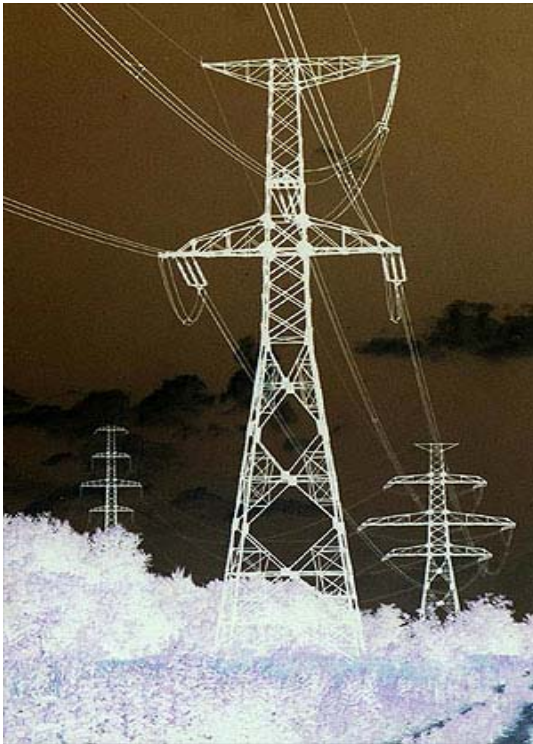


Comparing Efficiency in Central European Electricity Distribution (Poland, Czech Rep., Slovakia, Hungary, and Germany)

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Agenda

1. Theoretical background: DEA and SFA
2. Basic model, extensions, and data
3. DEA results
4. SFA results
5. Distance Function Approach
6. Conclusions

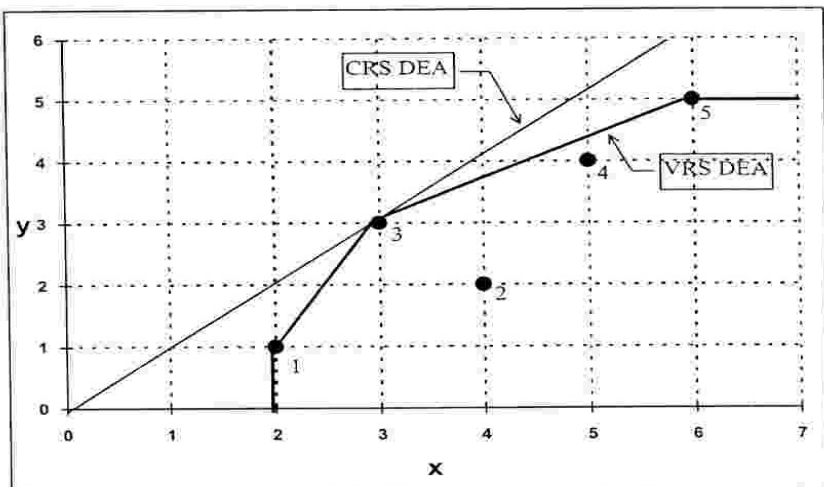
1. Theoretical Background

DEA

- Data envelopment Analysis
- Deterministic
- Chooses best firm as peer, benchmarks the other firms to the peers who set the production function (piecewise linear)

Figure 8

VRS Input-Orientated DEA Example



Reference 3, p.21

SFA

- Stochastic frontier Analysis
- Stochastic
- Translog production function used as production function
- The function is generated out of the data set
- Restrictions:
 - only one output computable; you must find a way to aggregate outputs, normation for example

See references 2,3

2. Basic model, extensions, and data

Basic model:

| Input | Output |
|--------------------|-------------------------------------|
| Employees | Electricity distributed to endusers |
| Length of the grid | Number of customers |

- The number of customers is determined by industry and households within the supply area and thus a given date
 - The demand of the end users is quite inelastic and must be satisfied.
 - ➡ Output is fix. Input has to be minimized in order to be efficient
-

Model extensions

Extension via structure variables:

- *Regional Influences:*

Taking the different population characteristics of the supplied area into account via application of Inverse Density Index (chosen here)

- *Other possibilities:*

Trading index, modifications of the Inverse Density,

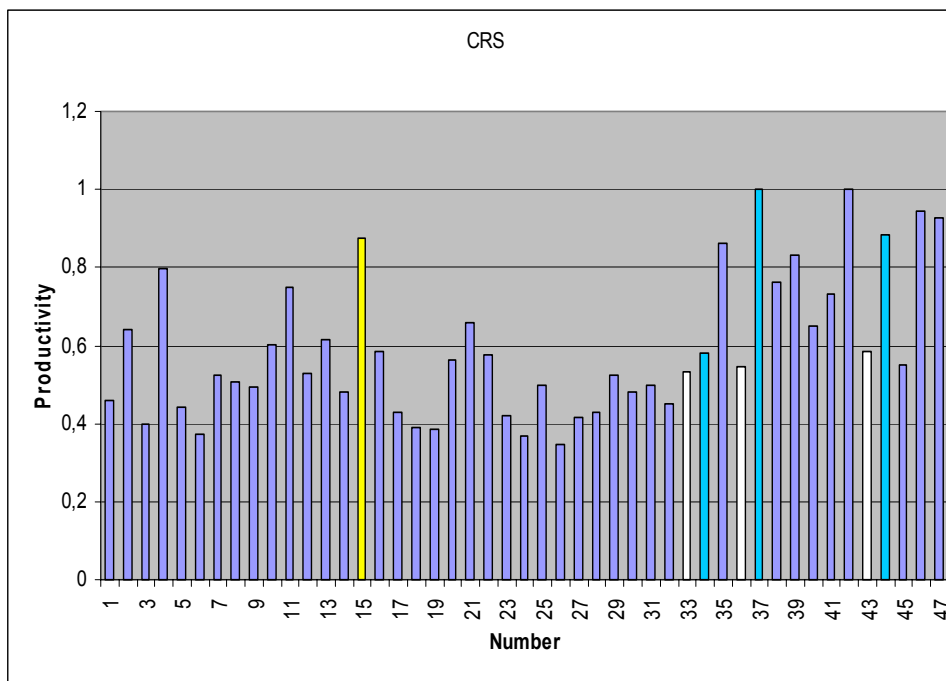
$$\text{Inverse Density Index} = \frac{\textit{Area}}{\textit{Population}}$$

Data

- Official data taken from publicly available sources
 - Germany: VDEW
 - Eastern Europe: Companies, Webpages, Statistical Yearbooks, data for Poland collected by Inerconsult (Mr. Reichel)
 - Inverse density index sometimes problematic
-

3. DEA results, Eastern Europe

- The Distribution companies are listed in the following order: Poland, Slovakia, Czech Rep., Hungary (two distribution companies were sorted out because of data shortage)
- The white lines represent the last Distribution company of a each country
- The yellow line is the distribution company of Warsaw
- The basic model was used



•The results seemingly make sense: The most efficient distribution company of Poland is Warsaw. This was to expect according to this model because the customers are very concentrated and the structure is easy to supply

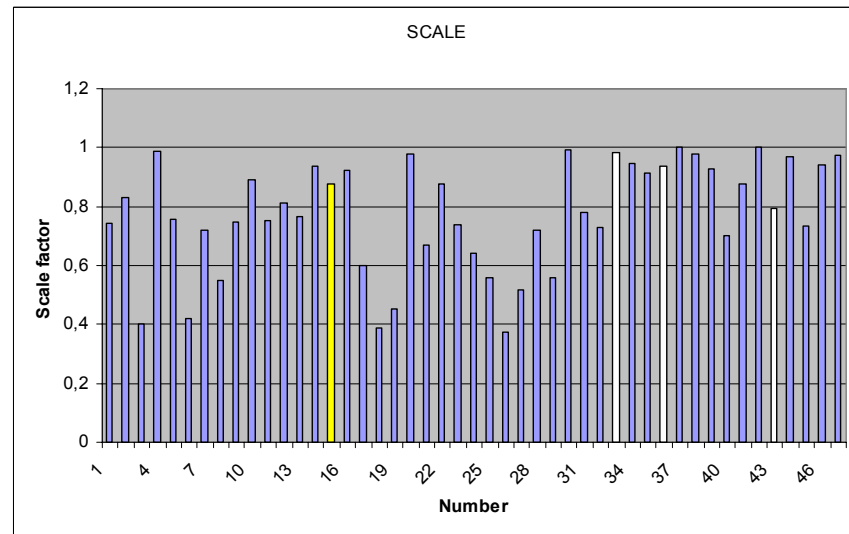
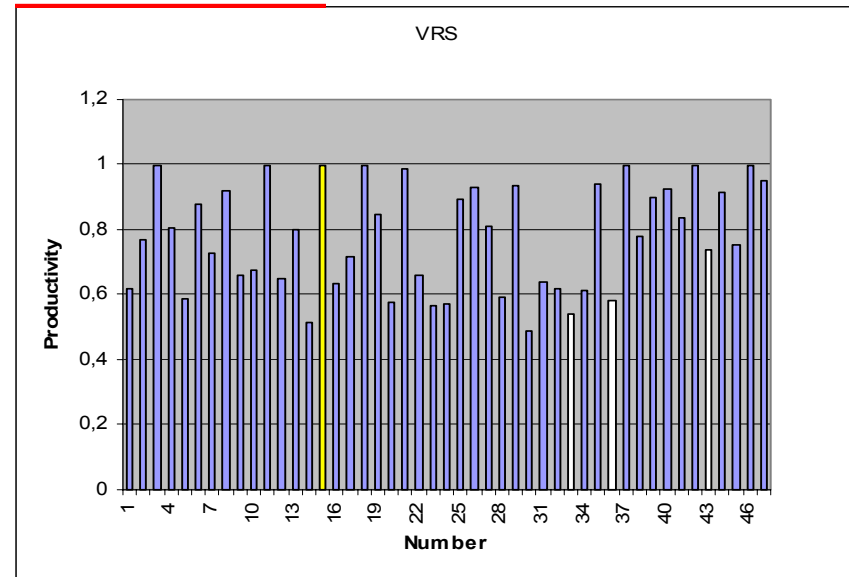
The distribution companies of Poland tend to gain lower efficiency values than the distribution companies of the other states

DEA results

- The VRS values are still a bit lower for the Polish distribution companies than for the other distribution companies. According to DEA their technical efficiency in this category improves

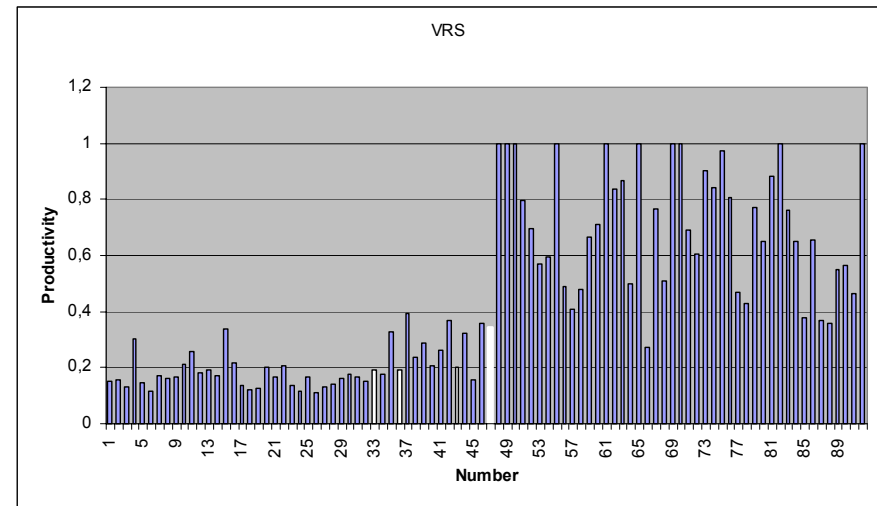
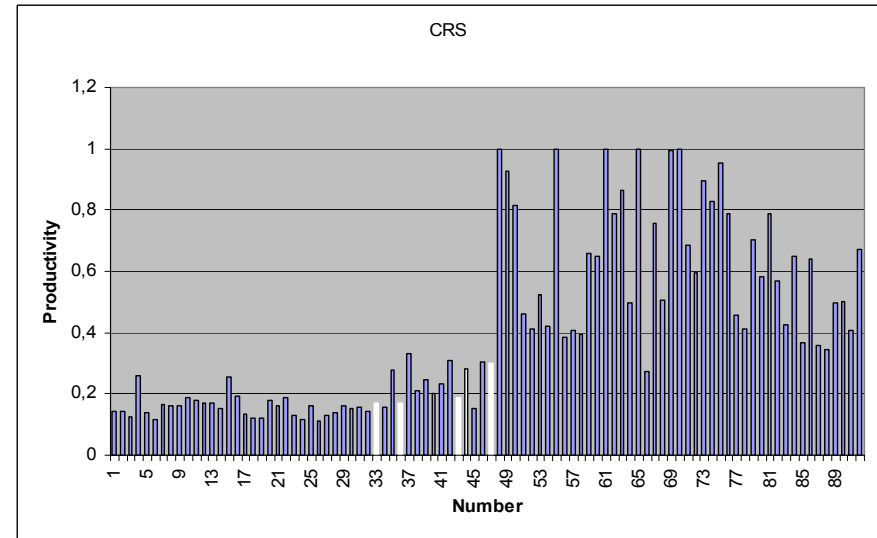
- The scale factor (CRS/VRS) shows one possible reason for the lower values; the scale factor for the Polish distribution companies is lower in the mean.

- This means, that they are too small. The other distribution companies can profit from economies of scale



DEA results, including Germany

- The basic model was used
- German distribution companies not supplying endconsumers were sorted out
- The comparison with the German distribution companies shows a big efficiency gap
- Since crs and vrs show approximatley the same picture this efficiency gap cannot be explained by the size of the companies

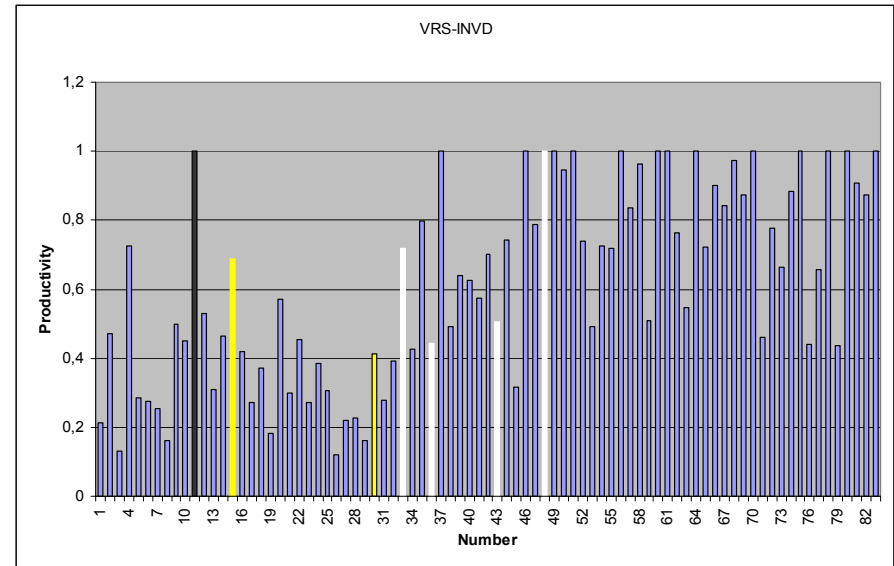
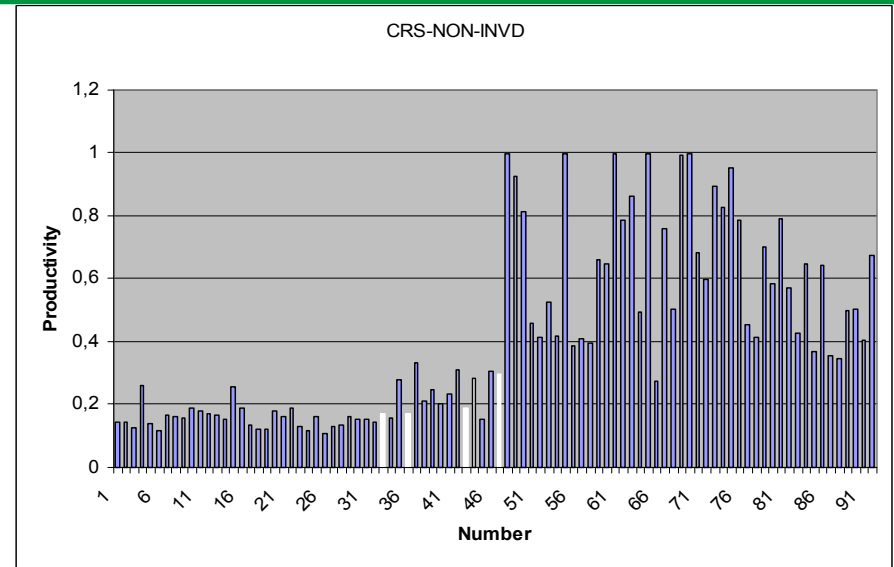


DEA results, including Germany

- The number of German distribution companies was reduced because of problems generating a solid Inverse Density Index for some firms
- The introduction of the Inverse Density Index pushed especially small companies (compare CRS and VRS Poland)
- The Eastern European distribution companies close the productivity gap

→ The German distribution companies profited in the base model from concentrated customer structures

- The distribution company of Warsaw lost, but is still in the leading group of the Polish distribution companies. So their productivity does not only root in the area they supply

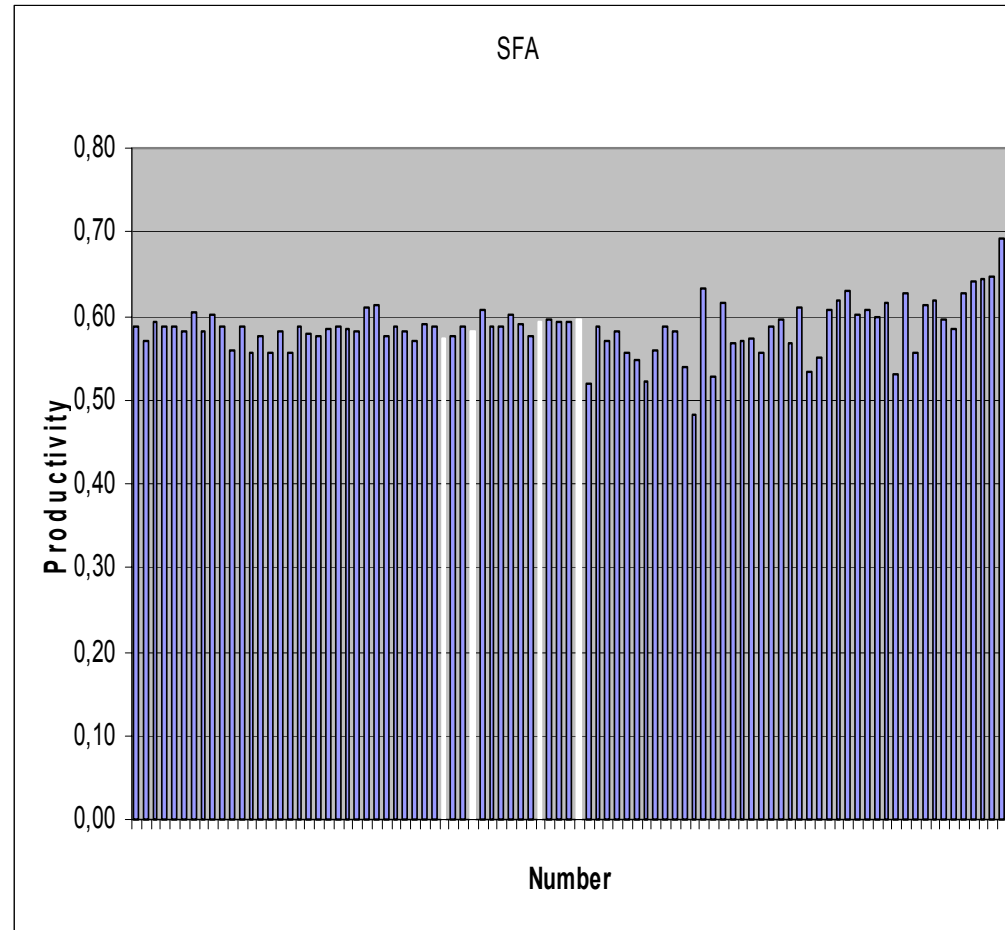


4. SFA results

- The stochastic frontier analysis closes the productivity gap. The productivity of all companies tends to be the same

- Unluckily only the influence of the length of the net is of statistical significance, so the results are mathematically on a weak fundament

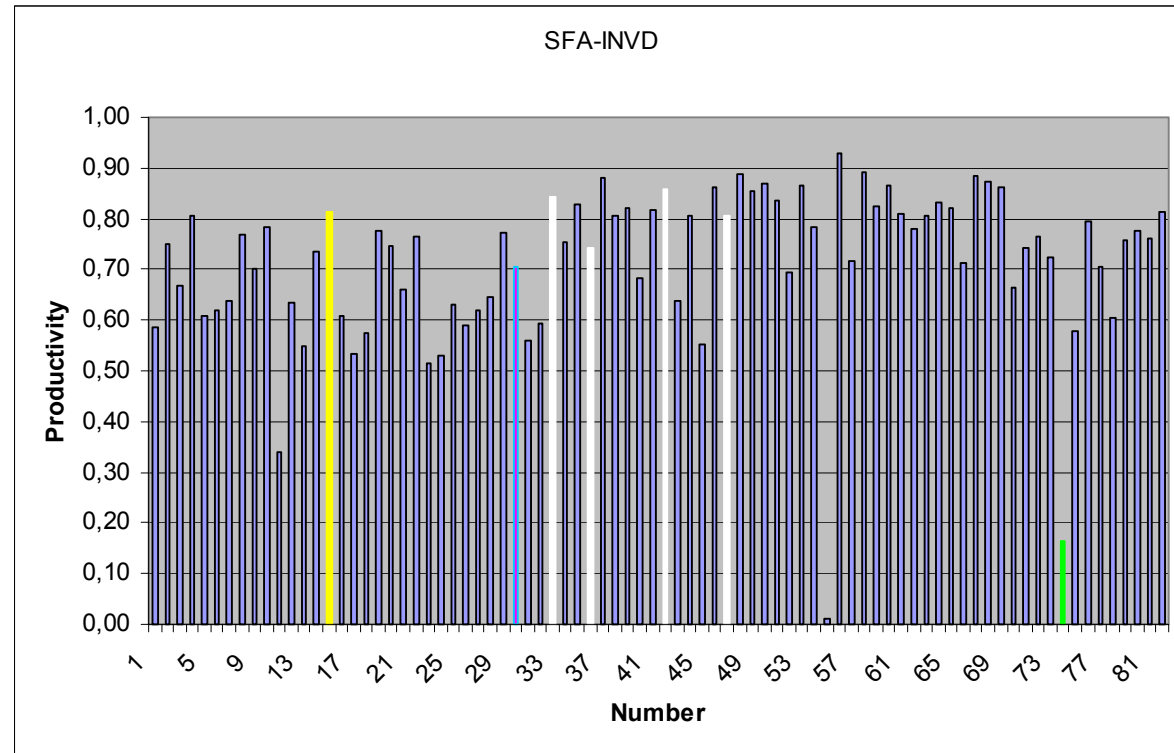
➔ The SFA base model offers no results in this case



SFA results

- The results gain mathematical significance

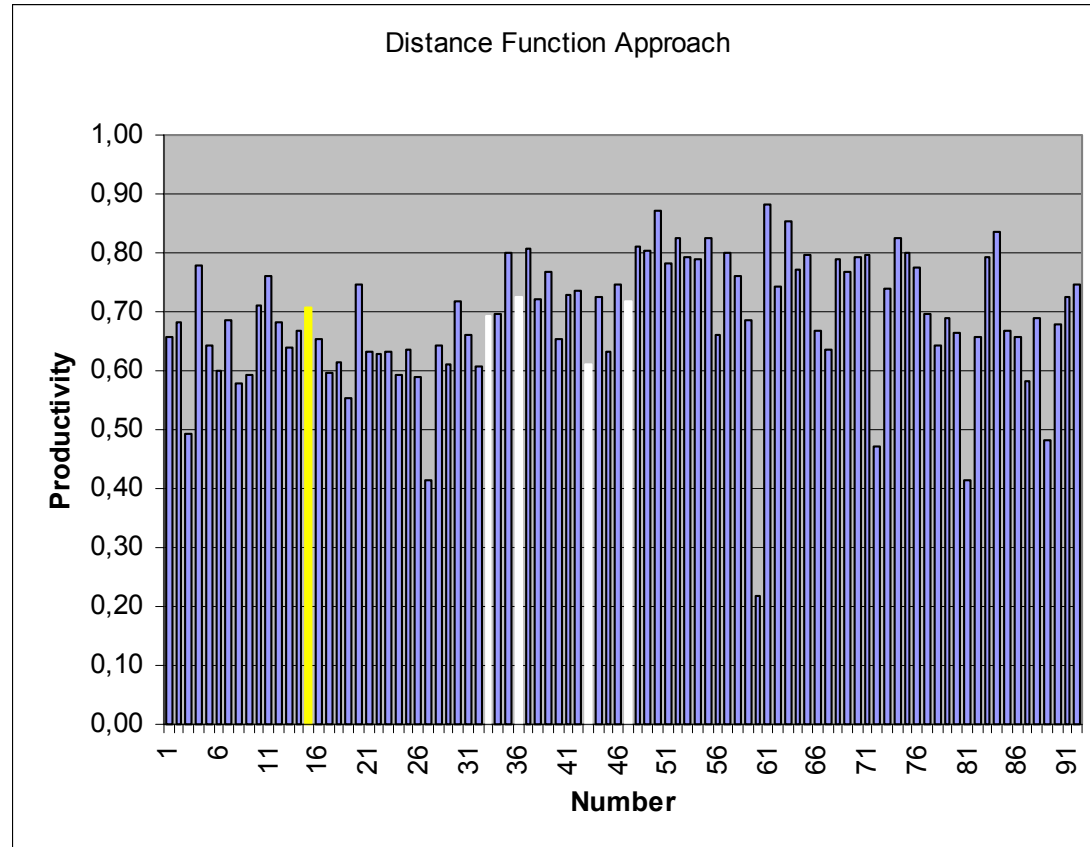
- The introduction of the Inverse Density Index downgrades some distribution companies, for example no 74 (Verbandswerke Eisenberg), but the tendency to equal the performance of the distribution companies is still there



- Note that the distribution company of Warsaw still is in the leading group of the Polish distribution companies

Distance Function Approach

- The distance function approach offers a similar view than the other methods
- The distribution company of Warsaw is still in the leading group among the Polish distribution companies
- With the exception of four downgraded companies, Germany stays in front



5. Conclusions

- Overall results seem to be robust
- German distribution companies gain from dense customer structures; they gap closes by introducing the Inverse Density Index
- According to the DEA basic model the Polish distribution companies lack of scale
- Some companies are overproportionally touched by model changes
- Stochastical approaches tend to reduce productivity gaps

Sources and references

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