Iteratively Weighted Least Squares in Stochastic Frontier Estimation

Applied to the Dutch Hospital Industry

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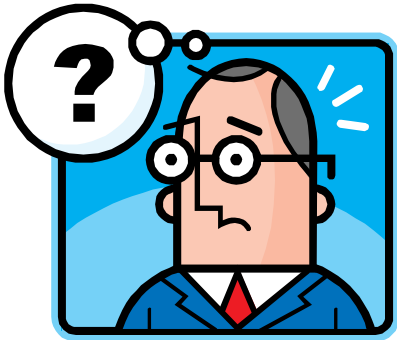
Background

- How to improve transparency SFA?

Policymaker + DEA ➔

Policymaker + SFA ➔



Central question

- Is there an alternative for SFA, that is more transparent, less complicated and more robust?
- ➔ YES.

Outline

1. SFA is a problem and a bless;
2. Alternative for SFA;
3. Application;
4. Further research.

Problems SFA

- A priori specification;
- Distributional assumptions on efficiency component;
- Far from transparent;
- Convergence issues;
- Hard to apply in system of equations;

- Conceptual: search for inefficiency !

DEA

- Advantages:
  - No distributional assumptions;
  - No a priori specifications.

- Conceptual: search for efficiency!

- Drawbacks:
  - No stochastics;
  - Hard to include control variables;
  - Hard to derive economic features.

Alternatives

- Thick Frontier (TFA) (Berger & Humphrey, 1991) ;
- Recursive thick frontier (RTFA) (Wagenvoort and Schure, 2006);

➔ selecting efficient firms by iterative procedure;

➔ Estimation based on efficient firms.

- Also serious drawbacks:
  - Loss of degrees of freedom;
  - Use of panel data (RTFA);
  - Firm specific efficiency (RTFA).

Iteratively Weighted Least Squares

- Search for the efficient firms (transparency);
- Single or multiple equations model;
- Easy programming (single eq. even in Excel);
- Promising results.

How does IWLS work?

- Choose parametric specification;
- Conduct LSQ estimation;
- Use residuals for establishing weights, for instance

$$w = \frac{1}{\left(1+\frac{\hat{\varepsilon}}{\sigma_{LSQ}}\right)} \text{ if } \hat{\varepsilon} > 0, \text{else } w = 1$$

- Re-estimate model with WLS;
- Repeat until parameter change $|\beta| < \delta$;
- Derive efficiency scores (eventually corrected for random noise).

Application: Dutch hospitals

- Data: about 80 hospitals 2003-2009;
- Outputs: 4 types of discharges;
- Inputs prices: 6 types of inputs;
- Input biased technical change;
- Translog specification cost function + share equations.

Results LSQ+IWLS

- Parameters plausible;
- Many parameters significant;
- Monotonicity and concavity conditions fulfilled.

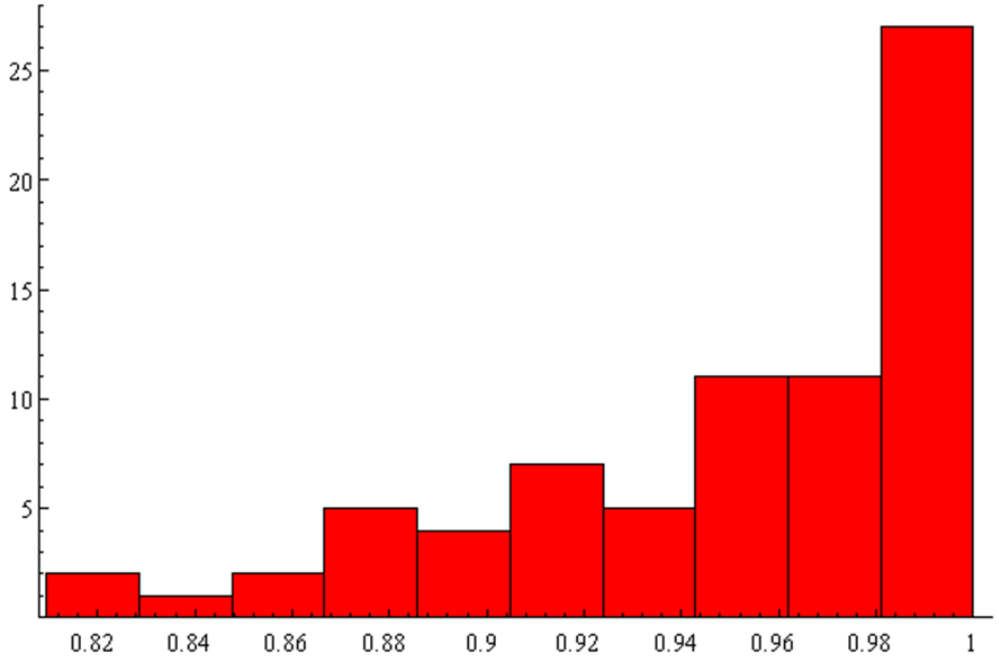
- BUT:

IWLS

- Show different pattern of technical change
  - TC 2003-2009: 18.6% (LSQ) versus 16.5% (IWLS);
- Parameters more efficient;
- Slight change in production parameters;
- No change in input price parameters.

Some other features

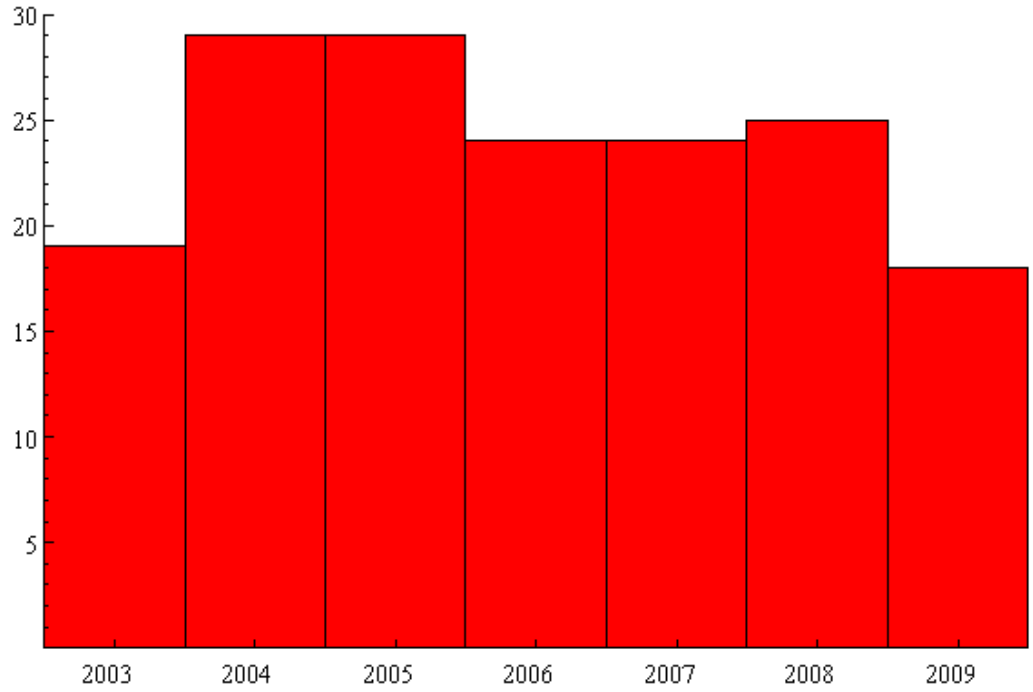
- 11 iterations to converge;
- Distribution of efficiency scores plausible.



Representativeness in time

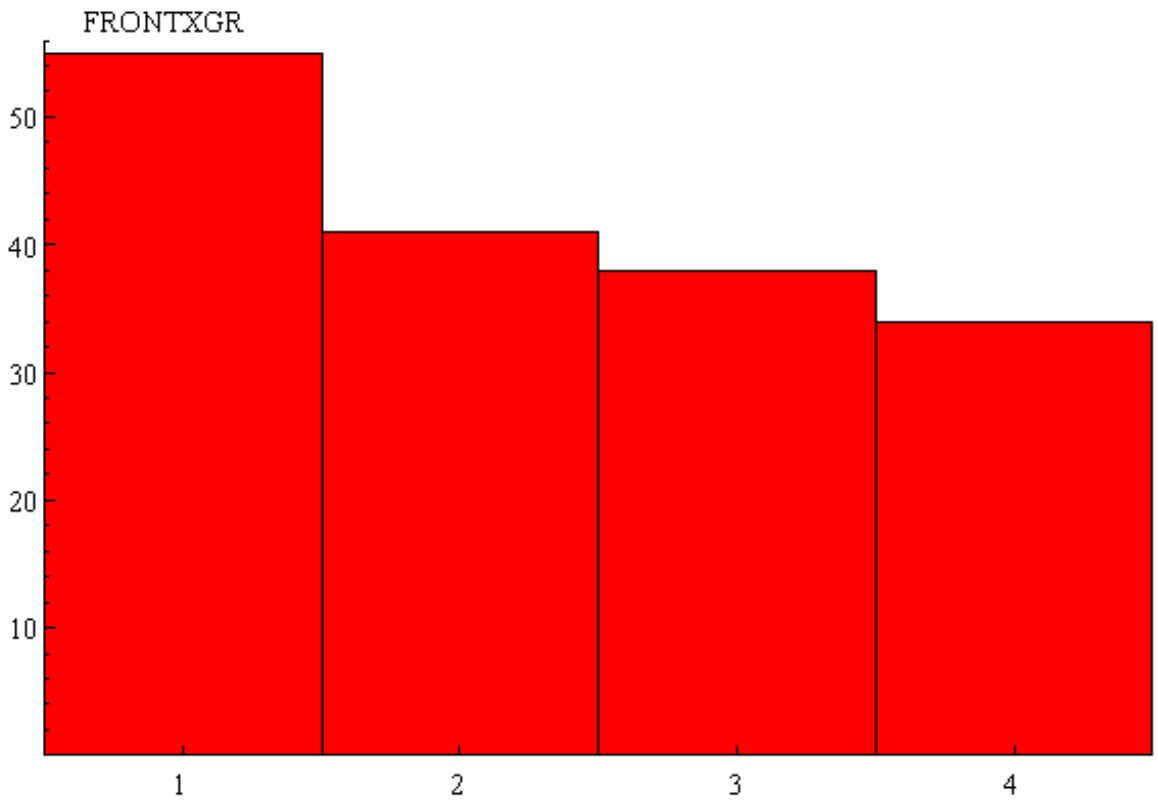
- Note: no stratification;

Figure 1 Number of efficient hospitals by year



Representativeness wrt size

Figure 1 Number of efficient hospitals by size



Conclusions + further research

- Promising results;
- Improved transparency;
- No loss of degrees of freedom;
- Easy programming, et cetera;
- No distributional assumptions.

- Comparisons with SFA, RTFA;
- Comparisons on other data sets;
- Maybe Monte Carlo simulations.

The end

- How to improve transparency SFA?

Policymaker + DEA ➔

Policymaker + IWLS ➔