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Analisi dell'efficienza ospedaliera con la Data Envelopment Analysis
Un'applicazione relativa agli ospedali della Regione Lombardia

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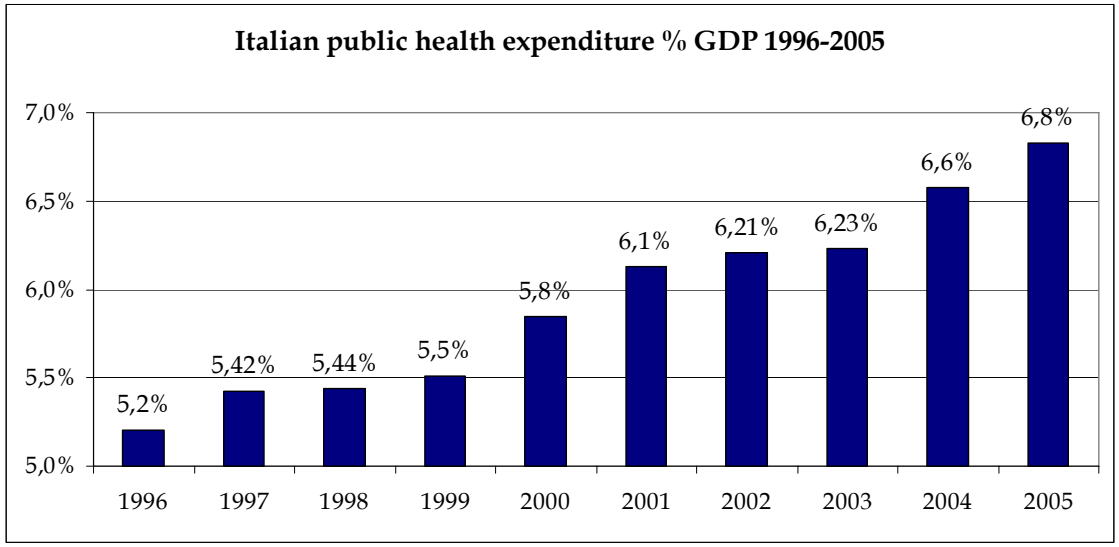
Summary

- Relevance of the topic
- Literature Review
- Research Questions
- Paper Structure
- Methodology
- Dataset
- Model

Relevance of the topic 1/2

- The pursuit of efficiency is a central objective of policy makers within most health systems.

  Main reason: in developed countries expenditure on health care amounts to a sizeable proportion of GDP and is likely to grow in future years.



Source: WHO

Health expenditure as % of GDP in Western Countries (2004)

	Public HE % GDP	Total HE % GDP
Iceland	8,3	9,9
France	8,2	10,5
Germany	8,2	10,6
Norway	8,1	9,7
Austria	7,8	10,3
Sweden	7,7	9,1
Monaco	7,5	9,9
Luxembourg	7,2	8
Denmark	7,1	8,6
Portugal	7,0	9,8
Malta	7,0	9,2
United Kingdom	7,0	8,1
Belgium	6,9	9,7
Switzerland	6,7	11,5
Slovenia	6,6	8,7
Italy	**6,5**	**8,7**
Israel	6,1	8,7
Spain	5,7	8,1
Netherlands	5,7	9,2

Source: WHO

Relevance of the topic 2/2

- Over the last two decades in the Western European countries many health care reforms aim at increasing efficiency, reducing the costs of health services and introducing a managerial culture into the health services environment.
- The 1992 Reform in Italy:
  - Regional autonomy in planning, managing and funding the Regional Health Care System
  - Local Health Authorities transformed into Local Health Care Enterprises
  - General management introduced
  - Introduction of a prospective capitation funding mechanism for the regions
  - Hospitals funded for what they produced rather than the resources they used.
- Since 1995 a new funding mechanism for hospitals operating in the National Health Service based on Diagnosis Related Groups (DRG) $\Rightarrow$ Prospective Payment System.

Literature review 1/2

- In the literature two principal types of approaches to measure efficiency :
  - linear programming (non-parametric) approach:
    - Data Envelopment Analysis
    - Free Disposal Hull
  - econometric (parametric) approach:
    - Deterministic: Corrected Ordinary Least Squares
    - Stochastic: Stochastic Frontier Analysis.

- DEA can be used to evaluate and efficiency at all levels of the health care industry:
  - Individual patient's experience (Scott 1979)
  - Individual physician's level (Chilingerian 1994, Chilingerian and Sherman 1997)
  - Department or organizational level: hospitals (Grosskopf and Valdmanis 1987) or specific services or departments (Puig-Junoy 1998b, Hollingsworth and Parkin 2001)
  - Entire health care system: the entire health care system (Puig-Junoy 1998a), health regions or health districts (Ozcan and Cotter 1994, Gerdtham, Rehnberg and Tambour 1999)

Literature review 2/2

- Topics:
  - Hospital ownership and technical inefficiency (Burgess and Wilson 1996, Barbetta and Turati 2001; Barbetta, Turati and Zago 2007)
  - Effects of competition on the efficiency (Cellini, Pignataro and Rizzo 2000; Hersch 1984; Robinson et al. 1985)
  - Hospital consolidations (Luke et al. 1995)
  - Rural hospital closures (Ozcan and Lynch 1992)
  - Urban hospital closures (Lynch and Ozcan 1994)
  - Comparison of teaching and non-teaching hospitals (O'Neill 1998)
  - Multi-output nature of the hospital industry (Conrad and Strauss 1983; Cowing and Holtmann 1983)
  - Hospital allocative efficiency (Byrnes 1994; Puig-Junoy 2000; Morey et al. 1990)
  - Comparison of DEA and SFA (Hollingsworth 2003; Jacobs 2001; Jacobs, Smith and Street 2006; Linna 1998; Street 2003)
  - Review of Data Envelopment Analysis Software (Hollingsworth 1997, 1999; Cooper, Seiford and Zhu 2004).

Research questions

- Contribute to the debate inherent the efficiency measurement of Italian hospitals.

  In particular:
  - Lombard hospitals
  - 9 years' interval: 1998-2006
  - Multi-output nature of the hospital:
    - In-patient services
    - Out-patients services
    - Emergency treatments.

- Methodology: Data Envelopment Analysis.

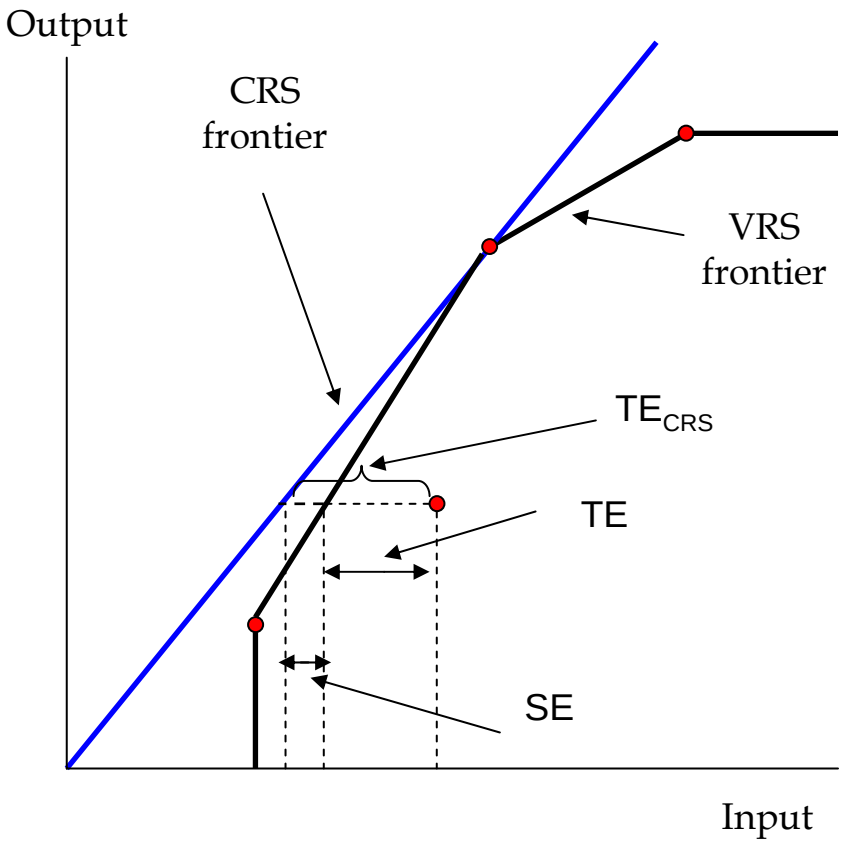
- Final aim: find policy implications
  - for the region
  - for the health care general management.

Paper structure

- Two-stage analysis:
  1. Measuring hospital technical efficiency with Data Envelopment Analysis ⇒ get DEA scores.
  2. Regress DEA scores over variables that may affect efficiency:
     - Ownership
     - Market concentration
     - Teaching status
     - Location
     - Measures of case-mix and patients' characteristics
     - Hospital's features.
- Evaluation of the efficiency change over time ⇒ Malmquist productivity index.

Methodology: Data Envelopment Analysis

- A linear programming method that constructs nonparametric production frontier by fitting a piece-wise linear surface over the data points.
- Efficiency is calculated in terms of scores on a scale of 0 to 1 (frontier firms).
- Inefficiency = firm's distance from the frontier.
- Input oriented efficiency vs output oriented efficiency.
- CRS vs VRS.
- Advantages: multi-input and multi-output; does not impose functional form.
- Disadvantages: assumes no data noise.



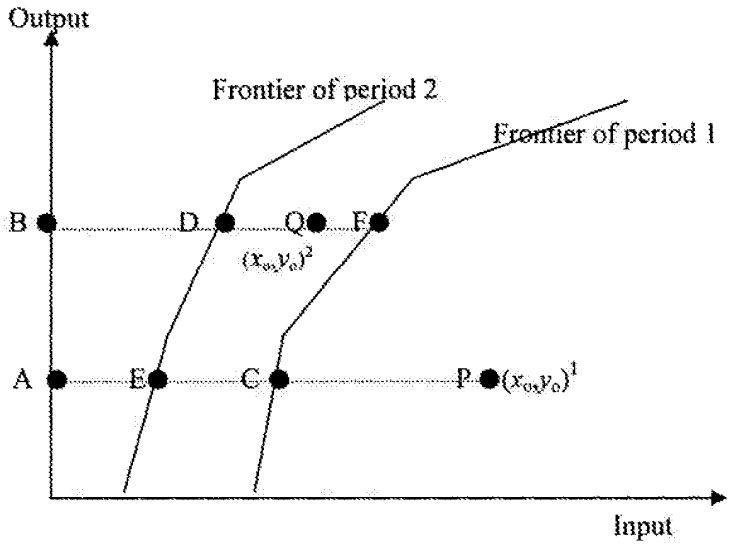
Technical Efficiency TE: horizontal distance from the VRS frontier

Technical Efficiency CRS TE_{CRS}: horizontal distance from the CRS frontier

Scale Efficiency SE: horizontal distance between the VRS and CRS frontiers

Methodology: Malmquist productivity index

- The Malmquist productivity index evaluates the productivity change of a DMU between two time periods.
- It reflects progress/regress in efficiency (catch-up effect) along with progress/regress of the frontier (frontier-shift effect) over time.



$$MI = (\text{Catch - up}) \times (\text{Frontier - shift})$$

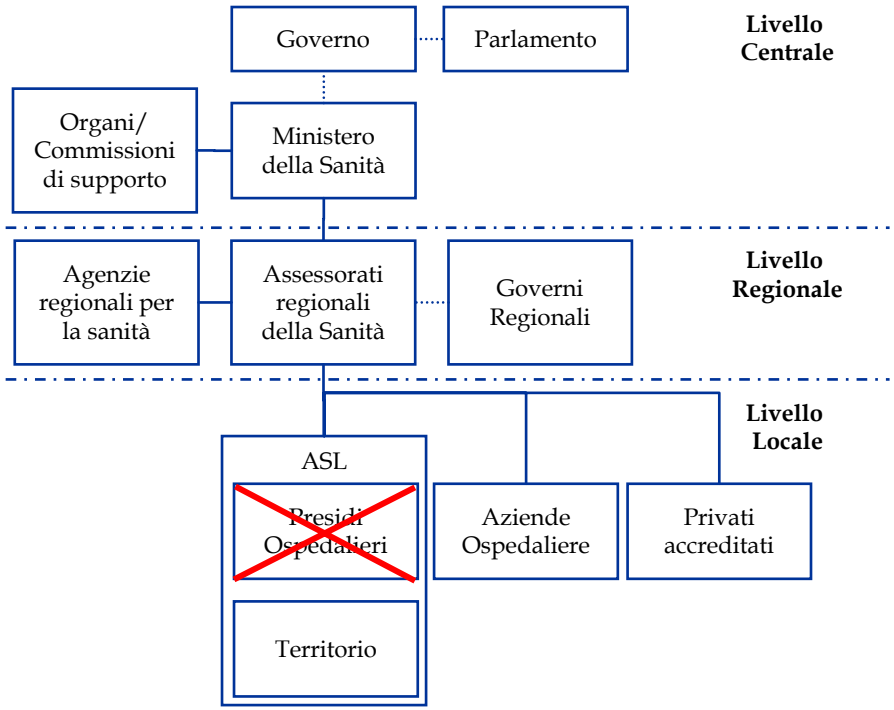
$$\text{Catch} - \text{up} = \frac{BD}{BQ} \Big/ \frac{AC}{AP}$$

$$\text{Frontier - shift} = \varphi = \sqrt{\varphi_1 \varphi_2}$$

$$\varphi_1 = \frac{\frac{AC}{AP}}{\frac{AE}{AP}} \qquad \varphi_2 = \frac{\frac{BF}{BQ}}{\frac{BD}{BQ}}$$

Dataset 1/3

- Lombard acute hospitals.
- Possible drawback: regional data.
- But:
  - Health Care under the competence of the regional level
  - Lombard Regional Health System's organizational structure from the other Italian Regions.



- Features of Lombardy:
  - Resident population : ~ 9.5 million (16.2% of the Italian population)
  - 20.3% Italian GDP
  - 131 hospitals, ~ 41.500 beds, ~ 2.1 million hospitalizations (16% of the Italian hospitalizations).

Dataset 2/3

- Analysed types of hospitals:
  - Local public hospitals (*Ospedali a gestione diretta ASL*)
  - Hospital trusts (*Aziende Ospedaliere*)
  - Public scientific research hospitals (*Istituti di Ricovero e Cura a Carattere Scientifico pubblici*)
  - Private scientific research hospitals (*Istituti di Ricovero e Cura a Carattere Scientifico private*)
  - Hospitals run by religious bodies (*Ospedali classificati*)
  - Private for-profit accredited hospitals (*Casa di Cura Privata accreditata*)
- Analysed data: from 1998 to 2006

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Local public hospitals	20	20	19	19	4	1	1	1	1
Hospital trusts	27	27	27	27	29	29	29	29	29
Public scientific research hospitals	5	5	5	5	5	5	5	6	5
Private scientific research hospitals	13	13	13	13	13	13	13	16	16
Hospitals run by religious bodies	6	6	6	6	6	6	6	6	7
Private for-profit accredited hospitals	55	55	55	54	56	58	61	71	73
TOTAL	126	126	125	124	113	112	115	129	131

Dataset 3/3

- Hospitals' features
- Employees
- Inpatient services
- Outpatient services
- Financial data

Hospitals' features

- Anno
- Struttura di ricovero
- Tipologia di struttura
- Direzione ospedaliera/universitaria dei reparti
- Numero di posti letto effettivi DO e DH
- Presenza di alcuni servizi di supporto all'assistenza ospedaliera:
  - Pronto Soccorso
  - Dipartimento Emergenza I livello (DEA)
  - Dipartimento Emergenza II livello (EAS)
  - Sale operatorie
  - Centro trasfusionale
  - Rianimazione
  - Dialisi
  - Camera iperbarica
  - Ambulanze di tipo "A" e di tipo "B".

Employees

- Anno
- Struttura di ricovero
- Full Time Equivalent per ruolo/macroprofilo:
  - Ruolo sanitario:
    - Medici
    - Infermieri
    - Tecnici sanitari
    - Tecnici della riabilitazione
    - Altro personale sanitario
  - Ruolo professionale
  - Ruolo tecnico
  - Ruolo amministrativo.

In-patient and out-patient services

IN-PATIENT SERVICES

- Anno
- Struttura di ricovero
- Regime di ricovero
- DRG
- Numero di ricoveri
- Numero di giornate di degenza

OUT-PATIENT SERVICES

- Anno
- Struttura di ricovero
- Branca specialistica
- Numero di prestazioni ambulatoriali per esterni
- Numero di prestazioni equivalenti
- Numero di prestazioni ambulatoriali per interni

Financial data

- MODELLO DI RILEVAZIONE DEL CONTO ECONOMICO DELLE AZIENDE UNITÀ SANITARIE LOCALI E DELLE AZIENDE OSPEDALIERE
- Rilevazione a consuntivo

- Costi totali
- Costo del personale
- Acquisto di beni:
  - Materiale sanitario
  - Materiale economale
- Acquisto di servizi:
  - Servizi non sanitari
  - Manutenzione
  - Godimento beni terzi
  - Altri servizi

Model

INPUTS

- FTE physicians
- FTE nurses and equivalent
- FTE other personnel
- Number of beds for ordinary hospitalization
- Number of beds for day-care treatments

OUTPUTS

- Case-mix adjusted discharged patients
- In-patient days in acute and sub-acute care services, except intensive care units (medicine, surgical, obstetrical, gynaecological and paediatric services)
- In-patient days in intensive care units, including intensive neonatal and burn units
- In-patient days in long-term services (psychiatric and long stay)
- Surgical interventions
- Hospital day-care treatments
- Ambulatory visits
- Number of emergency room cases

Thank you!

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