# Comparing welfare effects of different regulation schemes: an application to the electricity distribution industry

Maria Kopsakangas-Savolainen
and
Rauli Svento
University of Oulu, Department of Economics and Martti Ahtisaari Institute of Global Business and Economics

# Outline

- Motivation
- Different regulation schemes
- Stochastic Frontier Analysis
- Welfare effects

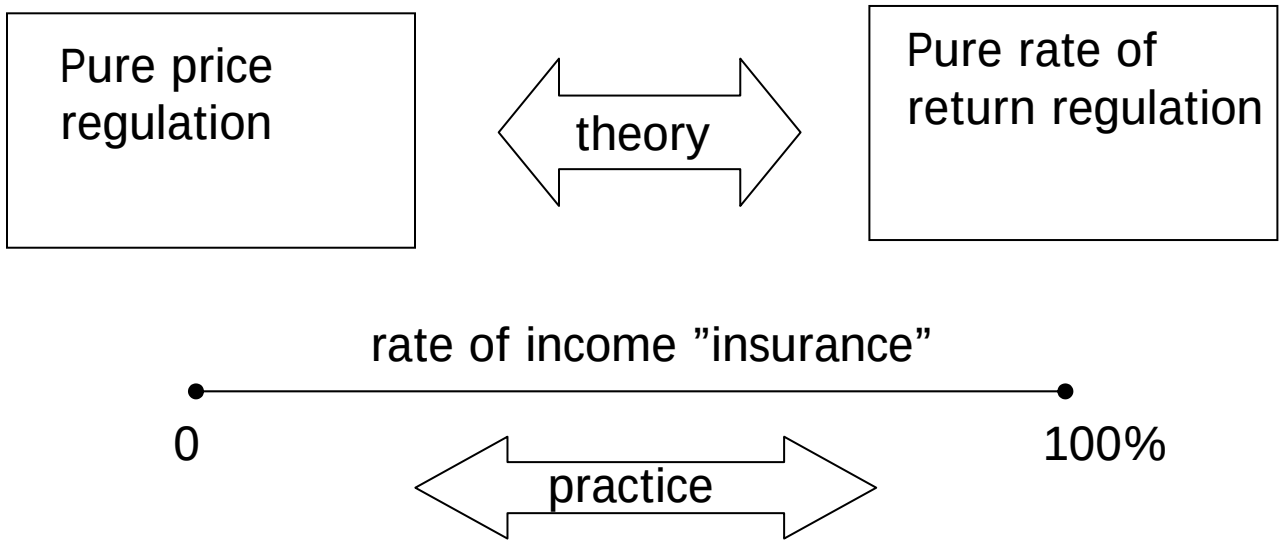
# Motivation

- Most regulation schemes need some information of the unit specific efficiency
- SFA and DEA are examples of the methods used in measuring cost efficiency
- This paper gives an example how to utilise this firm specific cost information (obtained by SFA) in order to evaluate the effects of different regulation schemes for the consumer and producer surplus.

# Why regulation?

- Problem 1: A Utility uses market power
  $\rightarrow$excessive pricing $\rightarrow$ allocative inefficiency and redistribution of income
- Problem 2: If the utility is vertically integrated with one part operating in competitive market and the other is monopoly it owns an incentive to cross-subsidise
  - increased production and lower prices in competitive markets
  - decreaced production and higher prices in monopoly markets.

# Price regulation – Rate of Return regulation



# Regulation schemes used in this study

- Price Cap Regulation
- Rate of return regulation/ cost of service
- Menu of Contracts
- Simple menus of contracts

# Estimated SFA model specifications

RE Model

$$\ln c_{it} = \alpha + \beta_y \ln y_{it} + \beta_{LF} \ln LF_{it} + \beta_{CU} \ln CU_{it} + \beta_l \ln p_{Lit} + \beta_k \ln p_{Kit} + \beta_t T + v_{it} + u_i$$

REH Model

$$\ln c_{it} = \alpha + \beta_y \ln y_{it} + \beta_{CU} \ln CU_{it} + \beta_l \ln p_{Lit} + \beta_k \ln p_{Kit} + \beta_t T + v_{it} + u_i$$

$$v_{it} = N(0, \sigma_v^2), \quad u_i = N^+\left(\mu_i, \sigma_u^2\right),$$

$$\mu_i = \delta_0 + \delta_1 \ln LF_{it},$$

TRE Model

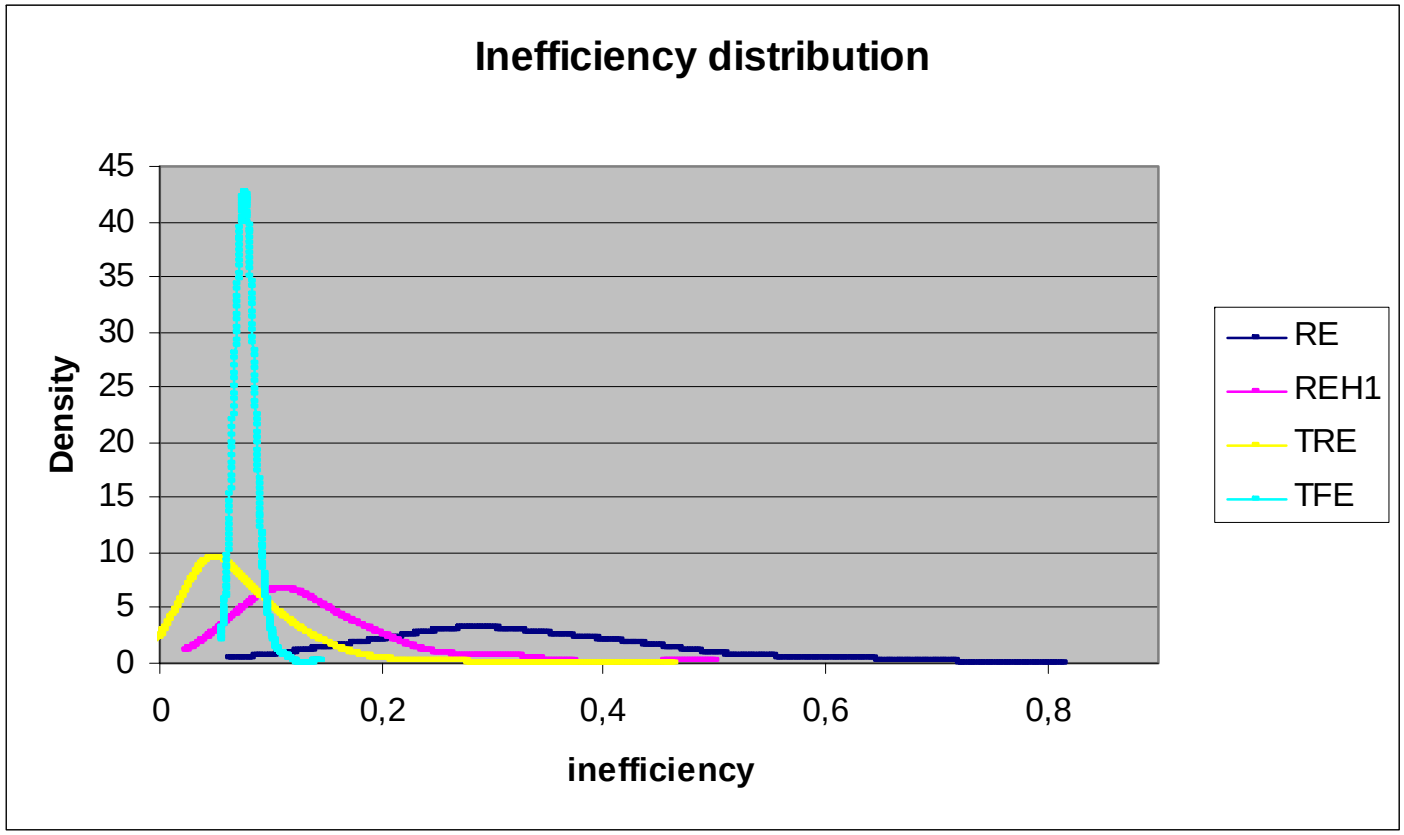
$$\ln c_{it} = (\alpha + w_i) + \beta_y \ln y_{it} + \beta_{LF} \ln LF_{it} + \beta_{CU} \ln CU_{it} + \beta_l \ln p_{Lit} + \beta_k \ln p_{Kit} + \beta_t T + v_{it} + u_{it}$$

TFE Model

$$c_{it} = \alpha_i + \beta_y \ln y_{it} + \beta_{LF} \ln LF_{it} + \beta_{CU} \ln CU_{it} + \beta_l \ln p_{Lit} + \beta_k \ln p_{Kit} + \beta_t T + v_{it} + u_{it}$$

## *Table 3 Statistics of inefficiency scores*

| | RE | REH | TRE | TFE |
|---|---|---|---|---|
| Minimum | .972-01 | .419-01 | .117-01 | .575-01 |
| Maximum | .782 | .481 | .450 | .142 |
| Mean | .327 | .141 | .737-01 | .775-01 |
| Std.Dev. of $E[u_i \mid \varepsilon_i]$ | .130 | .738-01 | .470-01 | .948-02 |
| σ(v) | .068 | .067 | .032 | .165 |
| σ(u) | .353 | .150 | .096 | .101 |


Inefficiency distribution
Density
45
40
35
30
25
20
15
10
5
0
0
0,2
0,4
0,6
0,8
inefficiency
RE
REH1
TRE
TFE

# Welfare effects

- We combine the cost information obtained by our SFA estimations to the four theoretical regulation models
- We calculate the changes (compared to the benchmark) in welfare measured as a sum of consumer and producer surplus

The price resulting from a range of regulatory options can be illustrated as follows.

- Consider a regulatory process in which the firm's allowed price *P* is determined based on a component of efficient costs of the highest type, C*, and on a component that is based on the firm's realized costs *C*. Then the allowed price is determined according to following equation:

$$P_{i,t} = aC^{*}_{t-1} + (1-a)C_{i,t-1}$$

where *a* is the sharing parameter that defines the responsiveness of the firm's allowed price to the realized costs, t refers to time and i to the firm in question.

# Welfare Results

- The change in consumer surplus can be written as the line integral:

$$\Delta CS_i = \int_{P_{Ci}}^{P_{Ni}} D^{-1}(Q_i)dQ_i$$

- The corresponding change in producer's surplus is:

$$\Delta PS_i = \left(P_{Ni}Q_{Ni} - C(Q_{Ni})\right) - \left(P_{Ci}Q_{Ci} - C(Q_{Ci})\right),$$

- Therefore, the change of total surplus is

$$\sum_{i=1}^{76}\left(\Delta CS_i + \Delta PS_i\right) = \sum_{i=1}^{76}\left[\int_{P_C}^{P_N} D^{-1}(Q_i)dQ_i + \left[\left(P_{Ni}Q_{Ni} - C(Q_{Ni})\right) - \left(P_{Ci}Q_{Ci} - C(Q_{Ci})\right)\right]\right]$$

# *Change in welfare (PS + CS), Cost of service regulation as benchmark, million€*

| **SFA Model** | **Price cap ΔTS** | **ΔPS** | **ΔCS** | **Menu of Contracts ΔTS** | **ΔPS** | **ΔCS** | **Simple menu of Contracts ΔTS** | **ΔPS** | **ΔCS** |
|---|---|---|---|---|---|---|---|---|---|
| **RE** | 177,8 (33,1%) | 240,9 | -63,1 | 194,4 (36,2%) | 150,0 | 44,4 | 144,43 (26,9%) | 70,6 | 73,9 |
| **REH** | 49,6 (9,2%) | 234,2 | -184,5 | 61,5 (11,5%) | 184,1 | -122,6 | 25,9 (4,8%) | 10,4 | 15,6 |
| **TRE** | 5,6 ( 1,1%) | 239,7 | -234,1 | 25,8 (4,8%) | 163,6 | -137,8 | 6,4 (1,2%) | 4,5 | 1,9 |
| **TFE** | 8,3 (1,5%) | 235,5 | -227,2 | 14,7 (2,7%) | 207,4 | -192,7 | 3,6 (0,7%) | 1,4 | 2,2 |

# Conclusions

- Changing the regulation scheme from cost of service to whatever other regulation regime presented above results welfare improvement.
- However, there is clear difference how different regulation schemes divide welfare to producers and consumers.
- The only regulation scheme which improves both producer and consumer welfare regardless of the model used in efficiency estimations is the simple menu of contracts. However, the overall welfare improvement is smaller than resulting from the price cap regulation or menu of contracts regulation
- The underlying benchmarking results (which method/model specification to use) have an important role.