



**TECHNISCHE
UNIVERSITÄT
DRESDEN**



**Effizienzanalysen in der
Wasserversorgung
Erfahrungen anhand eines internationalen
Literaturüberblicks**

**KIM, TU Berlin
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A. Cullmann / M. Walter / R. Wand / M. Zschille

EE²

Chair of Energy Economics and Public Sector Management

Agenda

1. Introduction
2. Survey of International Experience
3. Selected Study in Water Supply
4. Benchmarking in Germany
5. Conclusions and Recommendations
6. Literature

Efficiency Analysis Can Help to Ensure Fair Prices in Network Industries with Natural Monopolies

Motivation for Efficiency Analysis of Water Companies

1 Natural Network Monopoly:

- Not efficient to duplicate the water conduit network, only one operator per area
- Regulation of energy-related network industries: gas, electricity
- Determination of efficient subsidies and network access tariffs

2 Uniqueness of Water (composition, origin):

- Customers without possibility to choose between providers
- Customers as price-taker
- Fair prices have to be insured by a regulator

3 Surrounding Conditions:

- Ecological responsibility: Water companies as landscape protectors
- Geological aspect: Water quality, water allocation
- Geography: Differences in altitudes influence costs

3 Thesen

1. Wissenschaftliche Benchmarkingmethoden mit einem technisch-ökonomischen Ansatz spielen in der internationalen Wasserwirtschaft eine zunehmende Rolle.
2. Die Komplexität der Wasserversorgung kann durch die geeignete Wahl von Strukturvariablen auf ein akzeptables Niveau reduziert werden.
3. In Deutschland gibt es bisher keine transparente und bezüglich Daten und Ergebnissen nachvollziehbare Effizienzanalyse der Wasserversorgung. Internationale Erfahrungen können bei der Entwicklung der Methodik und des institutionellen Rahmens hilfreich sein.

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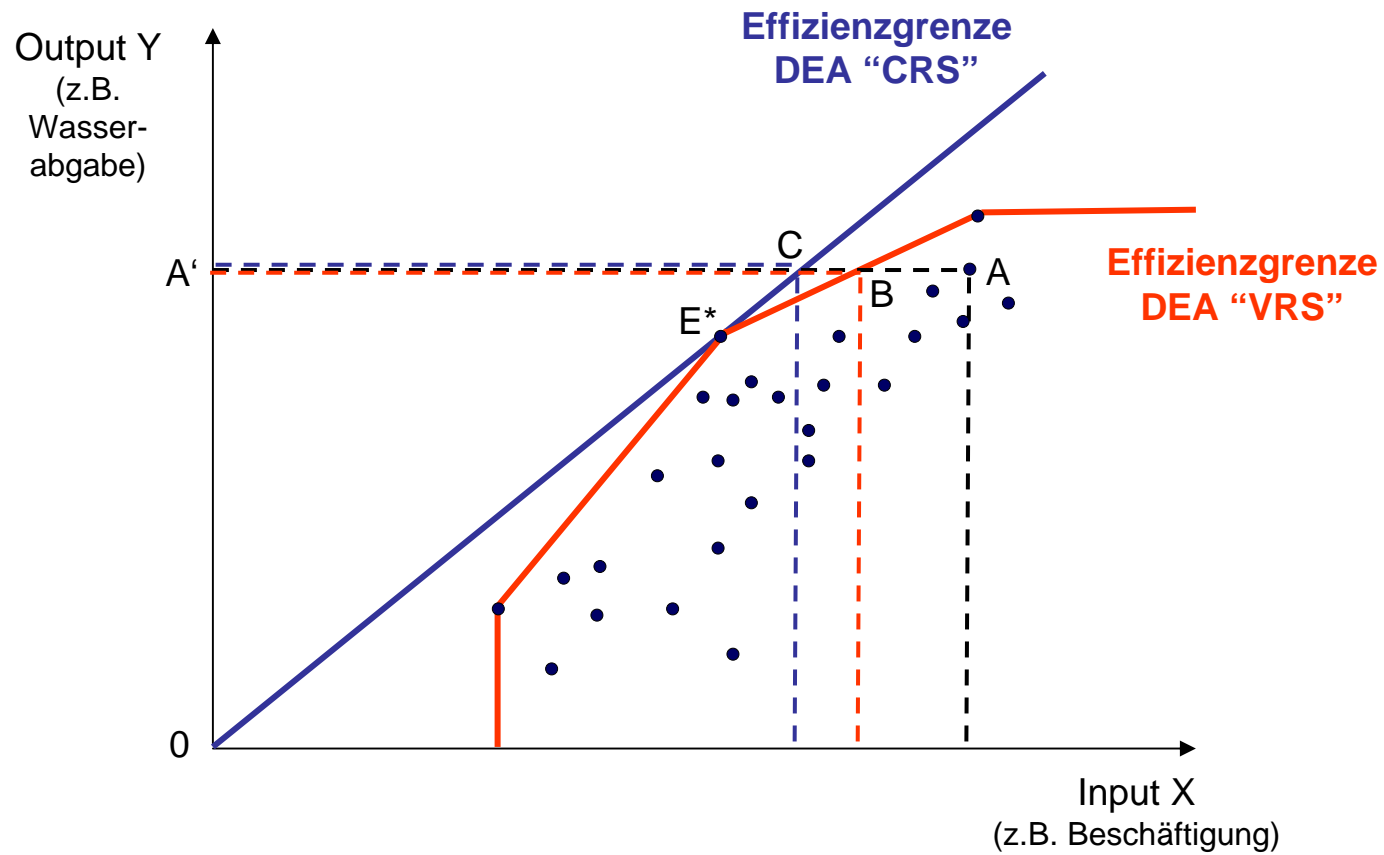
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Efficiency Analysis Should Not Be Mixed Up with Performance Indicators (“Kennzahlenvergleich”)

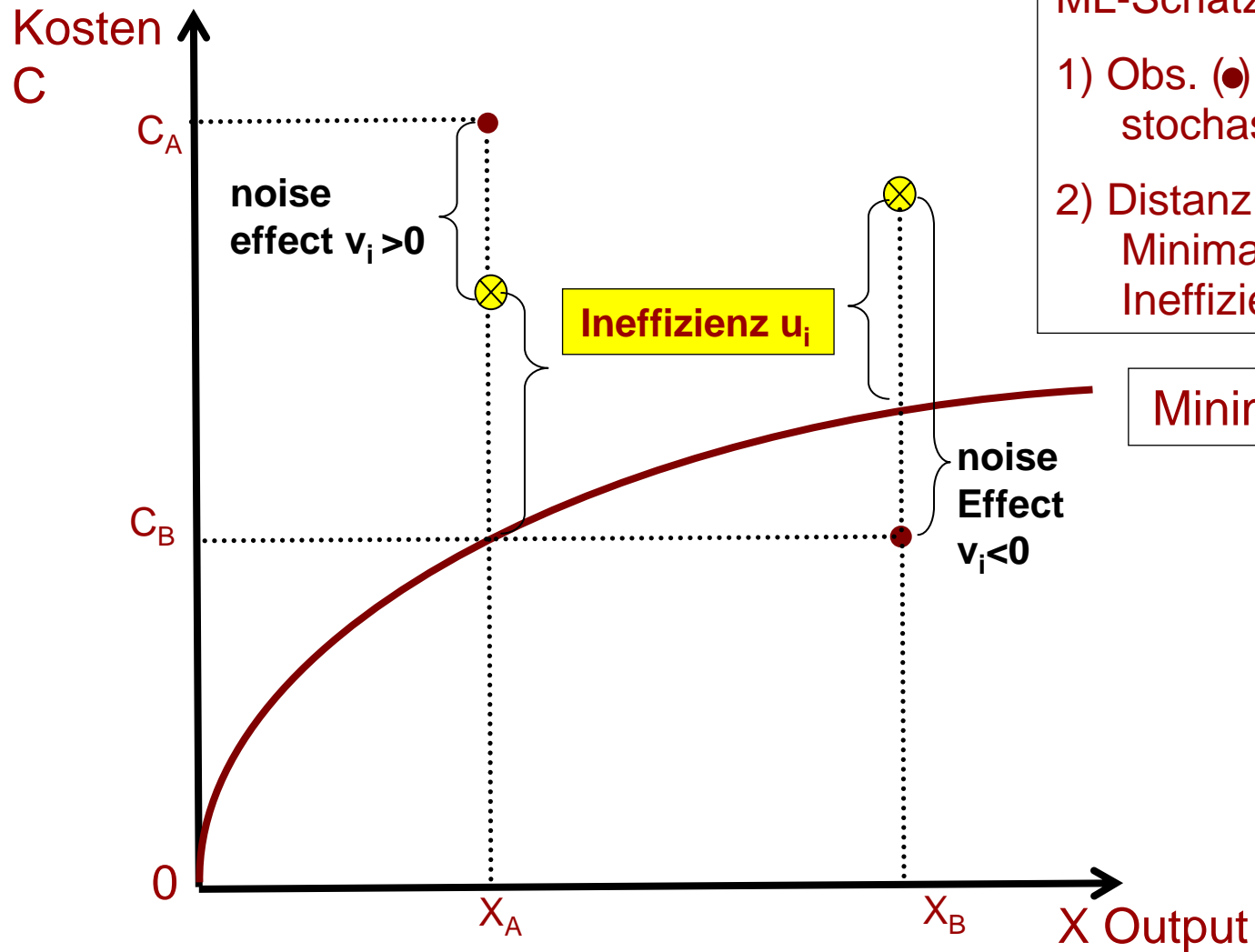
Comparison Scientific Benchmarking – Performance Indicators

	Scientific Benchmarking (Efficiency Analysis)	≠ Performance Indicators, usually called “Benchmarking”
Number of Indicators	One Efficiency Score (Total Factor Productivity)	Several Indicators (e.g. water delivered / employee)
Technical Change over Time	Included (Malmquist Index)	Sector Specific Change not Identifiable
Optimal Firm Size	Obvious (Constant Returns to Scale)	Not Directly Obvious
Heterogeneity	Structural Variables	Limited
(Further) Advantages	<ul style="list-style-type: none"> - Ability to Deal with Data Measurement Errors - Ability to Identify Peer Firms - Ability to Model “Unobserved” Heterogeneity 	<ul style="list-style-type: none"> - Ease of Calculation - Ease of Data Collection

Data Envelopment Analysis (DEA)



Stochastic Frontier Analysis (SFA)



ML-Schätzung

- 1) Obs. (●) werden um stochast. Fehler bereinigt
- 2) Distanz von Kosten (⊗) und Minimalkostenfunktion ist Ineffizienz

Minimalkostenfunktion

Benchmarking Water Utilities in Anglo-Saxon Countries

State of the Art Literature in Anglo Saxon Countries

		Study	Data	Method	Results
Overseas	USA	Wallsten / Kosec (2006)	All community water systems in the USA b/w 1997-2003		<ul style="list-style-type: none"> Ownership <i>per se</i> does not determine performance Benchmarking by consumers or regulators can improve performance
		Bhattacharyya et al. (1994)	221 firms (190 public, 31 private) in 1992	SFA	<ul style="list-style-type: none"> Larger firms are more efficient For small firms, privately owned firms are more efficient
	Australia	Coelli, Walding (2005)	18 water suppliers over 8 years	DEA	<ul style="list-style-type: none"> Input reduction by 9.6% possible Improving efficiency by 9% if companies grow to optimal firm size
European Union	UK	Thanassoulis (1997)	Methodology-related	DEA	<ul style="list-style-type: none"> Benchmarking refinement necessary
		Cubbin / Tzanidakis (1998)	English and Welsh water utilities in 1994/5	DEA and RA*	<ul style="list-style-type: none"> Illustration of differences in applied method (DEA vs. RA)
		Dassler, Saal, et al. (2006)	Inter-sectoral comparison of benchmarking in regulation		<ul style="list-style-type: none"> Benchmarking is only one means of regulation
		Saal et al. (2007)	10 water and sewerage companies b/w 1985 -2000	SFA	<ul style="list-style-type: none"> Improved technical efficiency Too large firms (decreasing returns to scale)

* Regression Analysis

Benchmarking Water Utilities in (Continental) Europe

State of the Art Literature: Continental Europe

		Study	Data	Method	Results
European Union	Italy	Antonioli / Filippini (2001)	32 water distributors b/w 1991-1995	OLS *	Geographical and morphological variables very important No evidence of size-dependent performance
	Slovenia	Fillipini / Hrovatin / Zoric (2008)	52 utilities b/w 1997-2003	SFA	Lack of model robustness concerning unobservable heterogeneity Medium-sized firms have optimal size
	France	Garcia / Thomas (2001)	55 utilities in the Bordeaux region b/w 1995-1997	GMM **	Significant economies of scale Local communities may benefit from merging into water districts
	Germany	Haug (2007)	37 utilities in Eastern Germany in 2004/2005	DEA	Organizational form has impact on TE Participation in voluntary and anonymous benchmarking does not have efficiency enhancing effects
		Sauer/Frohberg (2007)	47 rural utilities in 2000/1	SGM ***	Inefficient usage of input chemicals



Different Intensity of Water Benchmarking Internationally

* Ordinary Least Squares

** Generalized Method of Moments

*** Symmetric Generalized McFadden cost function

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Selected Study: Australia

Coelli, Walding, Shannon (2005):
Performance Measurement in the Australian Water Supply Industry

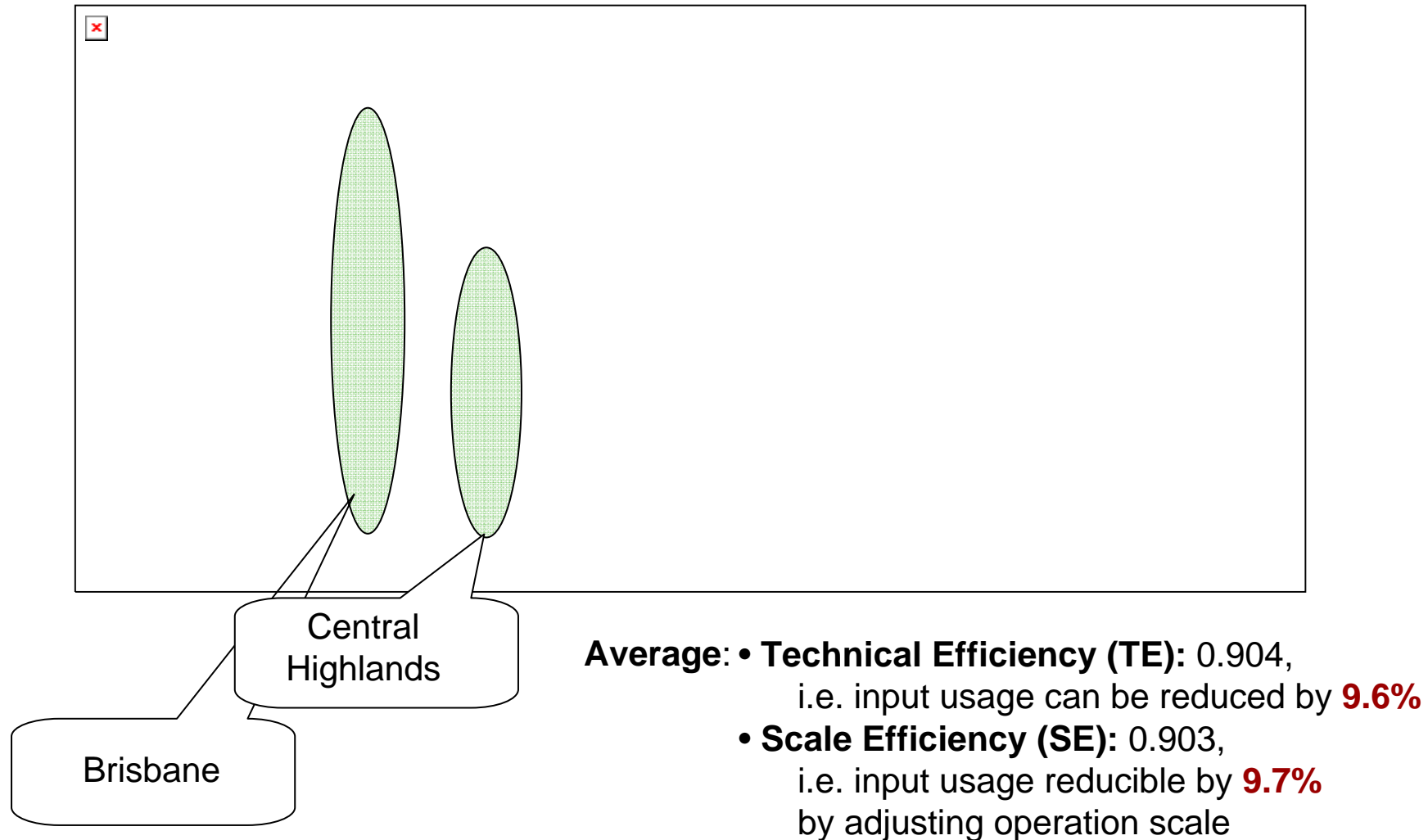
Data Description and Methodology	Objectives
<ul style="list-style-type: none">• 18 Australian Water Suppliers• Large Regional Cities' and State Capital Water Suppliers• Panel Data over 8 Years: 1995/6-2002/3• Data Envelopment Analysis (DEA)	<ul style="list-style-type: none">• Find out Main Cost Drivers and Structural Parameters• Focus on Variable Selection• Benchmark Structurally Comparable Water Suppliers• Determine Technical Efficiency (TE) and Scale Efficiency (SE)

Selected Study: Variable Selection for Australia (Coelli et al. (2005))

- **Percentage of Non-residential Customers**
- **Percentage of Water from Non-catchment Sources (rivers, lakes)**
- **Average Rainfall**
- **Temperature Differences**
- **Network Density**
- **Business Size**
- **Topography**
- **Soil**
- **Local Regulations and Policies**

 **Structural Variables can Account for the Heterogeneity among Water Utilities**

Selected Study Australia: Results



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Background Germany

- Ca. 6,400 Water Suppliers in Germany
- Heterogeneity in Water Supply (legal, geographical, geological, hydrological)
- Price Differences for Drinking Water up to 409% within Germany *
- EU Water Framework Directive:
Water Resource Management within
River Basin Districts (Hydrological Cycles)
vs. fragmented Water Utility Structure
- **What Do We Need?**
 - ➔ Nationwide Performance Analysis
 - ➔ Size-independent Analysis
 - ➔ State of the Art - Methods



Source: BMU (2002)

*Source: Daiber, 2008

Benchmarking in Germany


- **Very few Scientific Analyses on Germany**
 - Methodologically Advanced, but Insufficient Data
 - Qualitative Research (Clausen and Scheele (2002, 2003)) or Regional Studies
 - Little Reflection in the Sector
 - **Competitive Market Concept (Hessian Cartel Office)**
 - **Benchmarking Projects by the Industry ***
 - Water Supply (27 projects), Sewerage Treatment (28 projects)
 - Until 2007: 750 Companies Participated, Covering 60% of Water Supply
 - Mainly Partial Benchmarking / Performance Indicators
- **Interesting Initiatives, But not Useful for Transparent Comparison of Cost and Efficiency**

* as of 1 February 2008, Source: BDEW et al., 2008

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Conclusions and Recommendations

- **Numerous Scientific Studies are Available for the UK and Overseas**
 - **Open Discussion Between Science and Practice in Anglo-Saxon Countries**
 - **Advanced Benchmarking Methods available, Taking into Account**
 - **Structural Differences, Temporal Changes, Water and Sewerage Quality**
- 
- **Improve Availability of Data for Performance Analysis in Germany**
 - **Benchmarking should be more transparent in Methodology and Results**
 - **Take the UK's Experiences in Benchmarking into Account**
 - **Well Documented and Scientifically Discussed Methodology**
 - **Hydrologically Comparable**
 - **Tested and Applied within the Regulation Framework since 1989**



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**Thank you very much
for your attention!
Any questions or comments?**

Robert.Wand@mailbox.tu-dresden.de

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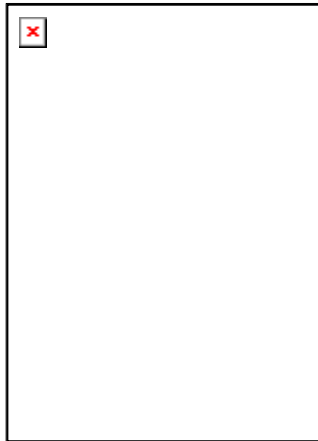
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Concept of Non-Discretionarity

Backup

- Some variables are under the control of the manager, some are not
 - Divide the inputs into discretionary and non-discretionary sets.



θ associated with radial reductions in this subsets of inputs.

- Important for structural variables
- Capital input, fix in the short run