

Ownership and hospital productivity

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→ Work in progress

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Purpose of the paper

- Compare the productivity of Public, Private for profit (FP) and Private not for profit (NFP) hospitals in France
- Evaluate the respective impacts of differences in
 - Efficiency
 - Patient characteristics
 - Production characteristics

Background

- Numerous papers try to identify the impact of ownership structures in the hospital industry
- Public hospitals have little incentives to eliminate waste
- NFP hospitals might expand the quantity and quality of services provided beyond the socially optimal level (because quality is an argument of the manager's objective function) (Newhouse, 1970, Lakdawalla and Philipson, 1998)
- FP hospitals are likely to be the most efficient (in terms of costs): they maximize profit and can lower noncontractible quality to maximize return
- Differences in performances among ownership types can be diminished if a payment system based on yardstick competition is implemented

- Many empirical results show that FP status (or conversion to FP) is connected to a lower care quality
- Regarding the impact of ownership on costs the papers have yielded mixed findings

- No systematic difference in efficiency between for-profit and nonprofit hospitals (Sloan, 2000)
- Inefficiency can be reflected in radial, slack or scale inefficiency (Burgess and Wilson, 1996)
 - No kind of hospital ownership appears to be more efficient in every dimension
 - Hospitals of the Veteran Administration (VA) are more efficient than FP and NP hospitals in terms of radial efficiency, but highly inefficient as concerns scale

The French debate

- In France, all hospitals are financed by a unique third-party payer, the French National Health Insurance
- Since 2004, a prospective payment system (PPS) with fixed payment per stay in a given DRG is gradually introduced for both private and public hospitals
- Currently, payments differ for the same DRG, depending on whether the stay occurred in a nonprofit or a for profit hospital

- In 2006, an administrative report shows that payments per stay in a given DRG are on average 81 % higher in the nonprofit sector (public and private) than in the for profit sector
- Currently, payments per stay in a given DRG are on average 27 % higher in the nonprofit sector
- Lot of controversy about this assessment
- It is decided that a convergence of payments between the nonprofit and for profit sector should be achieved by 2012 (date recently delayed to 2018)
- Pursuing such a convergence comes down to suppose that there are differences in efficiency between nonprofit and for profit hospitals, which would be reduced by the introduction of competition between these two sectors
- Currently, a strong lobbying from the private for profit sector (FHP) in favor of the convergence of payments

www.hostocomparateur.com

mobilisons-nous pour permettre à la Sécurité Sociale de prendre en charge **un même soin à un tarif unique**



accouchement...

3 140 €

à l'hôpital public

2 742 €

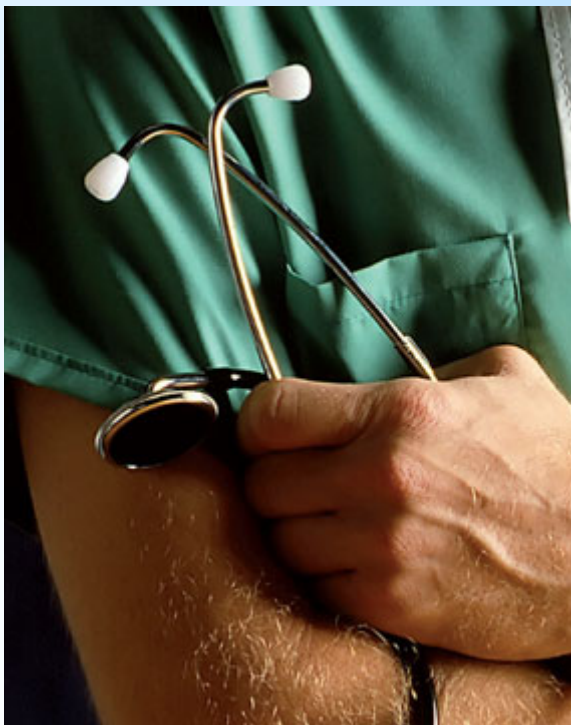
à la clinique privée

économie pour la sécu 398 €

[FAQs](#)

[suivant >](#)

Cholécystectomies sans exploration de la voie biliaire principale pour affections aiguës



à l'hôpital public

3 469,73 €

à la clinique privée

2 570,89 €

différence

898,84 €

économie réalisée sur un an de prestations

13 070 931 €

- Par exemple, qu'est-ce qui justifie encore qu'un accouchement coûte à la Sécurité sociale **3140 €** à l'hôpital public et seulement **2742 €** dans une clinique ?
- Un accouchement, sans difficulté particulière, se déroule dans les mêmes conditions techniques, les mêmes contraintes et les mêmes obligations, qu'il soit effectué au sein d'un hôpital ou dans une clinique
- C'est pourquoi nous demandons aujourd'hui aux pouvoirs publics de mettre en place un tarif unique pour ces prestations hospitalières standard
- **En un an, une telle disposition permettrait une économie de 1,4 milliard d'euros.**
- Si cette initiative vous semble pertinente et juste, venez-vous engager à nos côtés en signant notre pétition qui sera remise au Président de la République.

Purpose of the paper

- Focus on productivity and technical efficiency
- Evaluate the impacts on productivity of differences in
 - Efficiency
 - Patient characteristics
 - Production characteristics
- Draw conclusions on the potential impact of payment convergence

Outline

- The French regulation of hospital care
- Definition of “production”
- Data
- Econometric specification
- Estimation and results
- Decomposition of productivity differences between hospital types

The French regulation of hospital care

- In France, public, private nonprofit and for profit hospitals do not only differ in their objectives
- They are also subject to different rules as regards investments, human resources management and patient selection
- In the public sector
 - the number of beds is defined by an administrative authority
 - doctors, nurses and other employees are civil servants, which prevents any dismissal or transfer
 - a continuous (24/24) access to care must be guaranteed for all

- In the private sector
 - decisions are mostly influenced by the demand function faced by the hospital and by conditions prevailing on the market for health care
 - FP hospitals can select their patients
- NP hospitals are not numerous. They are subject to the same constraints than public hospitals, except for human resources management

- The characteristics of large public hospitals in France are close to those of large NP hospitals in the U.S.
 - They account for the majority of admissions (about two-third),
 - a medical career in public hospitals is rather prestigious
 - all teaching hospitals are public
 - large public hospitals generally provide a high quality of care

Why should public and NP hospitals be less productive than FP hospitals?

- Differences in objectives and mandates
- Differences in rules relative to human resources management and patient selection
- Before 2003, reimbursement schemes differ for public, NP and FP hospitals
 - 1983-2003: Global budget for public hospitals. Rather constraining for dynamic hospitals (but soft budget constraint → inequality between hospitals)
 - Retrospective payment scheme for private FP hospitals

Private for profit hospitals in France

- Sizeable contribution to hospital care services : about 1/3 discharges in acute care
- Growing specialization towards short (< 24 h) and surgical stays : currently about 1/2 of surgical stays
- Doctors salaried in the public sector are allowed, for a limited amount of time per week, to work in a private hospital. They are self-employed for this part of their activity

- Private for profit hospital were originally owned and operated by a physician, or group of physicians
- Now this physician generation is coming to retirement age and in the process of selling these establishments to investor-owned companies seeking corporate profits.
- Large chains of hospital are set up, partly owned by “American pension funds” (French representation): *Générale de Santé*, *Vitalia* (owned at 35 % by pension fund Blackstone)
- The financial returns of such investments rely on political choices regarding payment systems implemented in France for the private sector

Definition of production

- The literature devoted to performance of hospitals in relation to ownership status generally considers Cost functions.
- Great advantage: makes it possible to deal with multiproduct activity
- Here, we estimate a production function
 - For that purpose, we define a variable measuring the volume of care services provided by hospitals

The reasons to consider a production function

- Costs are difficult to observe in the private for profit sector
- For competitive reasons, information about cost is rather sensitive
- Doctors can be part owners of the for-profit hospital → difficulties to measure real costs and profitability
- In the case of France, the cost definition differs between public and private hospitals: it does not encompass the doctors' payments, nor overbilling in private for-profit and nonprofit hospitals sector
- No reliable comparison between the nonprofit and for profit sectors could be performed on the basis of costs

- The multiproduct hospital activity is synthesized by one homogenous output

$$Q_{ht} = \sum_{j=1}^J p_{jt} N_{jht}$$

- p_{jt} number of “ISA” points
- with p_{jt} , $j = 1, \dots, J$; $t = 1, \dots, T$ scale of costweights based on relative costs estimated on a subsample of public and NFP hospitals (“public” scale)
- A scale for the private sector is not available for the period
- A unique scale has to be used for a relevant comparison

Remarks

- This costweight scale is used since 2004 to define the payments per stay in the context of the PPS
- No measure of quality of care is available
→ here a rehospitalization induces an increase in production

The Data

- Information about stays for acute care in all French hospitals
- The information is almost exhaustive: participation to *PMSI* is mandatory, except for very small public hospitals (*hôpitaux locaux*)
- Two administrative sources
- PMSI database : information is recorded for each hospital at the stay level
 - DRG, secondary diagnoses, procedures implemented, severity, mode of entry into the hospital (coming from home or transferred from another hospital), mode of discharge (return home, transfer or death), length of stay, age, and gender of the inpatient
- SAE database : information at the hospital-year level
 - production factors → number of beds, facilities, number of doctors, nurses, nursing auxiliary staff, administrative staff and support staff (full-time equivalent measures)

The data (continued)

- Matching these two database provides information at the hospital-year level, about production composition and production factors
- We eliminated hospitals
 - for which the identification code was not recorded, preventing any match with the SAE database
 - with no bed or no employees → small establishments devoted to chemotherapy, radiotherapy or dialysis sessions
- We do not eliminate hospitals with only self-employed doctors (435 hospitals, FP or NFP)
- Final database :
 - 1,604 hospitals over the period 1998-2003
 - 7,731 observations at the hospital-stay level (unbalanced panel)
- For year 2003, this database represents
 - About 90 % of total discharges for acute care

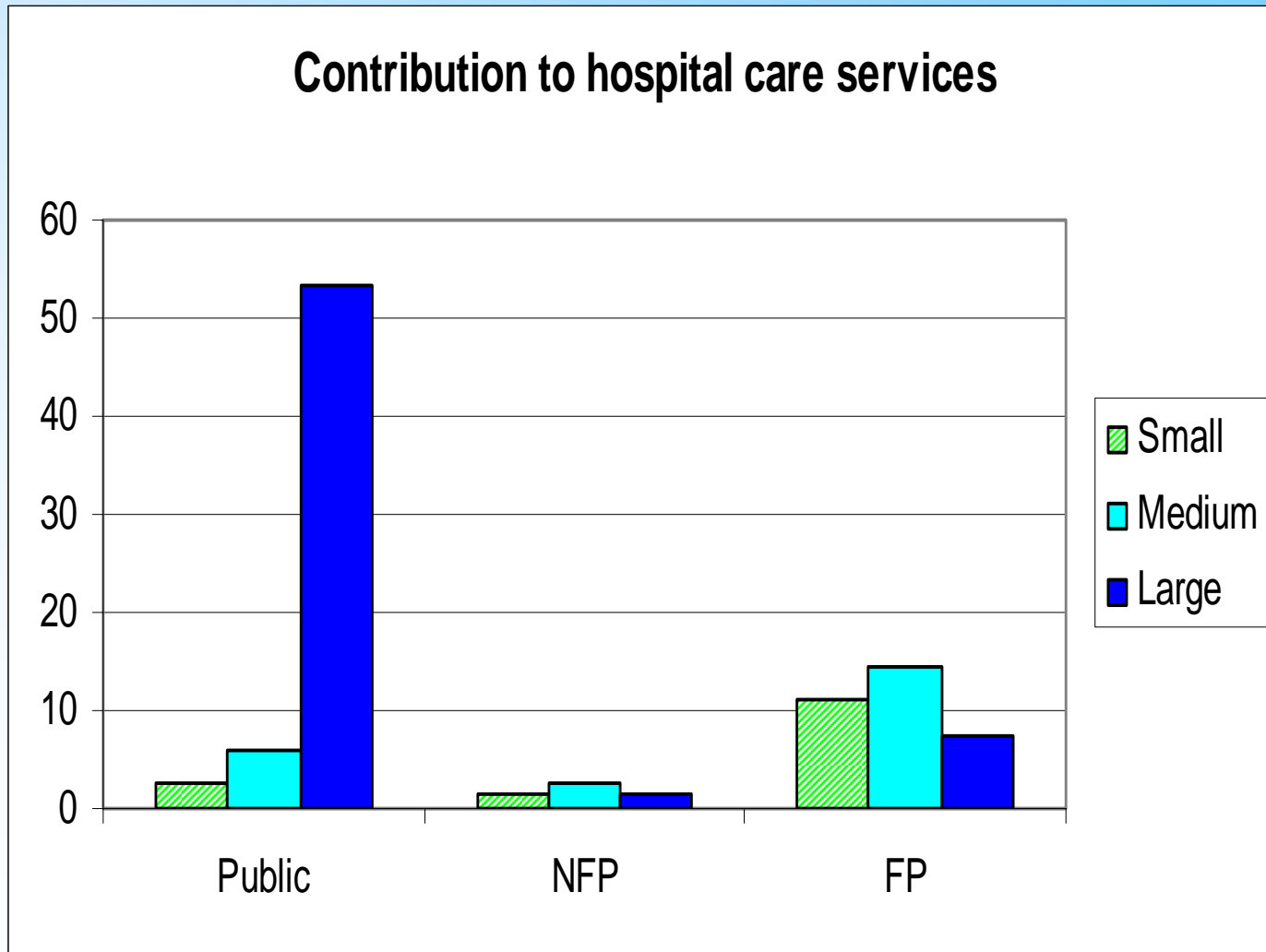
Basic features of the data

- National statistics for acute care : FP hospitals represent 1/3 discharges and 50 % surgical stays
- We observe 1,604 hospitals over the period 1998-2003 of which
 - 642 hospitals are public,
 - 126 are private not-for-profit (NFP)
 - 836 are private-for-profit (FP)
- Public: 62.9 % discharges and 40.5 % surgical stays
- NFP 4.6 % discharges and 4.4 % surgical stays
- FP 32.5 % discharges and 55.1 % surgical stays

Size	Ownership	Number of Hospitals	Number of beds per hospital	Annual number of stays per hospital	Share % in total production* [in total stays]	Average LOS** [average median LOS]
Small	Public	282	45	1,794	2.7 [3.0]	9.3 [7.1]
	NFP	72	64	2,499	1.3 [1.1]	6.9 [4.6]
	FP	541	58	2,986	11.1 [11.7]	3.9 [2.3]
Medium	Public	117	151	7,129	6.0 [6.9]	5.4 [3.5]
	NFP	40	153	6,811	2.5 [2.0]	4.5 [2.5]
	FP	234	118	6,823	14.3 [14.1]	3.5 [1.8]
Large	Public	243	566	26,865	53.4 [53.0]	5.3 [2.7]
	NFP	14	339	15,303	1.6 [1.4]	4.7 [2.4]
	FP	61	201	12,381	7.3 [6.7]	3.8 [2.1]
Total		1,604 (7,731 obs)	169	8,334	100.0 [100.0]	5.1 [3.1]

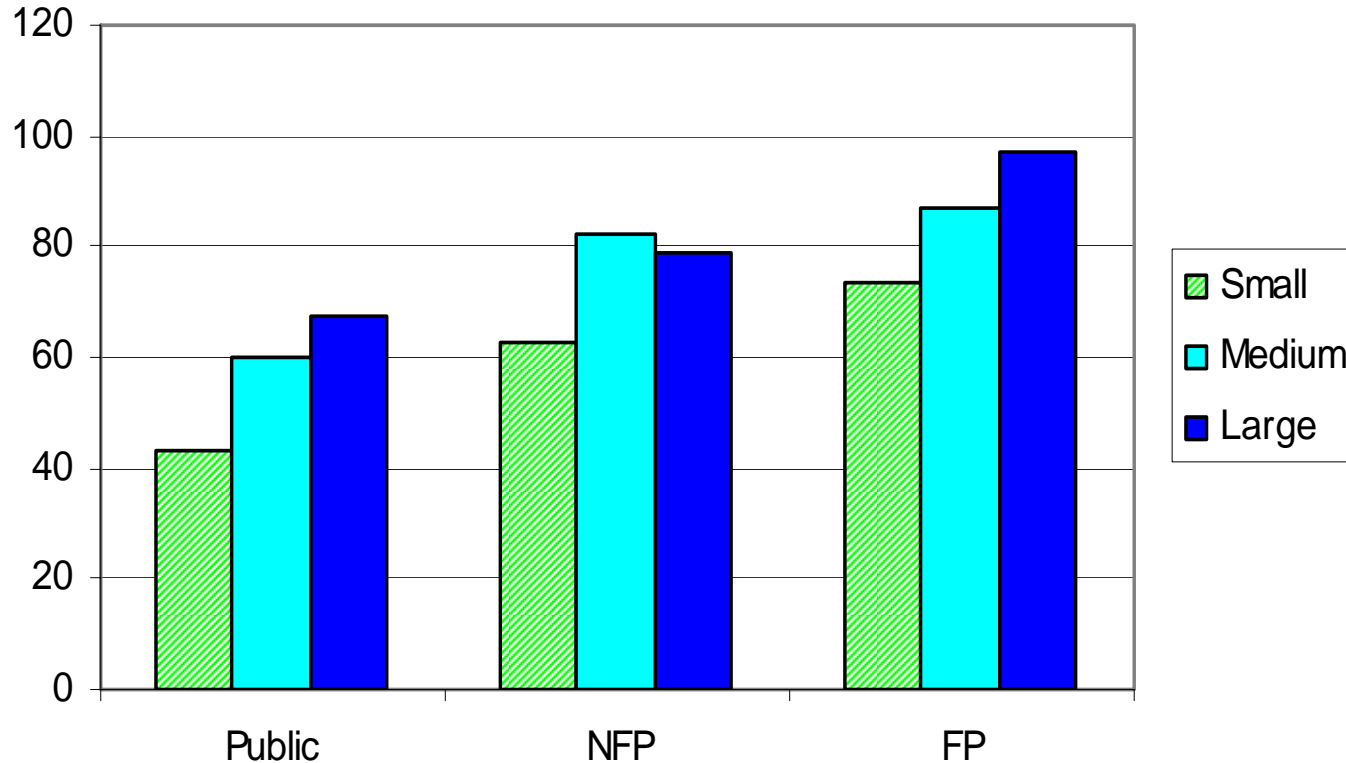
Small hospitals → less than 5,000 discharges per year, Medium → less than 10,000 discharges

Contribution to hospital care services (acute care)

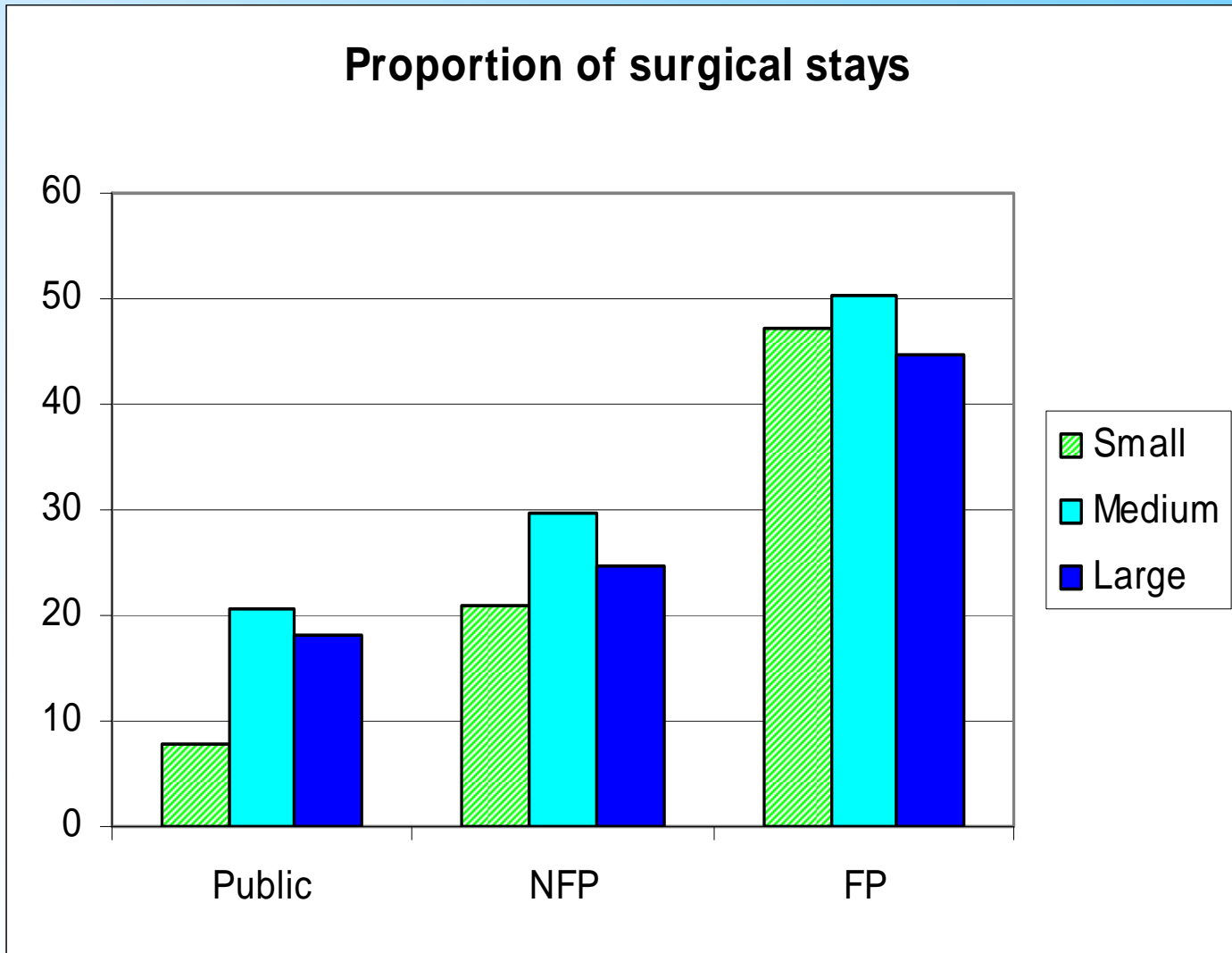


Productivity

**Productivity: annual number of ISA points
(thousand) per bed**



Proportion of surgical stays



Production factors

- Six production factors are considered
 - Beds: *bed*
 - Physicians : *phys*
 - Nurses: *nurs*
 - Nursing auxiliary staff: *nurs_aux*
 - Administrative staff: *adm*
 - Support staff: *supp*
 - The number of physicians
 - not recorded for 435 FP or NP hospitals (because self-employed physicians)
 - measured with errors for nearly all FP and NP hospitals (partial activity)
- the number of physicians will be treated as an omitted variable

Differences in organisation

Size	Ownership	Number of beds	Total persons /bed	Doctors / bed	Nurses/bed	Nursing auxiliary staff/bed	Adm.staff/ bed	Support staff/bed
Small	Public	45 ^{***}	7.62 ^{***}	0.24 ^{***}	1.63 ^{***}	3.84 ^{***}	0.68 ^{***}	1.23 ^{***}
	NFP	64 ^{***}	3.56	0.20 ^{***} [0.15 ; 0.24]	1.10	1.12	0.53 ^{***}	0.62
	FP	58 ^{***}	1.76 ^{***}	0.26 ^{***} [0.13 ; 0.36]	0.51 ^{***}	0.59 ^{***}	0.25 ^{***}	0.14 ^{***}
Medium	Public	151 ^{***}	3.66	0.29 ^{**}	1.08 ^{**}	1.33 ^{***}	0.38	0.57 ^{***}
	NFP	153 ^{***}	2.62 ^{***}	0.17 ^{***} [0.15 ; 0.19]	0.83 ^{***}	0.71 ^{***}	0.44 ^{**}	0.47 ^{***}
	FP	118 ^{***}	1.67 ^{***}	0.22 ^{***} [0.13 ; 0.29]	0.54 ^{***}	0.58 ^{***}	0.21 ^{***}	0.12 ^{***}
Large	Public	566 ^(ref)	3.65 ^(ref)	0.32 ^(ref)	1.16 ^(ref)	1.15 ^(ref)	0.39 ^(ref)	0.63 ^(ref)
	NFP	339 ^{***}	2.86 ^{**}	0.13 ^{***} [0.11 ; 0.14]	0.95 ^{**}	0.77 [*]	0.47 ^{**}	0.55
	FP	201 ^{***}	1.91 ^{***}	0.27 ^{***} [0.17 ; 0.35]	0.63 ^{***}	0.65 ^{***}	0.21 ^{***}	0.14 ^{***}

Econometric specification

- We first consider a simple parametric approach with a stochastic production frontier approach (Aigner et al, 1977) applied to the estimation of a CD production function (a more flexible translog specification is then considered)

$$Q_{ht} = A (phys_{ht})^{\alpha_1} (nurs_{ht})^{\alpha_2} (nurs_aux_{ht})^{\alpha_3} (adm_{ht})^{\alpha_4} (supp_{ht})^{\alpha_5} (bed_{ht})^{\beta}$$

$$q_{ht} - b_{ht} = (\nu - 1) b_{ht} + \alpha_1 [\log(phys)_{ht} - b_{ht}] + \alpha_2 [\log(nurs)_{ht} - b_{ht}] + \alpha_3 [\log(nurs_aux)_{ht} - b_{ht}] \\ + \alpha_4 [\log(adm)_{ht} - b_{ht}] + \alpha_5 [\log(supp)_{ht} - b_{ht}] + c_t + C^{te} + \mu \cdot teach_h + \nu_h - u_h + \xi_{ht}$$

with $b_{ht} = \text{Log}(bed_{ht})$ and $q_{ht} = \text{Log}(Q_{ht})$ ν is the return to scale parameter

ν_h is the unobserved heterogeneity relative to the hospital

$u_h \geq 0$ is representing technical inefficiency

(The dependent variable is the log of the productivity, as defined above)

Estimation

- Given that *phys* is omitted, the estimated model is:

$$q_{ht} - b_{ht} = (v - 1) b_{ht} + \alpha_2[\log(nurs)_{ht} - b_{ht}] + \alpha_3[\log(nurs_aux)_{ht} - b_{ht}] + \alpha_4[\log(adm)_{ht} - b_{ht}] \\ + \alpha_5[\log(supp)_{ht} - b_{ht}] + c_t + C^{te} + \mu \cdot teach_h + v_h - u_h + \xi_{ht}$$

- Two steps :

- OLS with hospital fixed effects η_h (in addition to year dummies)

- MLE applied to $\hat{\eta}_h = C^{te} + \mu \cdot teach_h + v_h - u_h$

assuming $v_h \sim N(0, \sigma_v^2)$ and $u_h = |\epsilon_h|$, with $\epsilon_h \sim N(0, \sigma_u^2)$

in order to identify the components relative to unobserved heterogeneity and technical inefficiency

From the estimation, one can deduce the asymmetry parameter

$$\lambda = \frac{\sigma_u}{\sigma_v}$$

and an efficiency rate at the hospital level defined by:

$$effi_h = \exp \{-u_h\} = \frac{Q_h}{Q_h^{\max}}$$

- The first specification defined above is a classical production function connecting inputs and output, and defining the frontier of efficient production:

$$q_{ht} - b_{ht} = z'_{ht} \alpha + c_t + \eta_h + \xi_{ht} \quad (1)$$

- where z'_{ht} is a [1,5] vector corresponding to the production factors, as introduced in the specification above
- Our model considers two kinds of deviations from this frontier (+ teaching dummy)
 - Hospital specific heterogeneity
 - Inefficiency

- We then consider specifications with additional regressors relative to patients and production characteristics
- This comes down to explaining unobserved hospital heterogeneity and technical inefficiency by regressors relative to patients and production characteristics
- This approach is rather “eclectic” (Vita, *JHE*, 1990): variables describing heterogeneity in the output appear at the right hand side of the production function
- Specifying a fixed hospital effect makes it possible to deal with a possible correlation between these variables and time-invariant hospital unobserved heterogeneity

Additional specifications

- In model (2) we add a vector [1,19] describing patient characteristics: detailed age*gender effects, severity, entry and discharge mode

$$q_{ht} - b_{ht} = z'_{ht} \alpha + x'_{ht} \beta + c'_t + \eta'_h + \xi'_{ht} \quad (2)$$

- In model (3) we add a vector [1,13] describing prod. characteristics: proportion of stays in 10 important MDC (major diagnoses categories: neurology, ophtalmology, otorhinolaryngology, pneumology, cardiology, gastroenterology, orthopaedics, deliveries, short stays (<24H)), degree of specialization, proportion of surgical stays)

$$q_{ht} - b_{ht} = z'_{ht} \alpha + x'_{ht} \beta + \pi_{ht} \delta + c''_t + \eta''_h + \xi''_{ht} \quad (3)$$

- Model (4) considers an additional [1,3] vector giving indication about the length of stay (LOS): the value of the first decile, median and ninth decile of LOS

$$q_{ht} - b_{ht} = z'_{ht} \alpha + x'_{ht} \beta + \pi_{ht} \delta + \lambda_{ht} \theta + c'''_t + \eta'''_h + \xi'''_{ht} \quad (4)$$

Estimation: final remarks

- For each model, we estimate hospital fixed effects and apply the second step to estimate efficiency rates
- The production function is supposed to be identical for any hospital, whatever ownership status and size
- This is the assumption of the regulator implementing a PPS, i.e. Introducing a yardstick competition between hospitals of all types

Results (1) - first step

Variable	Model 1	Model 4
<i>Log (bed)</i>	-0.3317***	-0.4778***
<i>Log (nurs/bed)</i>	0.2780***	0.2045***
<i>Log (nurs aux staff/bed)</i>	0.0437	0.1095*
<i>Log (adm staff/bed)</i>	0.4562***	0.4107***
<i>Log (support staff/bed)</i>	-0.2973***	-0.2469***

<i>% women 19-40</i>		0.1596
<i>% men 19-40</i>		0.8077**
<i>% women 41-50</i>		0.0006
<i>% women 51-60</i>		-0.1278
<i>% men 51-60</i>		0.4232
<i>% women 61-70</i>		0.8032**
<i>% men 61-70</i>		0.3737
<i>% women 71-80</i>		0.4365
<i>% men 71-80</i>		0.0057
<i>% women 81-90</i>		-0.5484**
<i>% men 81-90</i>		-0.1175
<i>% women 91+</i>		0.1938
<i>% men 91+</i>		-0.5659
<i>Percent adm. severity 2</i>		0.8432***
<i>Percent adm. severity 3</i>		1.623***
<i>Admission from home</i>		-0.1325**
<i>Discharge</i>		
<i>home</i>		0.0311
<i>other hospital</i>		-0.0266
<i>death</i>		-0.8927**
<i>% stays in MDC 1</i>		-0.1271
<i>% stays in MDC 2</i>		-0.2346
<i>% stays in MDC 3</i>		-0.6033**
<i>% stays in MDC 4</i>		0.8626***
<i>% stays in MDC 5</i>		0.7813***
<i>% stays in MDC 6</i>		1.673***
<i>% stays in MDC 8</i>		0.5521***
<i>% stays in MDC 14</i>		2.1258***
<i>% stays in MDC 23</i>		0.4514***
<i>% stays shorter than 24h</i>		0.6876***
<i>% stays with surgery</i>		0.9388***
<i>Specialization index</i>		0.1940***
<i>Specialization intensity</i>		-0.6701***
<i>First decile of LOS</i>		-0.0077
<i>Median of LOS</i>		-0.0097**
<i>Ninth decile of LOS</i>		-0.0051***

Results (2) – second step

estimation of the SCF model	Model 1	Model 2	Model 3	Model 4
asymmetry parameter $\lambda = \frac{\sigma_u}{\sigma_v}$	3.471	2.763	1.222	1.172
-value for the LR test for $\sigma_u = 0$	0.000	0.000	0.000	0.000
Coefficient for Teaching	0.649***	0.694***	1.027***	1.008***

Results (2)- second step: median value of estimated hospital efficiency rates $effi_h$

$$effi_h = \exp \{-u_h\} = \frac{Q_h}{Q_h^{\max}}$$

Size	Ownership	Model 1	Model 2	Model 3	Model 4
Small	Public	17.2	30.2	48.2	52.1
	NFP	43.6	50.1	64.4	66.1
	FP	57.9	57.0	62.9	64.4
Medium	Public	64.2	74.9	78.6	79.1
	NFP	79.4	75.7	78.6	79.4
	FP	80.8	80.5	76.3	77.2
Large	Public	82.4	85.9	84.5	85.0
	NFP	87.6	85.5	83.8	84.1
	FP	88.7	87.4	81.7	82.3

Robustness of the results

- Same ranking with
 - Translog production function
 - Cobb-Douglas without teaching hospitals
 - Cobb-Douglas with the doctors (reduced sample : 1169 hospitals, 5798 observations)
 - Cobb-Douglas without “Hôpitaux locaux”
 - Cobb-Douglas without “hybrid” hospitals

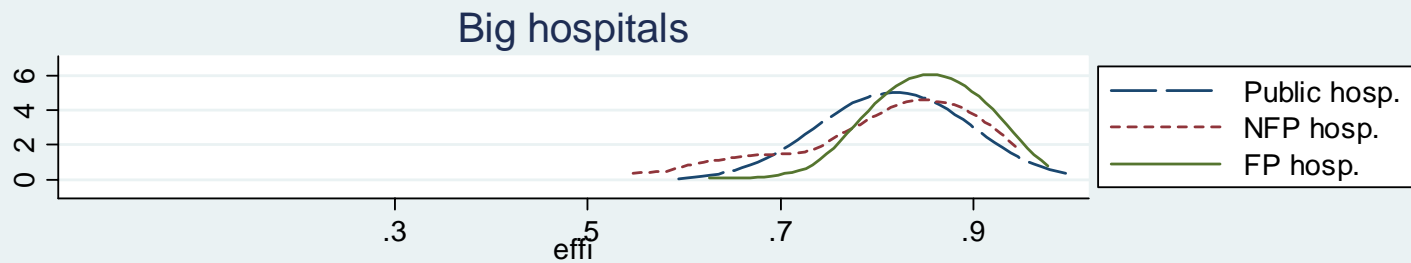
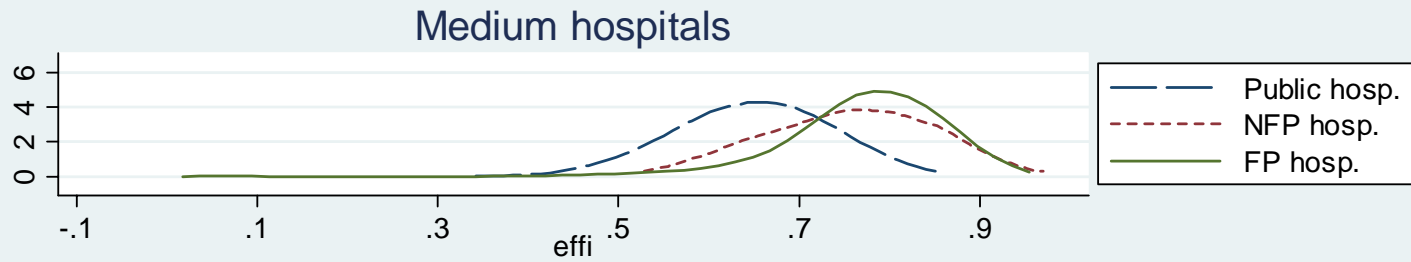
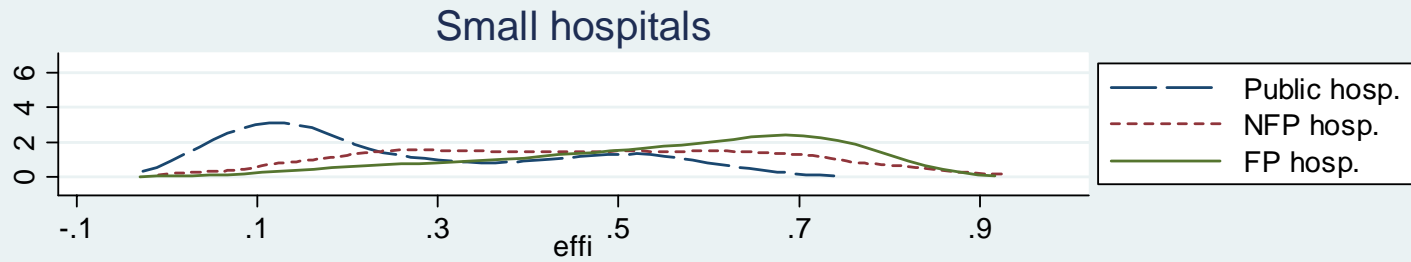
Decomp of average productivity differences (model 4)

	Small Public – FP (a)	Medium Public – FP (b)	Large Public – FP (c)
Average diff in productivity (to be explained) (1)	-54.5	- 33.6	- 33.7
Due to :			
Beds	+ 23.5	- 12.2	- 37.5
nurses	9.6	5.7	+ 5.7
Nursing aux staff	10.2	4.2	+ 2.9
administrative staff	10.6	5.1	+ 5.4
Support staff	-14.5	- 8.1	- 8.8
Total diff due to production factors (2)	+ 39.4	- 5.3	- 32.3
Total diff due to patient characteristics (3)	- 22.6	- 14.0	- 11.1
Total diff due to production characteristics (4) (of which pchir)	- 40.3 (- 36.9)	- 23.6 (- 28.1)	- 26.5 (-24.9)
Total diff due to diff. in LOS (5)	- 10.4	- 3.6	- 2.1
Teaching hospital	+ 4.3	+ 2.6	23.2
Unobservable heterogeneity (6)	- 5.3	+ 7.3	13.3
Inefficiency (7)	- 31.5	+ 2.5	0.6
Residual* (8)	12.0	0.6	1.2

Decomp of productivity differences (continued)

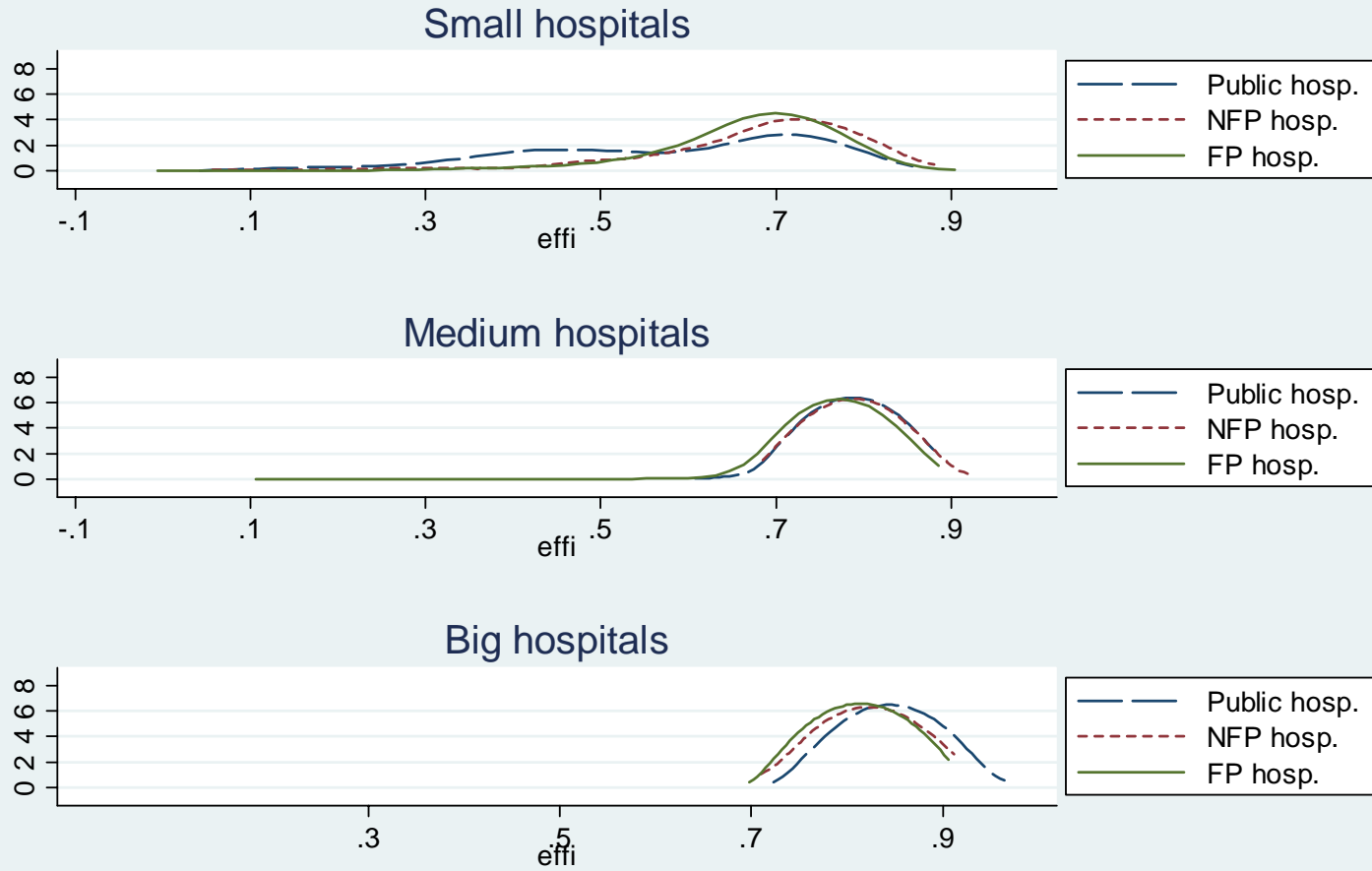
	Small Public – NFP (d)	Medium Public – NFP (e)	Large Public - NFP (f)	Small NFP – FP (g)	Medium NFP – FP (h)	Large NFP – FP (i)
Average diff in productivity (to be explained) (1)	- 37.2	- 27.5	- 12.7	- 17.3	- 7.4	- 21.0
Due to :						
Beds	+ 24.0	+ 0.5	- 16.0	- 0.5	- 12.7	- 21.5
nurses	4.2	2.3	2,1	5.4	3.4	3.6
Nursing aux staff	7.8	3.4	2,1	2.5	0.8	0.7
administrative staff	3.4	-1.6	-2,1	7.2	6.7	7.5
Support staff	- 7.4	- 2.0	- 1.8	- 7.1	- 6.1	- 7.0
Total diff due to production factors (2)	+ 31.9	+ 2.5	- 15.6	+ 7.5	- 7.9	- 16.7
Total diff due to patient characteristics (3)	- 18.4	- 19.6	- 13.9	- 4.2	+ 5.6	+ 2.8
Total diff due to production characteristics (4) (of which pchir)	- 17.9 (- 12.2)	- 6.3 (- 8.7)	- 7.6 (- 6.3)	- 22.4 (- 24.6)	- 17.3 (- 19.4)	- 18.9 (- 18.6)
Total diff due to diff. in LOS (5)	- 4.7	- 1.8	- 0.8	- 5.7	- 1.8	- 1.3
Teaching hospital	+ 4.3	+ 2.6	23.2	-	-	-
Unobservable heterogeneity (6)	- 10.3	- 2.9	+ 3.3	+ 5.0	+ 10.2	+ 10.0
Inefficiency (7)	- 30.5	- 2.0	- 0.8	- 0.9	+ 4.5	+ 1.4
<i>Residual*</i> (8)	<i>8.5</i>	<i>1.3</i>	<i>- 0.6</i>	<i>3.4</i>	<i>- 0.7</i>	<i>1.8</i>

Efficiency Rate by size _ Model1



Source: SAE_PMSI 1998-2003

Efficiency Rate by size _ Model4



Source: SAE_PMSI 1998-2003

Conclusion

- The lower productivity of public hospitals is mostly explained by:
 - Oversized establishments
 - Patient characteristics (severity)
 - Production characteristics (small proportion of surgical stays)
 - And not by inefficiency
- Payment convergence would provide incentives for public hospitals to change the composition of their supply for care
- Costweights p_{jt} used to compute payments (and our productivity measure) are based on relative costs
- And not, on the demand side, on social value attributed to care provided during one stay in a given DRG

Results (2)- second step: median value of estimated hospital efficiency rates *effih* (Cobb-Douglas production function) **without teaching** hospitals

Size	Ownership	Model 1	Model 2	Model 3	Model 4
Small	Public	18.1	35.5	54.2	57.3
	NFP	43.9	50.7	66.0	68.7
	FP	58.3	57.2	64.5	66.5
Medium	Public	64.9	75.4	79.2	80.0
	NFP	79.5	75.8	79.0	79.9
	FP	81.0	80.5	77.0	78.1
Large	Public	83.7	87.6	85.5	86.0
	NFP	87.6	85.6	84.1	84.4
	FP	88.8	87.6	82.0	82.8

Results (2)- second step: median value of estimated hospital efficiency rates $effi_h$ (**translog** production function)

$$effi_h = \exp \{-u_h\} = \frac{Q_h}{Q_h^{\max}}$$

Size	Ownership	Model 1	Model 2	Model 3	Model 4
Small	Public	20.5	36.6	49.8	53.5
	NFP	51.1	56.6	62.3	65.1
	FP	63.9	65.5	63.2	65.4
Medium	Public	65.9	73.8	75.4	76.0
	NFP	72.5	72.1	74.3	75.0
	FP	75.0	76.3	73.1	74.0
Large	Public	78.9	82.0	82.1	82.5
	NFP	79.0	78.7	77.6	79.6
	FP	80.2	80.8	79.4	78.3