Cost Benchmarking in the German Water Sector

Implications of an Assessment of Current German Approaches

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Outline

- Introduction
- Literature Survey and Variables
- Data Set
- Methods
  - Cluster Analysis
  - Efficiency Analysis
- Results
- Conclusion

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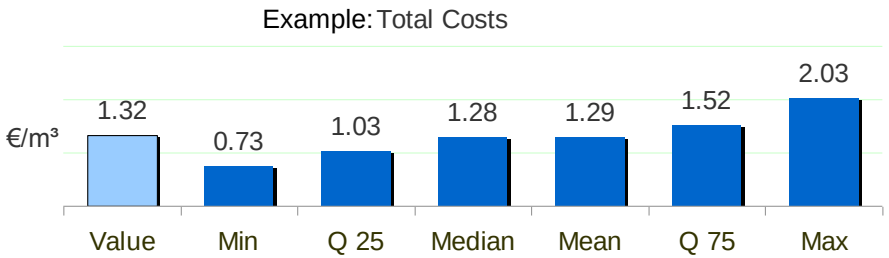
Introduction

- Cost-Benchmarking in the German water sector has never been done before, but a lot of metric benchmarking projects were carried out in Germany.
- “Modernisation Strategy” of the Federal Government and the Bundestag: Implementation of benchmarking-projects in each of the *Bundesländer* (many of them carried out by Rödl & Partner)
- Main idea: Confidentiality of individual data and freedom to participate leads to fruitful discussions between companies → The inefficient company in its widest sense (quality..) learns from the best performers.
- Main challenge: Differences between companies need to be explained as much as possible for giving the best achievable feedback to utilities.

Introduction

Current Approach:

- Costs in a certain part of the value chain are solely compared with those of others without taking into account differences in basic conditions



Future Approach:

- Aim of introducing established efficiency analysis: Improve the informative value of benchmarking for companies by better clarifying the deviation as the difference between the actual value of a company and the benchmark.

→ Value chains already performed

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Literature Survey and Variables
International Literature Survey (Selection) (1)

Author(s)	Region	Time Period	Number of Utilities	Method	Measure	Inputs	Outputs	Structural/Qualtiy Variables	Effect of Structural/Quality Variables
Coelli and Walding (2006)	Australia	2002/03 (1995/96-2002/03)	18	DEA	total factor productivity, technical change	operating expenditure, length of mains	number of properties connected, volume of water delivered	percentage of non-residential connections, percentage of water from non-catchment sources, average annual rainfall, average maximum temperature, peak of average flow, electricity connection per consumption	no effect
García-Sanchez (2006)	Spain	1999	24	DEA	technical efficiency	total staff, network length, treatment plants	water delivered, number of connections, chemical analyses	population density	significant effect
Lin (2005)	Peru	1996-2001	36	SFA	cost efficiency, technical change	wage, price of capital	water billed, number of customers	accounted for water ratio, coverage, positive rate of chlorine tests, continuity of service	significant effect when treated as additional outputs rather than environmental variables
Picazo-Tadeo et al. (2008)	Spain (Andalusia)	2001	38 (water and sewerage)	DEA	technical efficiency	delivery network, sewage network, labor, operational costs	population served, water delivered, treated sewage	unaccounted for water	significant effect, but does not change ranking of sample

Literature Survey and Variables
International Literature Survey (Selection) (2)

Author(s)	Region	Time Period	Number of Utilities	Method	Measure	Inputs	Outputs	Structural/Quality Variables	Effect of Structural/Quality Variables
Renzetti and Dupont (2008)	Canada	1996	64	DEA	technical efficiency	expenditure on labor, expenditures on materials and energy, distribution length	water delivered	extreme temperature, total annual precipitation, dummy for source, population density, distance between water utility and highest elevation, residential demand, number of dwellings	overall exogenous environmental variables have significant impact on measured input slacks and efficiency scores
Tupper and Resende (2004)	Brazil	1996-2000	20 (water and sewerage)	DEA	technical efficiency	labor expenses, operational costs, other operational costs	water produced, treated sewage, population served (water), population served (treated sewage)	density of water network, density of sewage network, index for water loss	significant effect of density of water network and water loss
Zschille et al. (2009)	Germany	2006	373	DEA	technical efficiency	revenues	water meters, water delivered to households, water delivered to non-households	output density, leak ratio, groundwater ratio, elevation difference, dummy for East Germany, dummy for sewage services, dummy for other services	significant effect of output density, leak ratio (but neglected in stage 3 – controllable by management); overall relatively small changes in efficiency after input adjustment

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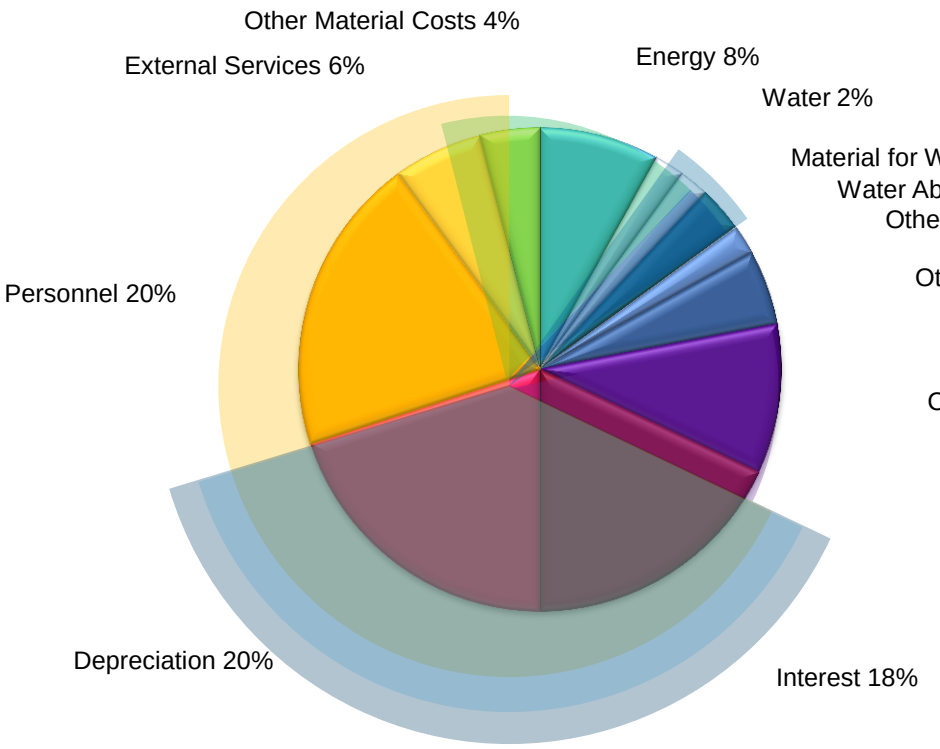
Literature Survey and Variables
Additional Literature Survey

The German “Hollaender”-Study (2008):



Specific conditions

- Factor 1
  Geographical conditions
- Factor 2
  Habitat density and demography, customer structure and service area size
- Factor 3
  Investment activity and cost approach to capital costs
- Factor 4
  Public funds
- Factor 5
  Concession levy
- Factor 6
  Water abstraction charges
- Factor 7
  Compensatory payments for agriculture

Easíly deducted in cost benchmarking

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Literature Survey and Variables
Variables (Selection)

Variable	Unit
GROUP 1:	
Number of household connections	No.
Accounted water	€
Transportation and distribution pipes	km
Inhabitants	No.
GROUP 2:	
Tanks	No.
Tank capacity	m^3
Valves	No.
Service areas	No.
Height Difference	M
Accounted water (excl. re-distribution) to distribution and transportation pipes	m^3/m
Distribution and transportation pipes per household connection	M
GROUP 3:	
Supply to re-distributors	m^3
Household supply relative to accounted water (excluding re-distribution)	%
Pipe damages	No.
Peak supply relative to supply of the day	%
Energy consumption per produced and treated m^3 of water (adjusted for re-distribution and imported water)	kWh/m^3
Chemicals per produced and treated m^3 of water (adjusted for re-distributed and imported water)	$€/m^3$

Variable	Unit
GROUP 4:	
Area	km^2
Inhabitants per m^3 (area)	No.
Water losses	m^3
Downturn in demand since 1992	%
Downturn in demand since 1998	%
Pumping Stations	No.
Water produced from spring water	m^3
Water produced from groundwater	m^3
Water produced from surface water	m^3
No treatment of raw water	m^3
Simple treatment of raw water	m^3
Sophisticated treatment of raw water	m^3
Supply (adjusted for re-distribution) per tank	m^3
Household connections per tank	No.

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Data Set
Adjustments (1)

- Starting Point:
  Total number of observations of Rödl & Partner (612 observation)

- Adjustment:

  - Step 1: Eliminate all observations from different years of the same company, keeping the most current one
  - Step 2: Delete all observations from before 2006
  - Step 3: Drop all companies without any distribution network at all
  - Step 4: Delete all observations where crosschecks revealed inconsistencies

- Result: 196 observations remained

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Data Set
Adjustments (2)

- Revision of usable data sets:
  - Step 1: Adjusting data by restating 2006 data in terms of 2007 prices (producer-price index “Water and Water Services”)
  - Step 2: Deduct the concession levy, the water abstraction charges, and the compensatory payments for agriculture from total costs to reach a maximum of comparability
- Remark:
  - Sample contains relatively bigger companies than the overall German average

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Methods
1. Cluster Analysis

- Applied Hierarchical Clustering
- Average Linking Clustering identified 15 Cluster
- Reduced No. of Clusters to statistically reasonable No. of Observations: 3 Clusters

	Cluster small	Cluster medium	Cluster large
Lower bound	0	3,097,810	6,212,020
Upper bound	2,794,820	5,400,300	17,748,300

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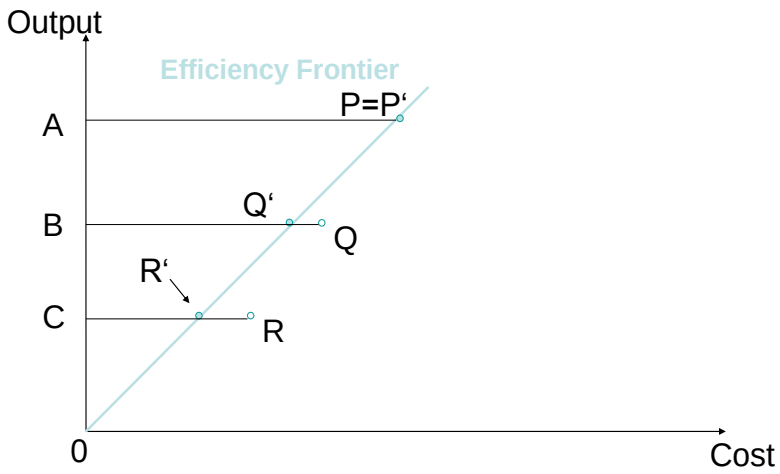
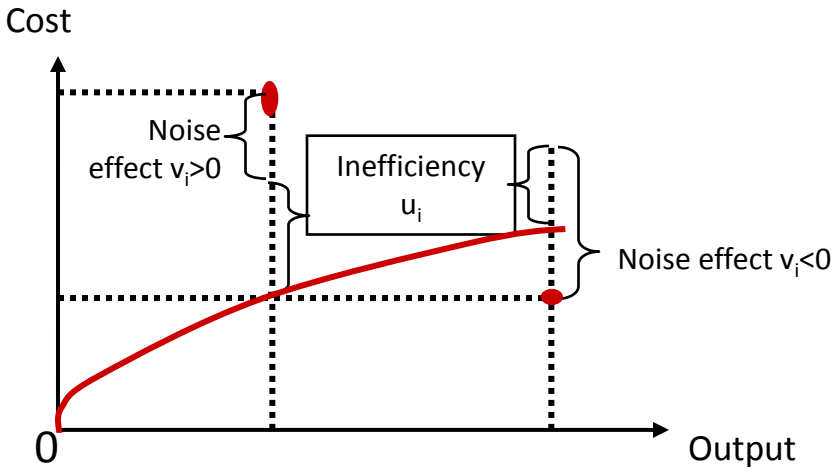
Methods
2. Efficiency Analysis

a. Data Envelopment Analysis (DEA)



- VRS
- Outlier detection: Peer-Stripping

b. Stochastic Frontier Analysis (SFA)



- Cobb-Douglas, Translog & normalized linear Functions
- Outlier corrected data set

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Results
Large utilities

- Large companies: water delivery of 2.5 – 50 million m³ annually
- 59 companies
- Variables:
  → Total Cost (excl. concession levy, water abstraction charges, compensatory payments for agriculture)
  → No. of Connections, Water delivered
- SFA Results:

	Mean	Standard Deviation	Minimum	Maximum
Efficiency Score	0.877	0.038	0.772	0.941

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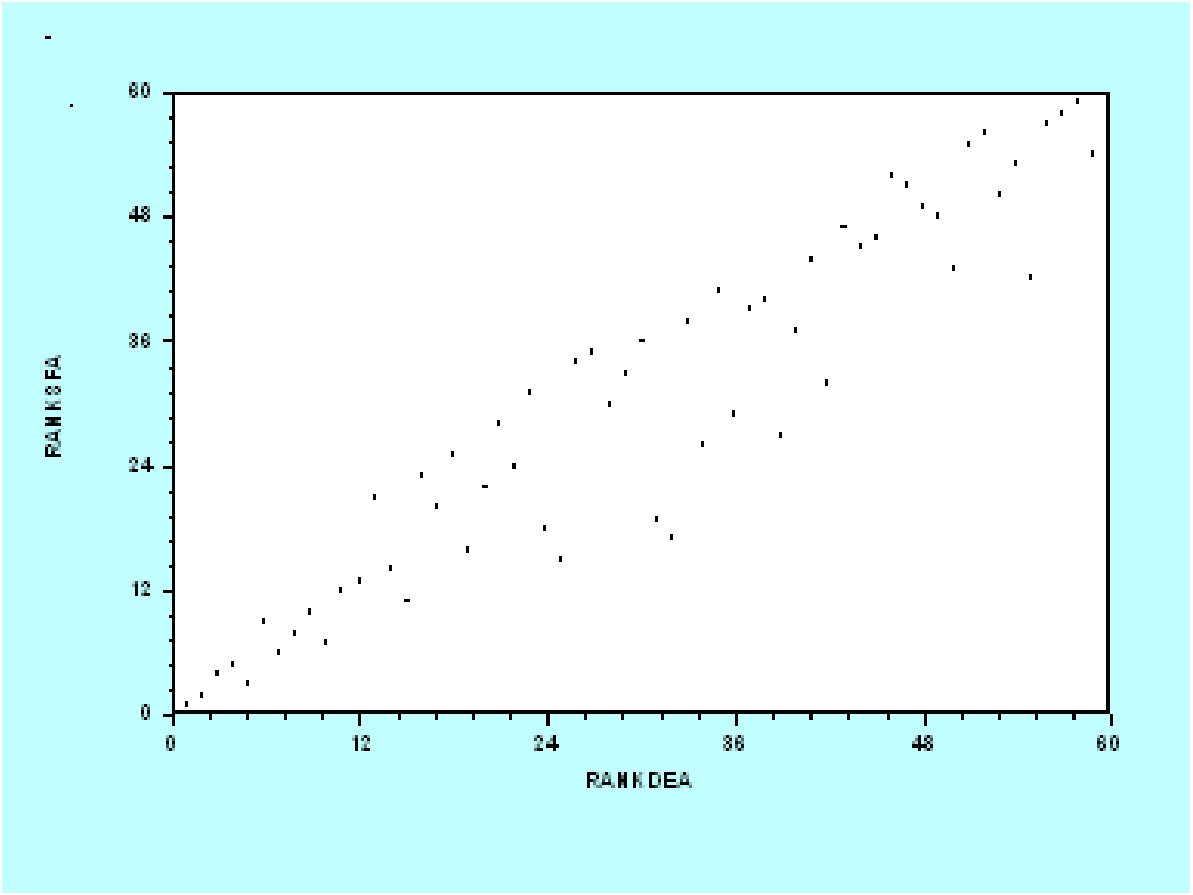
Results
Large utilities

- Rank Correlation: 0.946



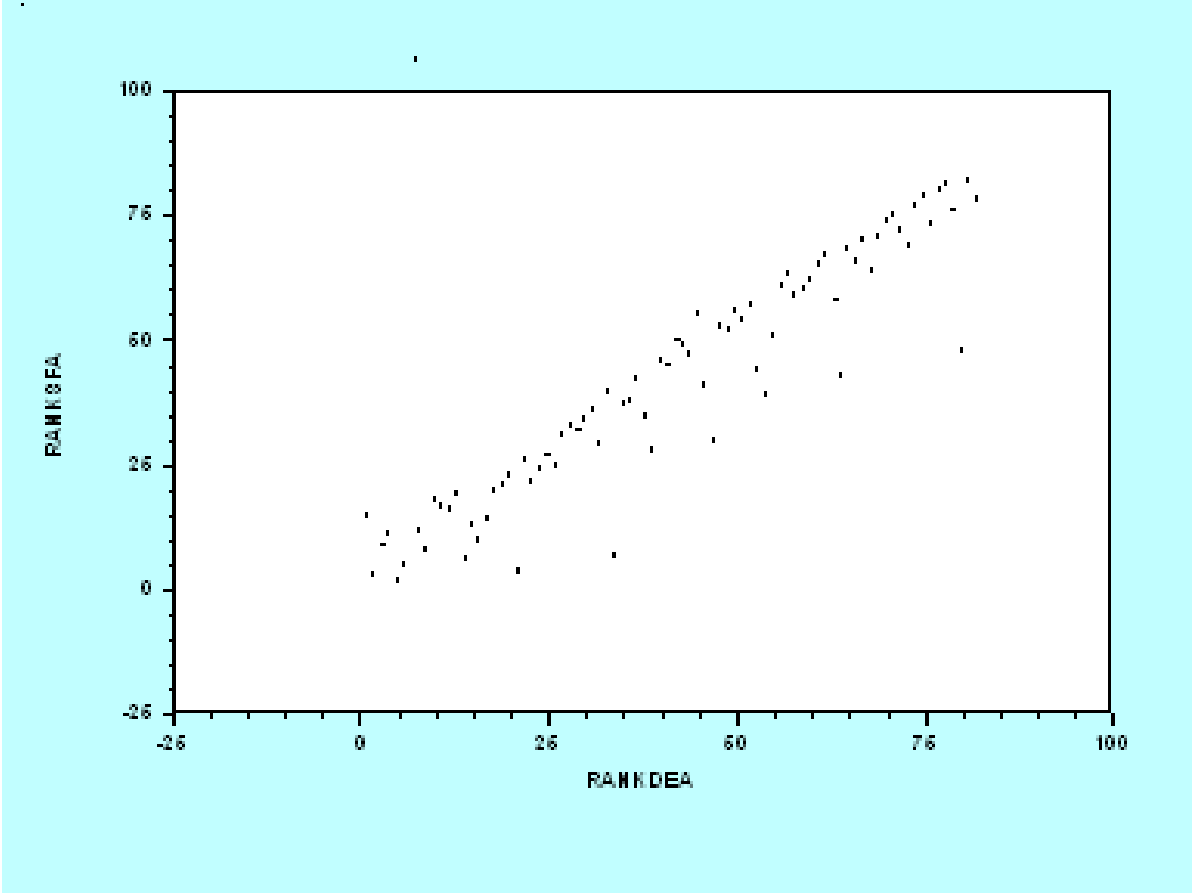
Results
Medium utilities

- Medium companies: water delivery of 0.5 – 2.5 million m³ annually
- 82 companies (after outlier analysis)
- Variables:
  →Total Cost (excl. concession levy, water abstraction charges, compensatory payments for agriculture)
  → No. of Connections, No. of Service areas
-

	Mean	Standard Deviation	Minimum	Maximum
Efficiency Score	0.800	0.104	0.668	0.967

Results
Medium utilities

- Rank Correlation: 0.948



Results
Small utilities

- Small companies: water delivery below 0.5 million m³ annually
- 34 companies (after outlier analysis)
- Variables:
  →Total Cost (excl. concession levy, water abstraction charges, compensatory payments for agriculture)
  →No. of Connections, Network (Distribution and transportation pipes) per connection
- SFA Results:

	Mean	Standard Deviation	Minimum	Maximum
Efficiency Score	0.799	0.111	0.559	0.959

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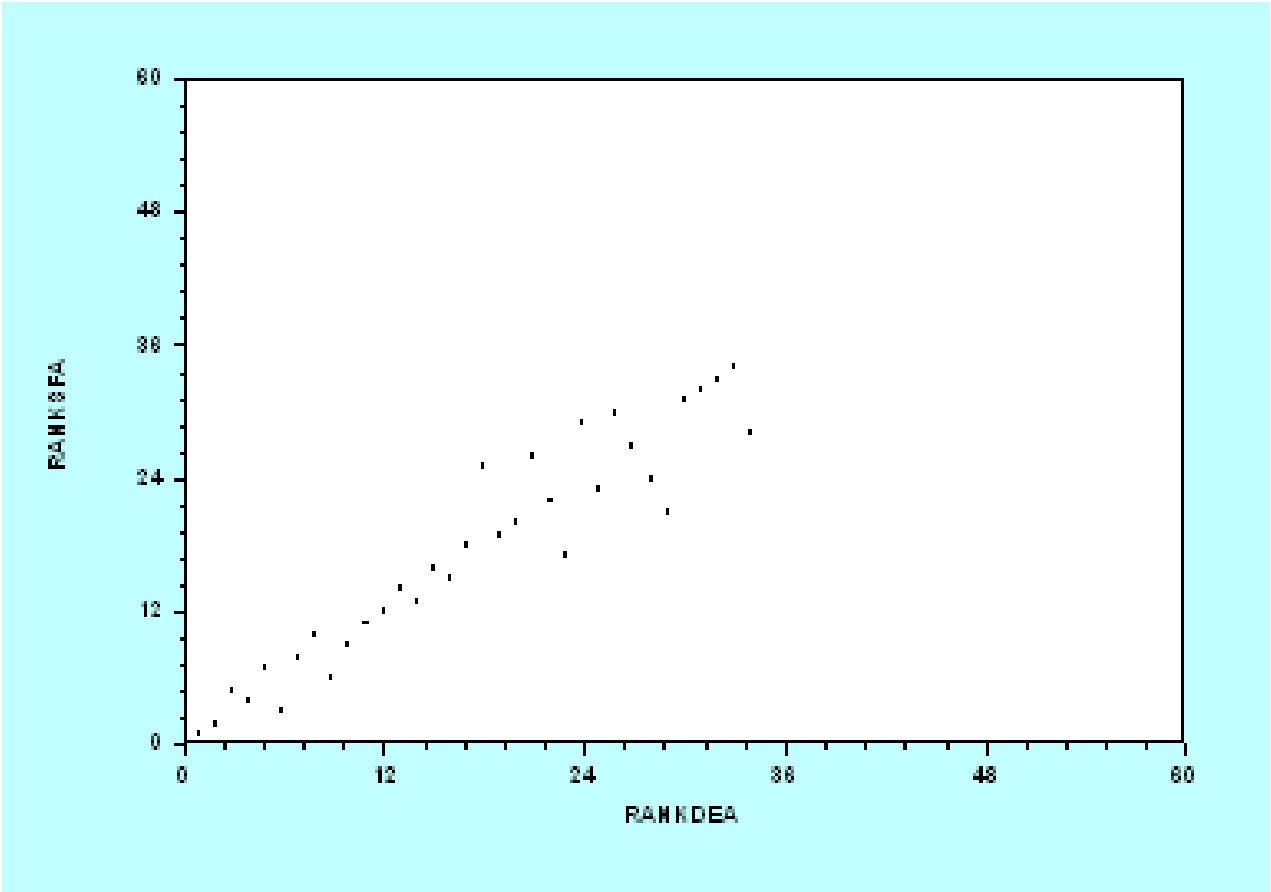
Results
Small utilities

- Rank Correlation: 0.790



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Conclusion

- Water distribution companies of different size do not share a common production technology
- However, No. Of connections seem to be an important cost driver for each of the three clusters
- Endogenous size cluster lead to less robust results than industry specific cluster
- Overall, average water utility efficiency seems comparably high.

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