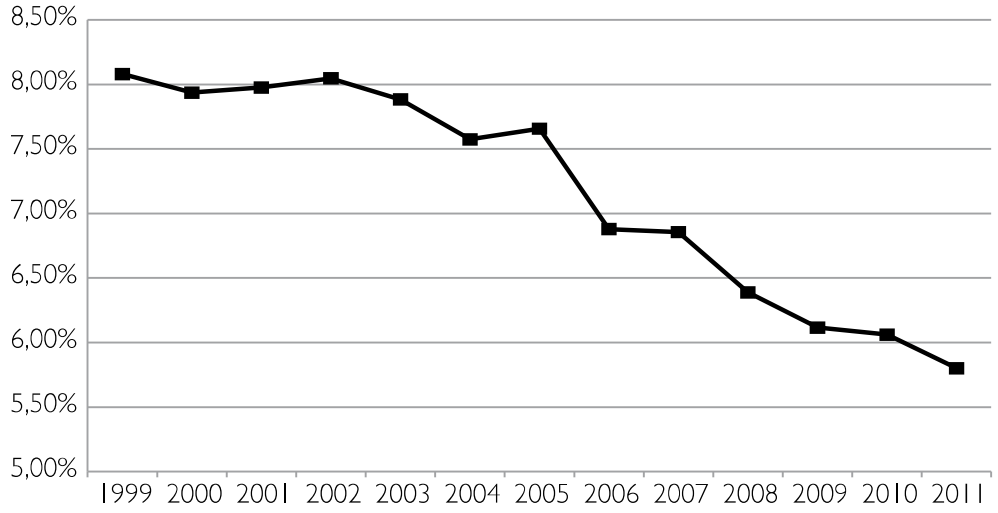

Figure 4.3 – Mortality Rate over the 1999-2011 Period.

Results

Table 4.1 – Competition Effect of the Reform on Mortality between 1999 and 2011, Ordinary Least Squares

Estimated coefficient	All hospitals	For-profit hospitals	Hospitals in the public sector			
			All	Non-profit	University	Non-teaching
Year 2011	−0.0243***	−0.0277***	−0.0242***	−0.0629***	−0.0125**	−0.0296***
	(0.00327)	(0.00643)	(0.00378)	(0.0168)	(0.00540)	(0.00558)
HHI	−0.00139	−0.0267***	0.000414	−0.0370	0.0141**	−0.00726
	(0.00417)	(0.00935)	(0.00466)	(0.0283)	(0.00714)	(0.00638)
Private sector	0.00660					
	(0.00408)					
HHI * Private sector	−0.0161***					
	(0.00554)					
HHI * Private sector	0.000414	0.00231				
* Year 2011	(0.00884)	(0.0127)				
HHI * Public sector	−0.000343		−0.000169	0.104**	−0.0135	0.00441
* Year 2011	(0.00567)		(0.00635)	(0.0459)	(0.00978)	(0.00874)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes
N	102,034	20,099	80,453	3,235	30,591	46,627
R^2	0.120	0.120	0.120	0.120	0.109	0.124

Notes: *significant at 10% level; ** significant at 5% level; *** significant at 1% level. Dependent variable: dummy taking the value one if the patient died at the hospital within 30 days after her admission following an AMI. Patient characteristics include: interaction between gender and age brackets, comorbidities, diagnoses, treatment with angioplasty, average income in the municipality. HHI: hospital weighted average of Herfindahl-Hirschman indexes computed for every patient taking into account establishments in a 30 km radius around her place of residence.

We now comment the results on the competition effect of the reform on mortality. We first focus on long-run effects by estimating specification (1) after restricting the sample to the years 1999 and 2011. As a first step, we ignore hospital unobserved heterogeneity and report in Table 4.1

the main coefficients of interest obtained with Ordinary Least Squares.[1] Results for the full sample in column (1) show that the reform would have a competition effect neither on hospitals in the private sector nor on those in the public sector. This is confirmed by columns (2) and (3) which give estimated coefficients when the specification is estimated separately for the two types of hospitals. We then dig further by re-estimating the model for the public sector by hospital status. Whereas the reform has a significant positive competition effect for non-profit hospitals (column 4), is has no significant competition effect for university and non-teaching public hospitals (columns 5 and 6). Hence, the introduction of the T2A reform would create competition incentives that are strong enough to decrease the mortality in non-profit hospitals only. This suggests that managerial autonomy would matter.

We then assess whether results remain the same when taking into account hospital unobserved heterogeneity. Table 4.2 gives the results when the specification is estimated in the within-hospital dimension. Results remain qualitatively similar although the estimated competition effect for non-profit hospitals is significant at the 5.2% level only (but this is very close to the 5% threshold).

To get an idea of the order of magnitude for the effects, we assess to what extent the change in mortality rate after the reform differs between low-competition and high-competition markets. A one standard deviation decrease in the concentration index (equal to 0.275) yields a decrease in mortality rate in non-profit hospitals according to the point estimate of 0.275*0.101*100 = 2.78 points between 1999 and 2011.[2] Corresponding figures for for-profit hospitals, university hospitals and non-teaching public hospitals are much smaller (in absolute terms) and amount to respectively

1. For other coefficients, similar results are commented in Gobillon and Milcent (2013) and Gobillon and Milcent (2016).

2. This corresponds to a yearly decrease in mortality rate of 2.78/13=0.214 points. This is a sizable effect but at the same time it is very imprecisely estimated.

–0.19 points, –0.18 points and –0.11 points. These estimated effects are not significant.

Table 4.2. Competition Effect of the Reform on Mortality between 1999 and 2011, Within Estimation

Estimated coefficient	All hospitals	For-profit hospitals	Hospitals in the public sector			
			All	Non-profit	University	Non-teaching
Year 2011	−0.0208***	−0.0239***	−0.0195***	−0.0239***	−0.0580***	−0.0145***
	(0.00350)	(0.00691)	(0.00401)	(0.00691)	(0.0184)	(0.00548)
HHI	−0.00248	−0.0124	−0.00212	−0.0124	−0.0462	−0.00173
	(0.00589)	(0.0113)	(0.00619)	(0.0113)	(0.0399)	(0.00931)
HHI * Private sector	−0.00786					
	(0.0122)					
HHI * Private sector	−0.00835	−0.00676				
* Year 2011	(0.00996)	(0.0137)				
HHI * Public sector	−0.00395		−0.00398	0.101*	−0.00653	-0.00395
* Year 2011	(0.00608)		(0.00679)	(0.0519)	(0.0100)	(0.00959)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes
N	102,034	20,099	80,453	3,235	30,591	46,627
R^2 Within	0.138	0.166	0.133	0.175	0.112	0.140

Notes: *significant at 10% level; ** significant at 5% level; *** significant at 1% level. Dependent variable: dummy taking the value one if the patient died at the hospital within 30 days after her admission following an AMI. Patient characteristics include: interaction between gender and age brackets, comorbidities, diagnoses, treatment with angioplasty, average income in the municipality. HHI: hospital weighted average of Herfindahl-Hirschman indexes computed for every patient taking into account establishments in a 30 km radius around her place of residence. R^2 Within gives the R^2 of the model projected in the Within dimension.

We then turn to results obtained using all the years of data over the 1999-2011 period. Results obtained with Ordinary Least Squares are reported in Table 4.3. When we pool all patients together (column 1), we find that the reform has no competition effect for for-profit hospitals, but has one during the 2004-2007 transition period for hospitals in the public

Table 4.3. Competition Effect of the Reform on Mortality over the 1999-2011 Period, Ordinary Least Squares

Estimated coefficient	All hospitals	For-profit hospitals	Hospitals in the public sector			
			All	Non-profit	University	Non-teaching
Time trend	−0.00173***	−0.00243***	−0.000767	−0.00238	0.000505	−0.00161
	(0.000421)	(0.000846)	(0.000728)	(0.00304)	(0.00104)	(0.00105)
Public sector *	−0.0139***		−0.0229***	−0.0321***	−0.0231***	−0.0266***
(Year ≥ 2004)	(0.00166)		(0.00218)	(0.00869)	(0.00334)	(0.00348)
Public sector *	−0.00630***		−0.00653***	−0.0317***	−0.00714*	−0.00289
(Year ≥ 2008)	(0.00144)		(0.00240)	(0.00932)	(0.00387)	(0.00381)
Private sector *	−0.00466***	−0.0121***				
(Year ≥ 2005)	(0.00127)	(0.00302)				
HHI	−0.00295*	−0.0180***	−0.00444**	−0.0588***	−0.0202***	−0.0127***
	(0.00175)	(0.00355)	(0.00204)	(0.0134)	(0.00410)	(0.00295)
HHI * Time trend	0.00158	0.00178	0.00104	0.00660	−0.00120	0.00225
	(0.00106)	(0.00179)	(0.00127)	(0.00793)	(0.00192)	(0.00174)
Private sector	−0.00297*					
	(0.00158)					
HHI * Private sector	−0.0154***					
	(0.00222)					
HHI * Public sector *	0.00507**		0.00670**	0.0271	−0.000872	0.00990**
(Year ≥ 2004)	(0.00235)		(0.00291)	(0.0185)	(0.00446)	(0.00396)
HHI * Public sector *	−0.00382*		−0.00214	0.0529***	−0.00557	−0.00275
(Year ≥ 2008)	(0.00231)		(0.00307)	(0.0200)	(0.00503)	(0.00407)
HHI * Private sector *	0.00158	0.00566				
(Year ≥ 2005)	(0.00106)	(0.00474)				
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes
N	651,453	135,023	516,430	20,825	184,835	310,770
R^2	0.123	0.115	0.124	0.121	0.122	0.124

Notes: * significant at 10% level; ** significant at 5% level; *** significant at 1% level. Dependent variable: dummy taking the value one if the patient died at the hospital within 30 days after her admission following an AMI. (Year ≥ *t*): dummy for year greater or equal to *t*. Patient characteristics include: interaction between gender and age brackets, comorbidities, diagnoses, treatment with angioplasty, average income in the municipality. HHI: hospital weighted average of Herfindahl-Hirschman indexes computed for every patient taking into account establishments in a 30 km radius around her place of residence.

sector and this effect attenuates afterwards. These results are confirmed when the sample is stratified by hospital status and as previously there is some heterogeneity in the competition effect within the public sector. As before, there is a long-run effect of the reform for non-profit hospitals (column 4). Unlike previously, there is a positive effect of the reform on non-teaching public hospitals but it slightly attenuates over time (column 6).

Robustness Checks

We conduct extensive robustness checks changing the definition of our measure of concentration.

Alternative Measures of Concentration

We considered as our main measure of concentration, the average of patients' HHI centred on their place of residence that takes into account only hospitals within 30 km. However, there is no real consensus in the literature on which measure is the most relevant, and ultimately trust in the results depends on robustness checks made by varying the local measure of concentration and on how much people believe in the indexes that are used.

In particular, it is not clear which radius should be used when computing the HHI, as some patients may consider only very local options to remain close to home while others may consider longer distances to get admitted in high-tech hospitals. As a consequence we experimented with the alternative radiuses of 10, 20 and 50 km. A statistical determination of the relevant radius can also be considered, and we experimented with the 95th percentile of the distance between patients and hospitals computed by year. This radius is very large and its average across patients reaches 107 km.

In fact, it may not be the distances between patients and hospitals which are relevant. It may rather be whether patients and hospitals are located or not in the same city as the city could be the most relevant local healthcare market. Therefore, we also experimented with hospital concentration indexes computed at the urban area level and at the local labour market

level. For instance, the index at the urban area level is computed as the sum of the squared ratio between the number of AMI patients in each hospital and the total number of AMI patients within the urban area.

Endogeneity is a concern when regressing a mortality variable on a concentration index constructed from patients' HHI because this index may be correlated with unobserved patient characteristics which effects are captured by the residual (see for instance Bresnahan, 1989; Kessler and McClellan, 2000). Indeed, patients are free to choose their hospital in France, and usually do so based on the information given by their physician, the press (a ranking of hospitals being published every year), family and relatives. It is possible that patients most likely to die are admitted to the best hospitals. These hospitals are mostly located in large cities where there is a considerable supply of good surgeons, and large cities usually exhibit a low concentration of hospitals. In that case, there is a negative correlation between the HHI index and the residual in specifications (1) and (2). On the other hand, good hospitals may be those that dominate locally and run the competition out of the market. Hospital quality could then be higher in more concentrated local markets, and we would then expect a positive correlation between the HHI index and the residual of our specifications. In line with the literature, we deal with unobservable patient characteristics by constructing an alternative HHI index from predicted flows of patients to hospitals. We first estimate a logit model of hospital choice, where the explanatory variables are the distance from patient to hospital, as well as interactions between age bracket × gender dummies at the patient level and dummies for hospital statuses. From these estimates, we deduce the probability of each patient going to each hospital, and thus predict the number of patients in each municipality going to each hospital. We then construct for patients of a given municipality a new set of patients' HHI indexes using predicted numbers of patients in the municipality going to every hospital on the territory. Our alternative concentration index for a given hospital is then a weighted average of these HHI computed across

all patients, where the weight for a given patient is her probability of going to the hospital.

We also consider a competition index proposed by Antwi, Gaynor and Vogt (2013) instead of a concentration index.[1] This index called Logit Concentration Index (LOCI) is initially derived from a model of price competition. However, Colla *et al*. in this volume show that the LOCI also intervenes in a fixed price setting since they establish that the proportional responsiveness of admissions to an improvement of quality depends multiplicatively on the elasticity of demand with respect to quality and the LOCI that captures the competition mechanisms affecting demand. A detailed presentation of the LOCI index is proposed in Colla *et al*. in this volume and Appendix A. We compute the LOCI index for a given hospital taking into account only other hospitals within a 30 km radius consistently with our construction of the HHI index. We thus depart from Colla *et al*. in this volume who rather use hospital referral regions that cover the whole US. Note that the LOCI index varies in the way opposite to HHI indexes so that negative correlations with our concentration indexes are expected.

Results of Robustness Checks

We first assess to what extent our alternative indexes are related. Table 4.4 reports the correlations between all our indexes. All correlations have the expected sign. Every two concentrations indexes are positively correlated, and every concentration index is negatively correlated with the LOCI index. Except for a few exceptions, correlations are rather large ranging in absolute terms from 0.3 to 0.8.

We then check whether our results are robust when using these alternative indexes. Table 4.5 reports results obtained for specification (1)

1. Note that alternative indexes are possible such as the local number of hospitals (see Combes and Gobillon, 2015).

when the model is estimated with Ordinary Least Squares. The negative effect of competition on mortality is robust for non-profit hospitals. The estimated coefficient is even significant at 1% when using the urban area or the local labor market as the relevant healthcare market. The order of magnitude is similar to the one obtained using our main measure of concentration except when the maximum radius of the market for the alternative measure is the 95th percentile of distance. In that case, the geographic area defining the market is very large and very different from the one considered in other measures.

Table 4.4 – Correlations between Different Measures of Market Structure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Mean	Standard deviation
(1)	1.000									0.612	0.259
(2)	0.747	1.000								0.584	0.325
(3)	−0.505	−0.484	1.000							0.477	0.201
(4)	0.232	0.349	−0.262	1.000						0.094	0.042
(5)	0.564	0.640	−0.370	0.307	1.000					0.686	0.294
(6)	0.559	0.711	−0.401	0.389	0.777	1.000				0.619	0.307
(7)	0.515	0.654	−0.422	0.458	0.630	0.800	1.000			0.499	0.280
(8)	0.399	0.545	−0.404	0.609	0.480	0.600	0.692	1.000		0.287	0.170
(9)	0.079	0.283	−0.302	0.482	0.234	0.338	0.383	0.489	1.000	0.139	0.077

Notes: correlations between nine alternative indexes of concentration or competition. All correlations are significant at the 0.1% threshold. HHI: Herfindhal-Hirschman Index; LOCI: LOgit Competition Index. (1) HHI at the employment area level; (2) HHI at the urban area level; (3) LOCI using a 30 km radius; (4) HHI using the 95th centile radius; (5) HHI using a 10 km radius; (6) HHI using a 20 km radius; (7) HHI using a 30 km radius (our main measure); (8) HHI using a 50 km radius; (9) HHI using a 30 km radius and applying Kessler and McClellan construction procedure.

Table 4.5 – Competition Effect of the Reform on Mortality between 1999 and 2011, Estimations with OLS when Using Alternative Measures of Competition

		For-profit	Non-profit	Univer-Sity	Non teaching		For-profit	Non-profit	Univer-sity	Non teaching
Index * Private *	(1)	−0.00532				(2)	−0.00437			
Year 2011		(0.0168)					(0.0139)			
Index * Public *			0.146***	−0.0333**	0.00924			0.109***	−0.0263**	0.0166**
Year 2011			(0.0430)	(0.0130)	(0.00952)			(0.0410)	(0.0105)	(0.00756)
Index * Private *	(3)	−0.0224				(4)	−0.0748			
Year 2011		(0.0206)					(0.0816)			
Index * Public *			−0.0514	0.0290	−0.0189			0.211	−0.0416	0.0898
Year 2011			(0.0667)	(0.0218)	(0.0153)			(0.284)	(0.0663)	(0.0701)
Index * Private *	(5)	0.0242*				(6)	0.00579			
Year 2011		(0.0134)					(0.0116)			
Index * Public *			0.0824**	0.0100	0.00583			0.0700*	−0.00856	0.0148*
Year 2011			(0.0359)	(0.0123)	(0.0115)			(0.0359)	(0.00939)	(0.00882)
Index * Private *	(7)	−0.00285				(8)	−0.0189			
Year 2011		(0.0216)					(0.0336)			
Index * Public *			0.117	−0.0295**	0.00190			0.098	−0.113***	0.0122**
Year 2011			(0.0814)	(0.0148)	(0.0144)			(0.122)	(0.0258)	(0.00623)

Notes: estimations conducted using eight alternatives indexes of concentration or competition. HHI: Herfindhal-Hirschman Index; LOCI: LOgit Competition Index. (1) HHI at the employment area level; (2) HHI at the urban area level; (3) LOCI using a 30 km radius; (4) HHI using the 95^{e} centile radius; (5) HHI using a 10 km radius; (6) HHI using a 20 km radius; (7) HHI using a 50 km radius; (8) HHI using a 30 km radius and applying Kessler and McClellan construction procedure.

We conduct the same exercise when hospital unobserved heterogeneity is taken into account by estimating the model in the Within dimension. Results reported in Table 4.6 for non-profit hospitals are in line with those in Table 4.5. For non-teaching public hospitals, the competition effect of the reform is never significant. A bit surprisingly, in case the concentration index is measured at the local labor market level, we find a positive competition effect

of the reform on mortality for for-profit and university hospitals that would suggest that an increase in local competition would increase mortality. This could be explained by the existence of other types of hospitals capturing part of their market share. However, confidence in the results relies ultimately in the trust that it is really competition that the concentration index captures. Note that we also find a positive competition effect of the reform on mortality for university hospitals when using the Kessler and McClellan index.

Table 4.6 – Competition Effect of the Reform on Mortality between 1999 and 2011, Within Estimations when Using Alternative Measures of Competition

		For-profit	Non-profit	University	Non teaching		For-profit	Non-profit	University	Non teaching
Index * Private * Year 2011	(1)	−0.0512** (0.0210)				(2)	−0.0257 (0.0175)			
Index * Public * Year 2011			0.111** (0.0544)	−0.0417*** (0.0136)	0.00389 (0.0111)			0.130*** (0.0499)	−0.0182 (0.0111)	0.00909 (0.00886)
Index * Private * Year 2011	(3)	0.0149 (0.0276)				(4)	−0.0696 (0.0920)			
Index * Public * Year 2011			−0.242** (0.0984)	0.0182 (0.0260)	−0.0191 (0.0197)			0.182 (0.343)	0.0262 (0.0688)	0.0297 (0.0799)
Index * Private * Year 2011	(5)	0.0180 (0.0142)				(6)	−0.00647 (0.0124)			
Index * Public * Year 2011			0.0459 (0.0394)	0.0178 (0.0125)	0.00365 (0.0128)			0.0410 (0.0399)	−0.000112 (0.00958)	0.00385 (0.00972)
Index * Private * Year 2011	(7)	−0.0213 (0.0239)				(8)	−0.0338 (0.0401)			
Index * Public * Year 2011			0.154 (0.160)	−0.0119 (0.0155)	0.00906 (0.0159)			0.170* (0.0897)	−0.105*** (0.0268)	0.0116 (0.0602)

Notes: estimations conducted using eight alternatives indexes of concentration or competition. HHI: Herfindhal-Hirschman Index; LOCI: LOgit Competition Index. (1) HHI at the employment area level; (2) HHI at the urban area level; (3) LOCI using a 30 km radius; (4) HHI using the 95th centile radius; (5) HHI using a 10 km radius; (6) HHI using a 20 km radius; (7) HHI using a 50 km radius; (8) HHI using a 30 km radius and applying Kessler and McClellan construction procedure.

Table 4.7 – Competition Effect of the Reform on Mortality over the 1999-2011 Period, Estimations with OLS when Using Alternative Measures of Competition

		For-profit	Non-profit	University	Non teaching		For-profit	Non-profit	University	Non teaching
Index * Public *	(1)		0.0362**	0.0243***	0.0199***	(2)		0.0157	−0.00297	0.0149***
(Year ≥ 2004)			(0.0181)	(0.00601)	(0.00445)			(0.0158)	(0.00488)	(0.00347)
Index * Public *			0.0523**	−0.00441	−0.00888*			0.0606***	−0.0125**	−0.00251
(Year ≥ 2008)			(0.0208)	(0.00686)	(0.00481)			(0.0172)	(0.00577)	(0.00359)
Index * Private *		−0.00187					−0.000823			
(Year ≥ 2005)		(0.00616)					(0.00504)			
Index * Public *	(3)		−0.0656***	−0.00457	-0.0106	(4)		0.0185	0.0301	-0.0395
(Year ≥ 2004)			(0.0206)	(0.00805)	(0.00755)			(0.0157)	(0.0305)	(0.0312)
Index * Public *			−0.00150	0.0213**	−0.00912			0.0462***	−0.0210	−0.000563
(Year ≥ 2008)			(0.0279)	(0.00923)	(0.00687)			(0.0159)	(0.0277)	(0.0276)
Index * Private *		−0.00508					−0.0469*			
(Year ≥ 2005)		(0.00846)					(0.0279)			
Index * Public *	(5)		0.0200	0.0157***	0.0194***	(6)		−0.0355	0.00392	0.0171***
(Year ≥ 2004)			(0.0148)	(0.00520)	(0.00517)			(0.0377)	(0.00421)	(0.00394)
Index * Public *			0.0322**	−0.00479	−0.0110**			0.105***	−0.00599	−0.00598
(Year ≥ 2008)			(0.0158)	(0.00575)	(0.00545)			(0.0346)	(0.00473)	(0.00412)
Index * Private *		0.00773					0.00554			
(Year ≥ 2005)		(0.00483)					(0.00424)			
Index * Public *	(7)		−0.0355	−0.00737	0.00327	(8)		0.0241	0.102	0.00137
(Year ≥ 2004)			(0.0377)	(0.00729)	(0.00686)			(0.0152)	(0.0845)	(0.0245)
Index * Public *			0.105***	−0.0124	0.00253			0.0538***	−0.0236	0.0237
(Year ≥ 2008)			(0.0346)	(0.00761)	(0.00636)			(0.0173)	(0.0887)	(0.0253)
Index * Private *		−0.00368					−0.0482***			
(Year ≥ 2005)		(0.00802)					(0.0147)			

Notes: estimations conducted using eight alternatives indexes of concentration or competition. HHI: Herfindhal-Hirschman Index; LOCI: Logit Competition Index. (1) HHI at the employment area level; (2) HHI at the urban area level; (3) LOCI using a-30 km radius; (4) HHI using the 95th centile radius; (5) HHI using a 10 km radius; (6) HHI using a 20 km radius; (7) HHI using a 50 km radius; (8) HHI using a 30 km radius and applying Kessler and McClellan construction procedure.

We repeat the same exercise for the evaluation of the competition effect of the reform on the whole 1999-2011 period. Results of robustness checks when the model is estimated with OLS are reported in Table 4.7. Overall, they are rather in line with those in Table 4.4 for non-profit hospitals although the magnitude of the estimated coefficients during the 2004-2007 transition period and afterwards varies across specifications.

Conclusion

The emerging evidence in the literature examining competition in a fixed-priced market is the positive correlation between competition and hospital quality. Results in the US are obtained for hospitals that are privately-run providers. Those for the UK concern the effect of a reform such that public hospitals have been given a more important managerial and fiscal autonomy. In France, there are three different hospital ownership statuses and the specific effect of competition on quality can be assessed by status within the same country.

In this chapter, we study the effect on hospital quality of a pro-competition reform gradually introduced in France over the 2004-2008 period. Whereas public and non-profit hospitals are under a global budget system and private hospitals are under a fee-for-service system before the reform, they are all under a diagnostic-related-group (DRG) payment system after the reform. We evaluate to what extent incentives for hospital competition created by the reform affect quality for the different types of hospitals. Estimations are conducted on an exhaustive dataset of heart attack patients over the 1999-2011 period for whom the 30-day in-hospital mortality is studied.

Our results suggest that patients admitted in non-profit hospitals are less likely to die in less concentrated markets after the reform. Nevertheless, it would not be the case for those in for-profit and public hospitals. This suggests that the funding system and management rules matter for the effect of the reform.

In our analysis, we use several alternative measures of local concentration to assess the robustness of our results. There is still no consensus on which index is the most relevant in particular because the way patients choose their hospital is still imperfectly known and is likely to vary across countries depending on institutions. This issue deserves additional empirical work.

We have considered that hospital quality is captured by the survival rate within the hospital. However, there are other dimensions to quality such as the room, the medicine devoted to every patient, or the attention paid by the staff to the well-being of patients. Moreover, we limited our attention to patients having a heart attack as the mortality rate for this pathology is considered to be a good predictor of hospital quality. However, the competition effect of the reform could well vary across pathologies depending on whether it is profitable or not to better cure patients after the reform. These topics are left for future research.

Appendix A. Details on the Logit Concentration index

We now give information on the Logit Concentration Index (LOCI) following Antwi, Gaynor and Vogt (2013) and Colla *et al.* in this volume.

The LOCI index for a given hospital captures the fractions of patients in municipalities which are not admitted in the hospital. It therefore corresponds to the potential market of the hospital. The LOCI is given by the formula:

$$\Lambda_j = \sum_{m \in \Phi_j} \frac{N_m S_{m \to j}}{\sum_{m \in \Phi_j} N_m S_{m \to j}} \left(1 - S_{m \to j}\right)$$

where m indexes the municipality, Φ_j is the set of municipalities from which the hospital draws patients, $S_{m \to j}$ is the share of patients in municipality m admitted in hospital j and N_m is the number of patients in municipality m.

The LOCI takes the value zero when the hospital has admitted every patient living in municipalities from which it draws patients. The LOCI tends to one when the market is perfectly competitive. It is important to note that the HHI and LOCI differ in their treatment of large and small hospitals. Consider a geographic area consisting in two municipalities such that there is a large hospital in a municipality and a small one in the other municipality. Suppose that each hospital draws the same proportional number of patients from each municipality. The HHI is identical for the two municipalities and so is then the HHI of the two hospitals, as a hospital HHI is computed as the weighted average of municipality HHIs (where the weight is the hospital share of patients coming from the municipality). By contrast, the LOCI is higher for the small hospital because the fraction of patients in each municipality not admitted in that hospital is larger. This index better captures the idea that there would be a larger potential market for the small hospital and thus more incentives for competition.

Table A.1. Summary Statistics by Hospital Status

Variable	All hospitals		University hospitals		Non-teaching public hospitals		Non-profit hospitals		For-profit hospitals	
	Mean (%)	Standard deviation	Mean (%)	Standard deviation	Mean (%)	Standard deviation	Mean (%)	Standard deviation	Mean (%)	Standard deviation
Female, 55-65	3.00	0.171	3.31	0.179	2.80	0.165	2.97	0.170	3.05	0.172
Female, 65-75	6.24	0.242	6.02	0.238	6.36	0.244	6.23	0.242	6.27	0.242
Female, 75-85	11.43	0.318	9.59	0.294	12.98	0.336	12.63	0.332	10.30	0.304
Female, more than 85	8.93	0.285	6.80	0.252	11.55	0.320	10.21	0.303	5.71	0.232
Male,35-55	18.12	0.385	21.94	0.414	15.58	0.363	16.99	0.376	18.72	0.390
Male,55-65	15.13	0.358	17.12	0.377	13.00	0.336	14.94	0.357	17.26	0.378
Male,65-75	15.37	0.361	15.42	0.361	14.45	0.352	14.98	0.357	17.51	0.380
Male,75-85	13.90	0.346	12.40	0.330	14.65	0.354	13.37	0.340	14.39	0.351
Male, more than 85	4.96	0.217	3.88	0.193	6.02	0.238	5.05	0.219	4.03	0.197
Alcoohol problems	1.30	0.114	1.33	0.115	1.43	0.119	0.99	0.099	1.04	0.101
Smoking problems	13.95	0.346	18.07	0.385	11.97	0.325	9.81	0.298	13.48	0.342
Obesity	8.28	0.276	10.33	0.304	7.17	0.258	7.78	0.268	8.09	0.273
Diabetes	17.45	0.380	16.66	0.373	17.64	0.381	19.00	0.392	17.86	0.383
Hypertension	35.64	0.479	35.27	0.478	34.82	0.476	39.89	0.490	37.37	0.484
Renal failure	6.92	0.254	6.99	0.255	7.38	0.261	8.11	0.273	5.58	0.230
Valvular disease	5.45	0.227	4.38	0.205	5.00	0.218	6.14	0.240	7.83	0.269
Peripheral arterial disease	6.21	0.241	5.91	0.236	5.89	0.236	8.63	0.281	6.96	0.255
Other vascular disease	3.33	0.179	3.04	0.172	3.47	0.183	3.33	0.180	3.39	0.181
Other ischemic disease	4.61	0.210	3.76	0.190	4.07	0.198	5.36	0.225	6.91	0.254
Heart failure	16.69	0.373	14.32	0.350	19.14	0.393	19.59	0.397	13.82	0.345
Conduction disease	21.02	0.408	17.86	0.383	22.49	0.418	23.30	0.423	21.64	0.412
Stent	43.65	0.496	57.38	0.495	27.52	0.447	48.47	0.500	60.54	0.489
Length Of Stay	7.574	7.091	7.493	7.660	7.873	7.164	7.6953	7.112	6.978	5.936

Notes: descriptive statistics computed on the sample of patients aged 35-100 admitted from their place of residence (and not a transfer).

Table A.2. Thirty-day Patient Mortality over the 1999-2011 Period (in %), by Hospital Status

	All hospitals			University hospitals		Non-teaching public hospitals		Non-profit hospitals		For-profit hospitals	
	Nb. Obs.	Mean (%)	Std Dev.	Mean (%)	Std Dev.	Mean (%)	Std Dev.	Mean (%)	Std Dev.	Mean (%)	Std Dev.
1999	50,975	7.95	0.2705	6.55	0.2474	9.51	0.2933	8.34	0.2765	6.23	0.2418
2000	53,277	7.79	0.2681	6.50	0.2465	9.40	0.2918	7.95	0.2706	5.99	0.2373
2001	54,841	7.82	0.2684	6.37	0.2443	9.51	0.2933	9.29	0.2903	5.71	0.2321
2002	54,585	7.88	0.2695	6.68	0.2497	9.69	0.2958	9.17	0.2888	5.28	0.2237
2003	54,309	7.77	0.2677	6.29	0.2428	9.47	0.2929	9.59	0.2945	5.68	0.2315
2004	51,906	7.42	0.2621	5.95	0.2365	9.16	0.2884	7.33	0.2607	5.13	0.2205
2005	49,530	7.44	0.2624	6.13	0.2399	9.09	0.2875	7.42	0.2622	5.07	0.2193
2006	48,372	6.69	0.2498	5.05	0.2189	8.35	0.2766	8.03	0.2718	4.71	0.2119
2007	48,808	6.71	0.2503	5.43	0.2265	8.17	0.2739	7.79	0.2681	5.02	0.2184
2008	49,208	6.17	0.2405	4.74	0.2124	7.63	0.2655	7.03	0.2558	4.87	0.2153
2009	50,359	5.86	0.2349	4.72	0.2121	7.15	0.2577	6.64	0.2491	4.63	0.2102
2010	51,377	5.79	0.2335	4.66	0.2109	7.21	0.2587	6.03	0.2381	4.33	0.2035
2011	51,063	5.68	0.2314	4.92	0.2164	6.94	0.2542	5.99	0.2374	3.95	0.1947
1999-2011	668,610	7.02	0.2554	5.68	0.2315	8.60	0.2804	7.76	0.2676	5.15	0.2209

Notes: descriptive statistics computed on the sample of patients aged 35-100 admitted from their place of residence (and not a transfer).

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