Efficiency Differences Between Critical Access Hospitals and Non-Converting Rural Hospitals

Ryan Mutter, Ph.D.
Agency for Healthcare Research and Quality
Rockville, MD

Michael Rosko, Ph.D.
School of Business Administration
Widener University
Chester, PA

Background

- Enactment of the Balanced Budget Act of 1997 (BBA) created the Critical Access Hospital (CAH) program
- Program subsequently modified by additional legislation
  - Medicare, Prescription, Drug, Improvement, and Modernization Act of 2003 (MMA)
- Seeks to enhance financial viability of small, isolated rural and “necessary provider hospitals”

Background (continued)

- Under the CAH program, hospitals accept a number of restrictions
  - Limits on the number of acute care patients treated at one time (25)
  - Limits on average patient LOS (4 days)
- In exchange, they receive 101 percent of costs

Background (continued)

- Medicare payments to CAHs rose at an annualized growth rate of 9.5 percent from 1998 to 2003.
- The growth rate for similar non-converting hospitals was 3.3 percent.
- Medicare paid an estimated $1 million more per CAH in 2006 than they would have had payment increased at the rate of non-converting comparison hospitals.

Background (continued)

- Quality improvement was one of the main goals of the CAH program.
- Many of these extra resources have gone into quality improvement and quality assurance activities.
- See Li et al. (2007) for a review of the impact of CAH status on quality.

Motivation

- Program has succeeded in its aim of halting the closure of hospitals providing care to under-served populations, but there are concerns about the efficiency impact of the program

Motivation (continued)

"Although the CAH program has helped to preserve access to emergency and inpatient care in isolated areas, it may not have accomplished this goal in an efficient manner."

- MedPAC (2005)

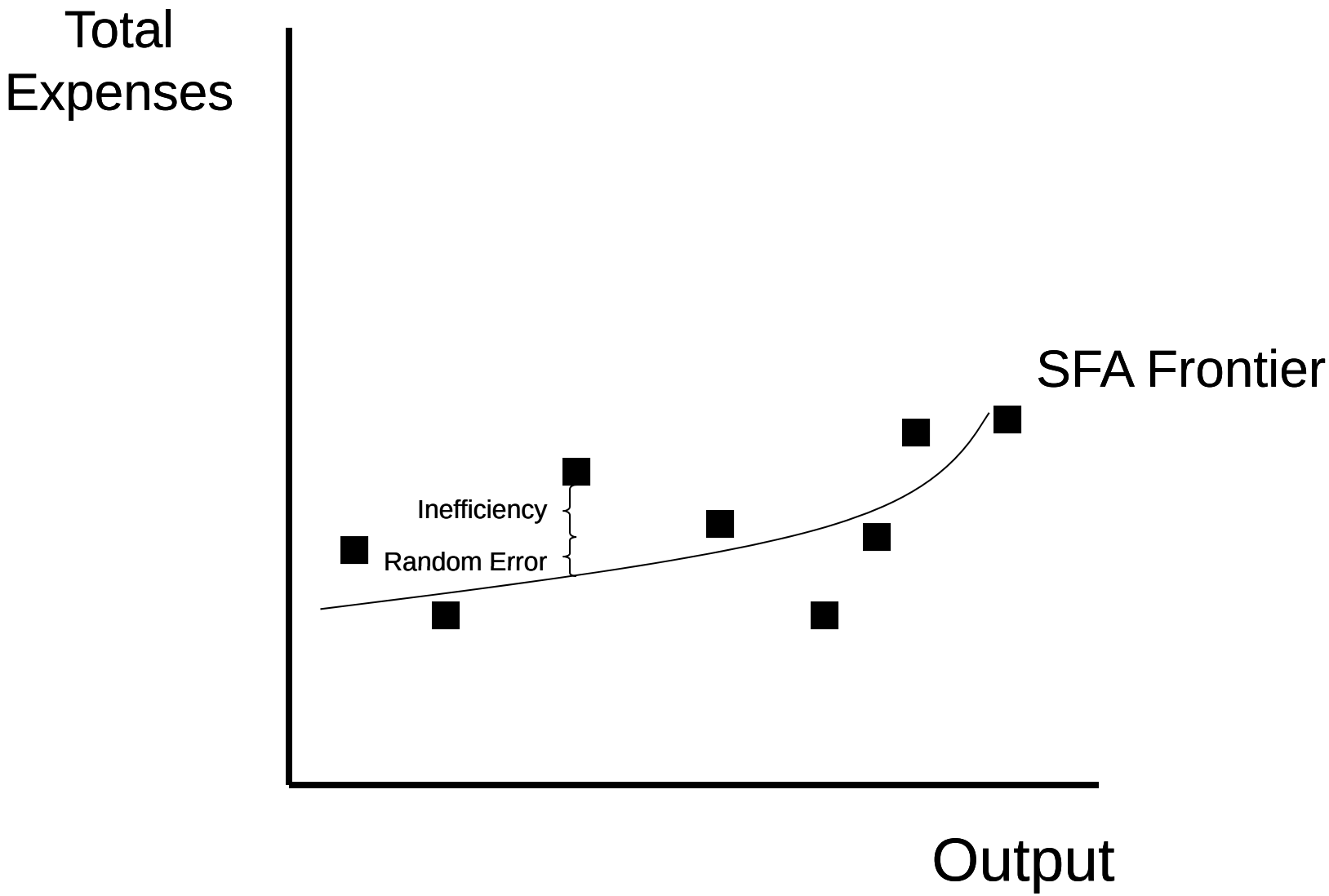
Aim

- Use stochastic frontier analysis (SFA) to estimate the efficiency impact of the CAH program.

Stochastic Frontier Analysis (SFA)

- Econometric technique
  - Generates provider-level (i.e., hospital-level) estimates of inefficiency
  - Inefficiency estimates are measured as departures from a statistically derived, theoretical best-practice frontier that takes input prices, outputs, product mix, quality, case mix, and market forces into account

SFA (continued)



SFA (continued)

- Measures cost inefficiency (i.e., the percentage by which observed costs exceed minimum costs predicted for a given level of outputs, input prices, etc.)
- Particularly useful for determining the **relative performance** of hospitals
  - Hospital A is among the top 40 percent most efficient hospitals in its **peer group**.
- Folland and Hofler (2001) demonstrate its usefulness for **comparing** the efficiency of **groups** of hospitals

SFA (continued)

- Specified generally as

$$TC_i = f(Y_i, W_i) + e_i$$

where *TC* represents total costs; *Y* is a vector of outputs; *W* is a vector of input prices; and *e* is the error term, which can be decomposed as follows

$$e_i = v_i + u_i$$

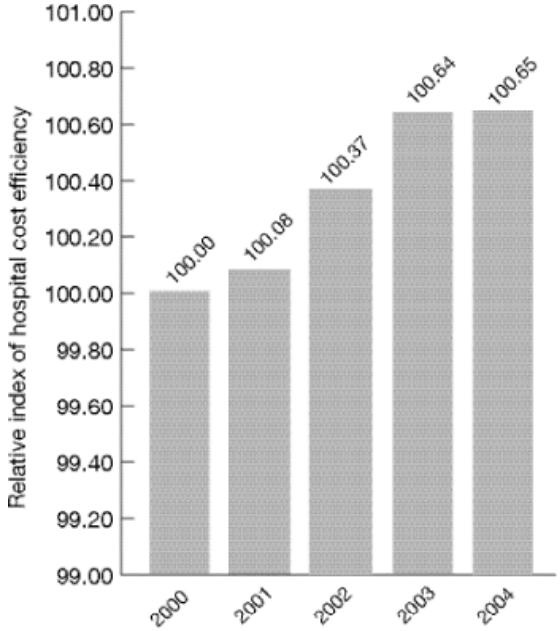
where *v* is statistical noise ~ N(0, σ^2) and *u* consists of positive departures from the cost-frontier

SFA (continued)

- Byproduct of the analysis is information about hospital-level variables on cost and environmental pressure variables on inefficiency

SFA (continued)

- Featured in the National Healthcare Quality Report (NHQR), a product of the U.S. Department of Health and Human Services



- See Rosko and Mutter (2008) for an overview.

Data

- Using 1997-2004 panel data for 543 hospitals located in 16 states, employ SFA to estimate inefficiency of CAH-designated hospitals, as well as a comparison group of prospectively-paid, non-converting hospitals located in rural areas

1997	12 CAHs	531 non-converting, rural comparison hospitals
2004	286 CAHs	257 non-converting, rural comparison hospitals

Data Sources

- American Hospital Association (AHA) Annual Survey of Hospitals
- Medicare Cost Reports
- AHRQ Healthcare Cost and Utilization Project (HCUP)
- Area Resource File

Methods

- Time-varying cost SFA with product mix descriptors, controls for quality, etc.
- Frontier 4.1 program

Intuition

- Compare the performance of CAHs to similar, prospectively paid rural hospitals **and** to their previous, prospectively paid rural selves.

Variables

- Input prices
  - Price of labor
  - Price of capital
- Outputs
  - Admissions
  - Outpatient visits
  - Post-admission inpatient days

Variables (continued)

- Product mix
  - Acute care beds / total beds
  - Births / total admissions
  - ED visits / total outpatient visits
  - Outpatient surgical operations / total outpatient visits

Variables (continued)

- HCUP
  - A family of health care databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by AHRQ.
  - Includes **State Inpatient Databases (SID),** which contain the universe of inpatient discharge abstracts from participating states.
    - Data from 24 states available to the public through the HCUP Central Distributor

Variables (continued)

- The AHRQ Quality Indicators (QIs) are measures of health care quality that make use of readily available hospital inpatient administrative data, such as HCUP.
- Free software tools available online
- Includes
  - **Inpatient Quality Indicators (IQIs)**, which reflect quality of care inside hospitals including **inpatient mortality** for medical conditions and surgical procedures.
  - **Patient Safety Indicators (PSIs)**, which reflect quality of care inside hospitals, but focus on **potentially avoidable complications** and **iatrogenic events**.

Variables (continued)

- Quality measured by the application of the QI software to HCUP data
- Analysis includes the following, risk-adjusted, in-hospital rates:
  - Mortality for congestive heart failure (CHF)
  - Mortality for pneumonia
  - Iatrogenic pneumothorax
  - Infection due to medical care
  - Accidental puncture laceration

Variables (continued)

- The Comorbidity Software assigns variables that identify comorbidities in hospital discharge records using the diagnosis coding of ICD-9-CM.
- Available for free online

Variables (continued)

- Patient burden of illness controlled by the inclusion of hospital-level rates per discharge of the following comorbidities identified by the Comorbidity Software

Congestive heart failure	**Cardiac arrhythmias**	**Valvular disease**
Pulmonary circulation disorders	**Peripheral vascular disorders**	**Hypertension**
Paralysis	**Other neurological disorders**	**Chronic pulmonary disease**
Diabetes, uncomplicated	**Diabetes, complicated**	**Hypothyroidism**
Renal failure	**Liver disease**	**Peptic ulcer**
AIDS	**Lymphoma**	**Metastatic ulcer**
Solid tumor without metastasis	**Rheumatoid arthritis**	**Coagulopathy**
Obesity	**Weight loss**	**Fluid and electrolyte disorders**
Blood loss anemia	**Deficiency anemias**	**Alcohol abuse**
Drug abuse	**Psychoses**	**Depression**

- See Mutter et al. (2008) for details.

Market Forces

- The model controls for
  - hospital ownership, hospital competition (county HHI), median family income, unemployment rate, Medicare HMO penetration, and % admissions paid for by Medicare, Medicaid
  - Time trend
  - **CAH program participant (0, 1)**
  - **Years in CAH program**

Results – Market Forces

Variable	Coefficient	t-statistic
Mu	-2.5530**	-15.54
Years in CAH Program	**0.0722****	**10.28**
FP Ownership	-1.5269**	-18.32
Gov't Ownership	0.2148**	9.60
Hospital Competition	0.4163**	8.93
CAH	**0.1958****	**7.91**
Medicaid Admissions %	0.0029**	2.76
Medicare Admissions %	-0.0037**	-3.98
Median Income	0.00004**	18.20
Medicare HMO %	-0.0452**	-4.08
Time Trend	-0.0180**	-4.20
Unemployment Rate	0.0024	1.03

** Significant at the 1% level.
* Significant at the 5% level.

Results – Mean Inefficiency

	All Hospitals			CAHs			Non-Converting Rural Comparison Hospitals		
Year	**N**	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**
1997	543	0.1130	0.0664	12	0.1776	0.0861	531	0.1116	0.0652
1998	543	0.1146	0.0647	15	0.1643	0.0673	528	0.1132	0.0641
1999	543	0.1140	0.0649	17	0.1831	0.0929	526	0.1117	0.0626
2000	543	0.1224	0.0752	48	0.1791	0.1201	495	0.1169	0.0669
2001	543	0.1212	0.0952	110	0.1501	0.0804	433	0.1139	0.0974
2002	543	0.1287	0.0845	186	0.1633	0.1073	357	0.1107	0.0628
2003	543	0.1432	0.0929	242	0.1770	0.1096	301	0.1161	0.0656
2004	543	0.1575	0.1057	286	0.1938	0.1184	257	0.1170	0.0701
All years	**4,344**	**0.1268**	**0.0838**	**916**	**0.1763**	**0.1091**	**3,428**	**0.1136**	**0.0699**

Results – Mean Inefficiency by time in CAH program

Year in CAH Program	N	Mean	Std. Dev.
1	278	0.1484	0.0900
2	238	0.1659	0.1018
3	185	0.1879	0.1133
4	110	0.2061	0.1267
5	48	0.2108	0.1228
6	16	0.2180	0.1050
7	15	0.2414	0.1100
8+	26	0.2329	0.1307
All years	916	0.1763	0.1091

Results – Correlations

- Pearson Correlations between SFA Estimates and Performance Measures

Variable	All Hospitals	CAHs	Non-Converting Rural Comparison Hospitals
EXP/ADJUSTED ADMIT	0.477*	0. 409*	0.467*
OPERATING MARGIN	-0.159*	-0.082*	-0.204*
FTE/ADJUSTED ADMIT	0.295*	0.256*	0.259*

- Note that CAHs have an average Medicare share of admissions of about 61%; corresponding figure for non-converting rural hospitals is about 49%.

Results – Correlations (continued)

- Estimated Pearson correlation coefficients (in 2004) between SFA-derived inefficiency measures and commonly used hospital performance measures
  - Positive and significant coefficients for expense per adjusted admission and FTE personnel per adjusted admission
  - Negative and significant correlation between inefficiency and operating margin
    - Correlation twice as strong in comparison group sub-sample in 2004 than in CAH facilities

Results - Quality

- In the cost function
  - Coefficient on risk-adjusted mortality rate for CHF was negative and significant.
    - Lower mortality rates associated with higher costs
  - Coefficient on iatrogenic pneumothorax was positive and significant.
    - Occurrence of this patient safety event is costly to hospitals
    - Zhan and Miller (2003) estimate it is associated with excess costs of $17,312.

Discussion

- Findings suggest that CAH facilities tend to be more cost-inefficient than non-CAH rural facilities

Discussion (continued)

- Results could be a reflection of more cost-inefficient hospitals choosing to convert to CAH status
- However,
  - Methodology not only compares CAHs to similar, prospectively paid rural hospitals, it also compares CAHs to their previous, prospectively paid selves
  - Findings suggest that CAHs tend to be more cost-inefficient over time

Discussion (continued)

- Among non-converting hospitals, stronger negative correlation coefficient between SFA-derived inefficiency measure and operating margin is not surprising
  - PPS is intended to reward hospitals financially for cost containment
- Although highly significant, coefficient was small (-0.204)
  - Variety of factors, among which is efficiency, determine profitability
  - Cost equation is an abstraction from reality, limiting accuracy of inefficiency estimates

Discussion (continued)

- The CAH program has succeeded in its aims
  - Has kept hospitals providing care to under-served populations open
    - Holmes et al. (2006) find that rural hospital closure leads to non-trivial decline in per-capita income and employment
  - Conversion to CAH status is associated with the provision of higher quality care
- But possible result of cost-based payment solution is increased inefficiency, which can fuel already escalating expenditures

Discussion (continued)

- The challenge is to find a payment mechanism that provides incentives for efficiency yet allows providers to maintain fiscal viability.
  - Why did small rural hospitals suffer so much under PPS?
    - Is PPS inherently ill-suited for these types of hospitals?
    - Could PPS work for these hospitals if payment levels were higher?
  - Perhaps the solution is to retain cost-based payment but to pay on the basis of historical costs