TECHNISCHE UNIVERSITÄT DRESDEN

DIW BERLIN

Ermittlung möglicher Fusionseffekte im öffentlichen Personennahverkehr – Eine Effizienzanalyse für Nordrhein-Westfalen

Konferenz

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EE2

Chair of Energy Economics and Public Sector Management

Agenda

1. German local public transport
2. Methodology
3. Data and mergers
4. Results
5. Conclusions

Market structure and subsidy payments in German local public transport are not sustainable

Current challenges of local public transport in Germany

- High fragmentation with several hundred firms causes inefficiency (cp. Hirschhausen et al. 2008)
- High direct subsidies (level of cost coverage << 100%) will not be sustainable
- Indirect subsidies through loss compensations in municipal utilities legally questionable
- Political guidelines differ from state to state and change from time to time

Instruments to change the market structure

Tenders

- Tenders in order to
  - enforce competition
  - decrease subsidies
  - increase quality (cp. KCW 2007)
- However, tenders cannot fully resolve the problem of an inefficient market structure

Merger & acquisitions

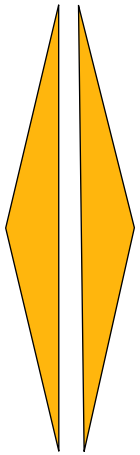
- "Geographically random" acquisitions by players with a strong capital base[1]
- **Acquisitions of urban providers with companies from suburbs[2]**
- **Mergers of (relatively) equal partners in geographical nearness**

(1) E.g. HHA, DB Stadtverkehr, Veolia (2) E.g. DVB with Meißen

Mergers seem best feasible with companies operating a common tram network in geographical proximity

Mergers of (relatively) equal partners in geographical proximity

- Rhein-Neckar-Verkehr (RNV): founded as joint-venture for the mobility divisions of MVV (Mannheim), HSB (Heidelberg) and VBL (Ludwigshafen) in 2004
- Meoline: founded as joint-venture for the mobility divisions of EVAG (Essen) and MVG (Mülheim) in 2005
- KVB and SWB: Two merger attempts in 2003 and 2007 of the municipal utilities from Cologne and Bonn failed because of political opposition
- …
- *One more candidate in Germany: Rheinbahn (Düsseldorf), DVG (Duisburg) and SWK (Krefeld)*



Characteristics

- Outstanding: Mergers of companies with tram and light railway networks with connecting lines
- Geographical proximity as necessary condition for raising saving potentials and communication between partners

Our objective

- Evaluate the gains of potential mergers which are geographically meaningful
- North-Rhine Westphalia with its large urban agglomeration seems to be best appropriate for a case study

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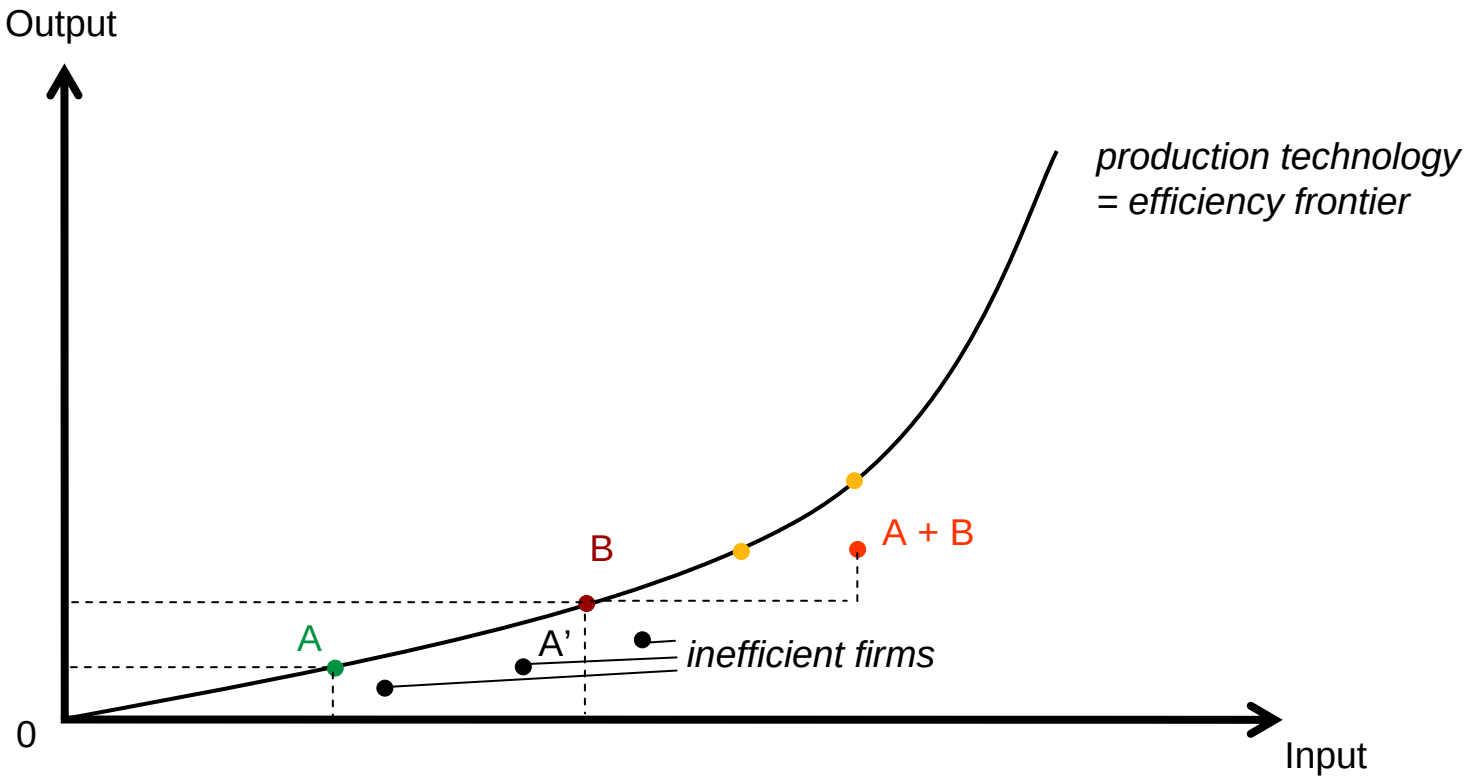
We use Data Envelopment Analysis to evaluate efficiencies of individual and merged companies

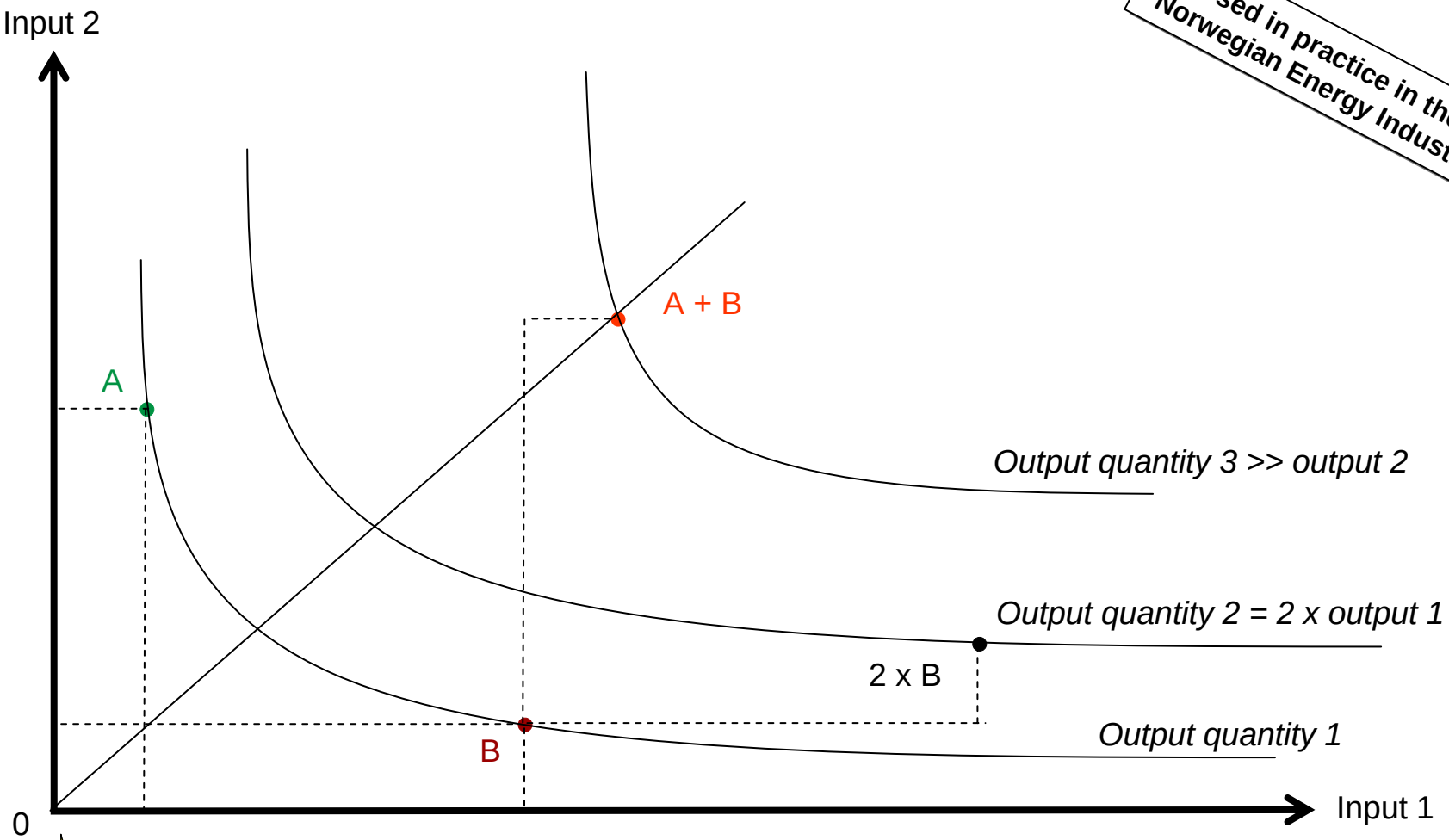


If economies of scale are present in a sector, in addition to technical efficiency gains further saving potentials (size effect) can be raised by a merger

Source: Bogetoft & Wang 2005

Additional to an individual technical efficiency and size gains, synergy gains are possible

Used in practice in the Norwegian Energy Industry



Size and synergy gains together are the real merger gains

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We use physical inputs and outputs of 41 companies as data basis for our analysis

Data facts

- 41 companies from North-Rhine Westphalia[1]
  - 12 multi-outputs including Rheinbahn (Düsseldorf), bogestra (Bochum), KVB (Köln) etc.
  - 29 pure bus operators

  plus BVG (Berlin), HHA (Hamburg) and MVG (Munich) as benchmark for very big mergers

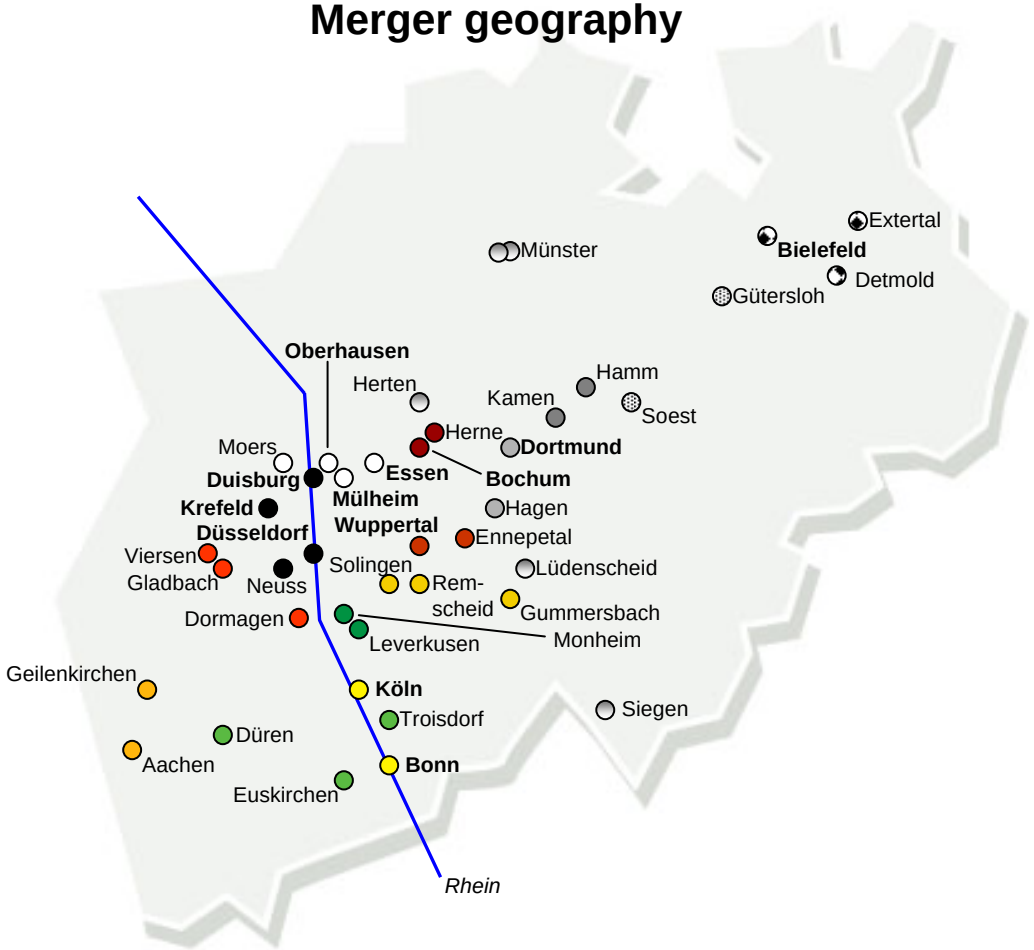
- Inputs “labor” and “capital”:
  - # of employees (FTE; adjusted to outsourcing following Leuthardt 1986 and 2005)
  - # of seats in trams, light railways and metros
  - # of seats in buses
- Outputs:
  - # of seat-kilometers in trams, light railways and metros
  - # of seat-kilometers in buses
- Source: Statistics of the Association of German Transport Undertakings 2006 (VDV Statistik)

- Use of cost data not possible due to limited availability of balance sheets (in particular for smaller companies)
- Introduction of a structural variable in an additional analysis: tram index defined as seats in trams divided by seats in all rail-bound vehicles (in order to account for different investments and operation costs)

(1) After deleting outliers (e.g. due to measurement errors)

We propose 14 mergers of local public transport companies in North-Rhine Westphalia

Merger geography



Legend: *Tram or light railway operators in **bold** font*
Not merged companies

Statistics

- 73 potential mergers evaluated, the map shows selected the 14 (with up to 4 companies)
- 3 mergers of companies with tram and light railway networks with connecting lines
- 4 mergers of a company with a tram and light railway network and up to 2 bus companies
- 7 mergers of pure bus companies
- 5 companies remain unmerged[1]

(1) Although VWS (Siegen) is part of Stadtwerke Bonn, we also considered possibilities in which this combination is parted again

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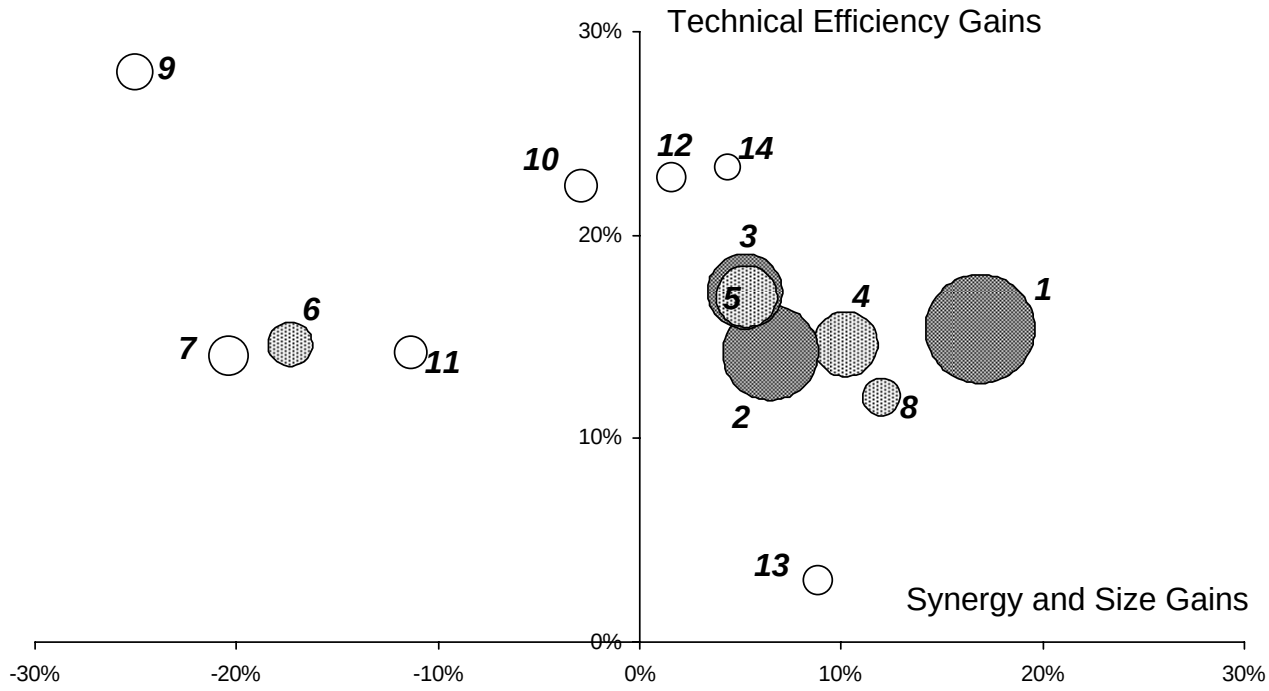
Merger gains are in particular inherent for mergers of tram and light railway operators with bus operators

Merger gains decomposition with respect to company size[1]



(1) For Variable returns to scale (VRS), i.e. acknowledging that there is an optimal firm size

Mergers

1. **Köln**, **Bonn**
2. **Duisburg, Düsseldorf, Krefeld**, Neuss
3. **Mülheim, Essen, Oberhausen**, Moers
4. **Dortmund**, Hagen
5. **Bochum**, Herne
6. **Wuppertal**, Ennepetal
7. Aachen, Geilenkirchen
8. **Bielefeld**, Detmold, Extertal
9. Troisdorf, Euskirchen, Düren
10. Gummersbach, Remscheid, Solingen
11. Dormagen, Gladbach, Viersen
12. Hamm, Kamen
13. Monheim, Leverkusen
14. Gütersloh, Soest

The real merger effects mainly rely on synergy effects with possible interdependencies to size effects

Merger gains decomposition[1]

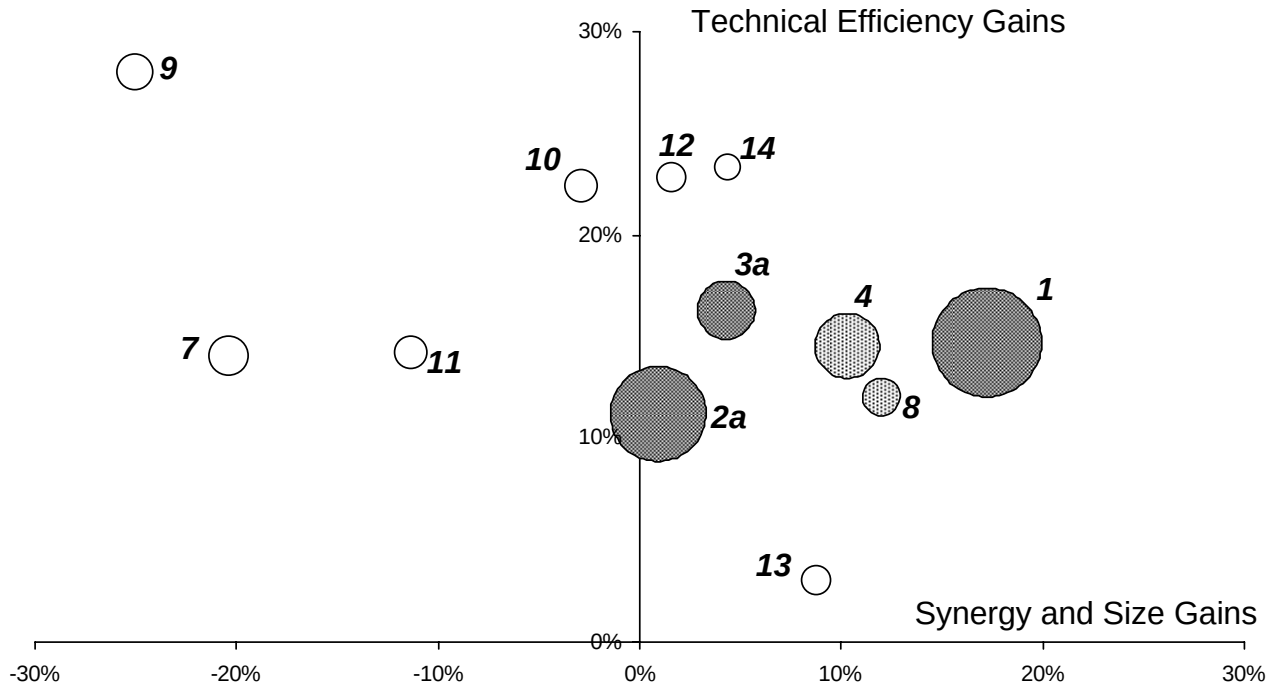
	Merger	Overall potential effect	Technical efficiency effect	Real merger effect	Synergy effect	Size effect
1)	Köln, Bonn	30%	15%	17%	16%	2%
2)	Duisburg, Düsseldorf, Krefeld, Neuss	20%	14%	6%	3%	3%
3)	Mülheim, Essen, Oberhausen, Moers	21%	17%	5%	7%	-2%
4)	Dortmund, Hagen	23%	15%	10%	11%	-1%
5)	Bochum, Herne	21%	17%	5%	3%	2%
6)	Wuppertal, Ennepetal	0%	15%	-17%	6%	-24%
7)	Aachen, Geilenkirchen	-3%	14%	-20%	9%	-32%
8)	Detmold, Extertal, Bielefeld	23%	12%	12%	3%	10%
9)	Troisdorf, Euskirchen, Düren	10%	28%	-25%	3%	-29%
10)	Gummersbach, Remscheid, Solingen	20%	22%	-3%	0%	-3%
11)	Dormagen, Gladbach, Viersen	5%	14%	-11%	2%	-13%
12)	Hamm, Kamen	24%	23%	2%	0%	1%
13)	Monheim, Leverkusen	12%	3%	9%	7%	2%
14)	Gütersloh, Soest	27%	23%	4%	2%	3%

(1) For Variable returns to scale (VRS), i.e. acknowledging that there is an optimal firm size

Merger gains mostly remain stable when accounting for differences in tram and light railway provision

Note: Some merger composition have changed

Merger gains decomposition with respect to company size with tram index[1]



Mergers

1. **Köln**, **Bonn**
2. **(a) Duisburg, Düsseldorf, Krefeld**
3. **(a) Mülheim, Essen**
4. **Dortmund**, Hagen
7. Aachen, Geilenkirchen
8. **Bielefeld**, Detmold, Extertal
9. Troisdorf, Euskirchen, Düren
10. Gummersbach, Remscheid, Solingen
11. Dormagen, Gladbach, Viersen
12. Hamm, Kamen
13. Monheim, Leverkusen
14. Gütersloh, Soest

(1) For Variable returns to scale (VRS), i.e. acknowledging that there is an optimal firm size

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Schlussfolgerungen

- **Einsparungen durch Fusionen von bis zu 17% des Faktoreinsatzes erscheinen möglich, speziell für Fusionen von Betreibern eines gemeinsamen Schienennetzes**
  - **Aussage bleibt erhalten wenn man differenziert zwischen Straßenbahnen und Stadt- und U-Bahnen**
- **Fusionen von Straßen- oder Stadtbahnbetreibern mit Busunternehmen erscheinen auch generell vorteilhaft**
  - **Ausnahme: Spezialfall Wuppertal mit Schwebebahn bei Berücksichtigung technologischer Spezifikation**
- **Fusionen von Busbetreibern erscheint fragwürdig auf Basis dieser Analyse, ein Problem bei dieser Aussage ist jedoch der fehlende Benchmark eines sehr großen puren Busunternehmens**
  - **DB Stadtverkehr wurde nicht in die Analyse miteinbezogen**
- **Örtliche Nähe der zu fusionierenden Unternehmen als Vorraussetzung für Fusion in dieser Analyse**

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

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Backup

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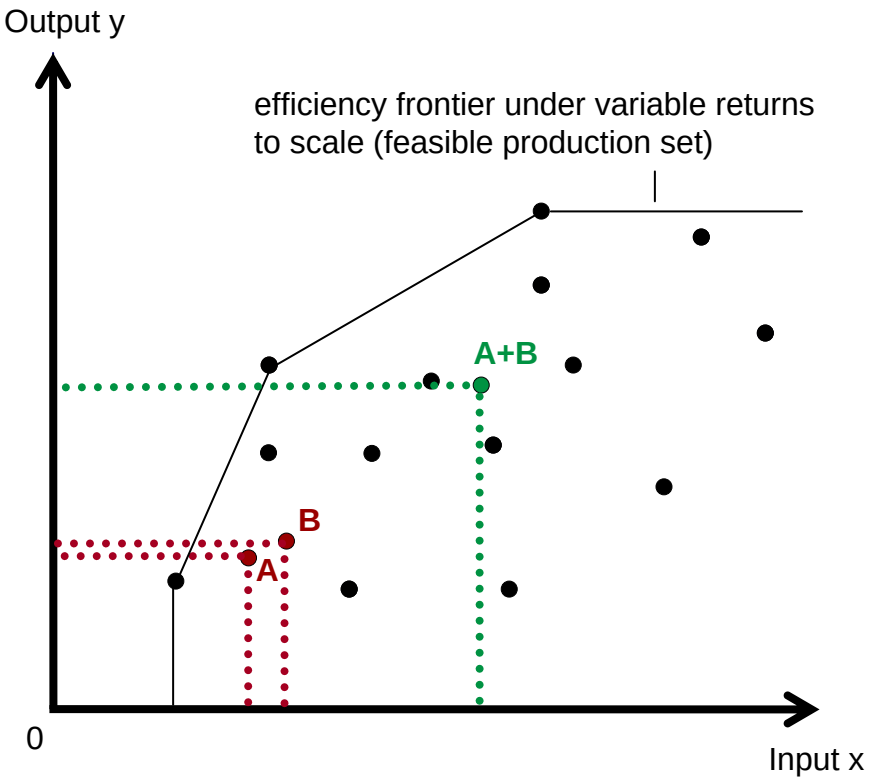
Main idea: Benchmarking mergers



1 Benchmarking individual firm i

$$\min \theta, _{\theta,\lambda}$$

$$s.t.$$

$$-y_i + Y\lambda \geq 0$$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0, \sum \lambda = 1$$

2 Benchmarking mergers:
overall potential effect

$$\min \theta^J, _{\theta^J,\lambda}$$

$$s.t.$$

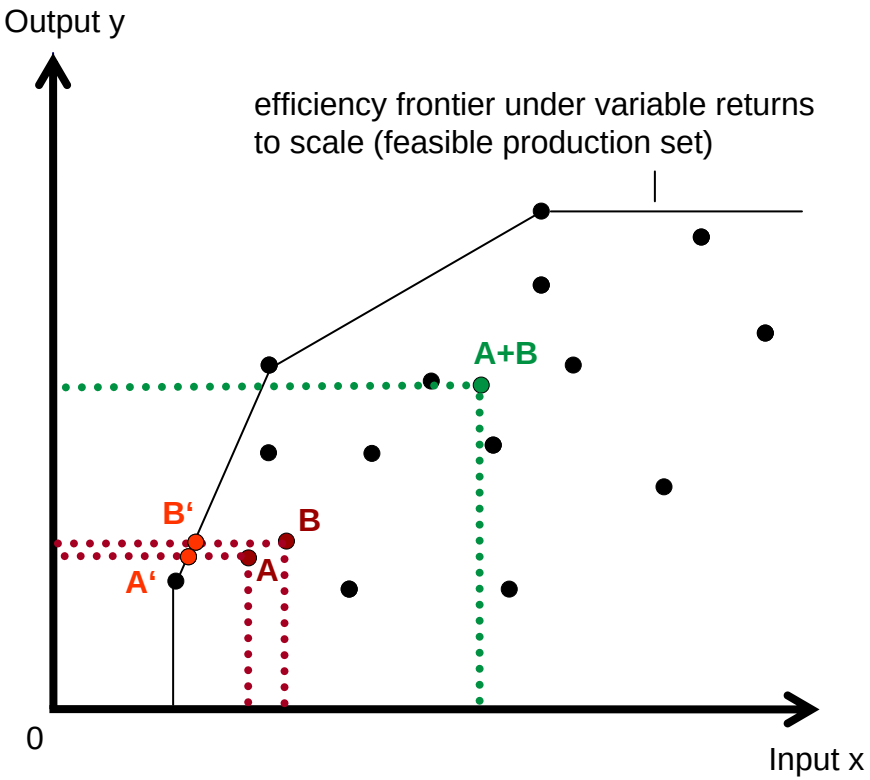
$$-\sum_{j\in J} y_i^j + Y\lambda \geq 0$$

$$\theta^J \sum_{j\in J} x_i^j - X\lambda \geq 0$$

$$\lambda \geq 0, \sum \lambda = 1$$

Decomposition of overall potential gains (I)

2a Technical efficiency effect T



$$\min \theta^{*J}{}_{,\theta^{*J},\lambda}$$

$$s.t.$$

$$-\sum_{j\in J} y_i^j + Y\lambda \geq 0$$

$$\theta^{*J}\sum_{j\in J}\theta^j x_i^j - X\lambda \geq 0$$

$$\lambda \geq 0, \sum \lambda = 1$$

T = overall potential effect / real merger effect

$$T^J = \theta^J / \theta^{*J}$$

Decomposition of overall potential gains (II)

2b Synergy effect H

$$\min H^J, _{H^J,\lambda}$$

$$s.t.$$

$$\alpha \sum_{j \in J} y_i^j + Y\lambda \geq 0$$

$$H^J \alpha \sum_{j \in J} \theta^j x_i^j - X\lambda \geq 0$$

$$\lambda \geq 0, \sum \lambda = 1$$

with $\alpha \in [0,1]$

determining the size of the firm
evaluated with the synergy measure

2c Size effect S

$$\min S^J, _{H^J,\lambda}$$

$$s.t.$$

$$\sum_{j \in J} y_i^j + Y\lambda \geq 0$$

$$S[H^J \sum_{j \in J} \theta^j x_i^j] - X\lambda \geq 0$$

$$\lambda \geq 0, \sum \lambda = 1$$

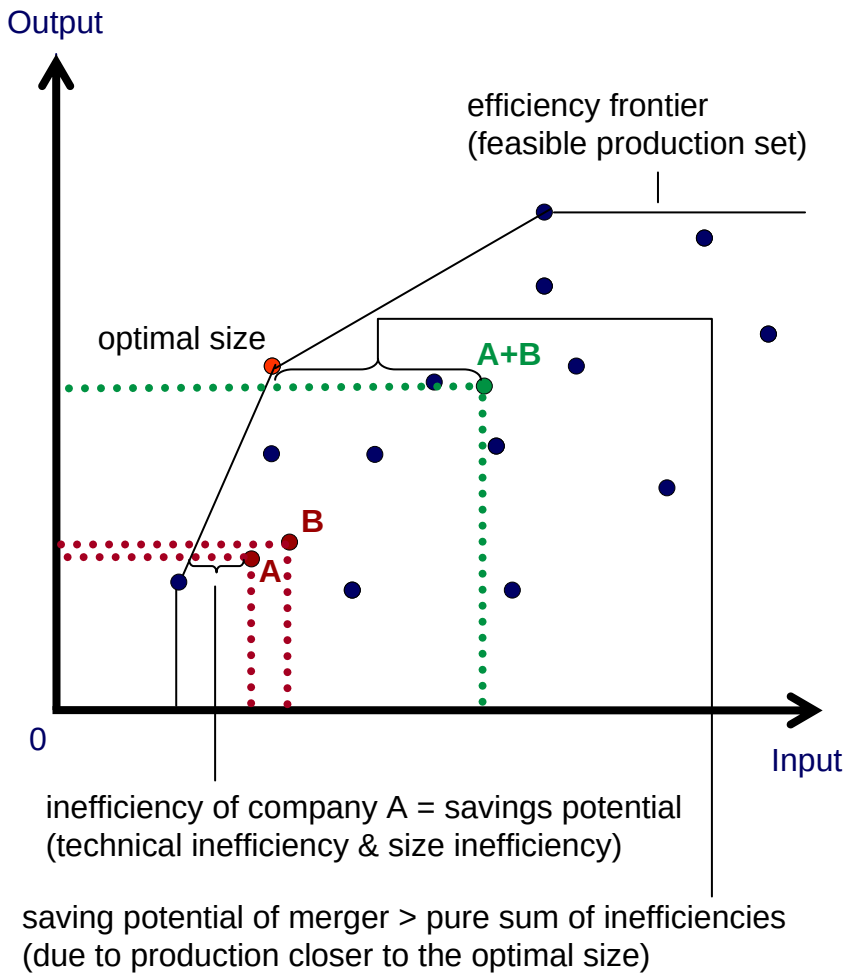
and finally

$$\theta^J = T^J * H^J * S^J$$

We use Data Envelopment Analysis to evaluate efficiencies of individual merged companies

Simplified illustration

Underlying Concept: Data Envelopment Analysis under input orientation



Comments

- Data Envelopment Analysis (DEA) as deterministic, non-parametric method of efficiency analysis
- Efficiency analysis = scientific benchmarking: Aggregation of all inputs and outputs in one efficiency measure
- Input orientation = output quantitiy beyond the control of the management
- Best firms define the efficiency frontier = best practice; other firms are benchmarked relative to the best firms
- Inefficiency measure is a relative measure

Modern methods of DEA allows to calculate potential gains from mergers, decomposed in learning, synergy and size effects

Specification of DEA merger evaluation following Bogetoft and Wang (2005)[1]

1. Step: Calculation of inefficiencies of individual, unmerged firms. These firms remain the reference throughout the whole calculation process

2. Step: Definition of mergers by simply summing each input and output of the individual firms

3. Step: Calculation of merger gains

   a) Benchmarking of mergers with the unmerged firms: overall inefficiency = overall potential gains

   b) Decomposition of overall potential gains in three parts

      1. Technical efficiency effect (also called learning gains): What would be the gain if each individual firm in a merger lay on the efficiency frontier (note that a merger is not ultimately necessary for this gain)

      2. Synergy effect: What is the gain from a more optimal input combination or output combination (e.g. an integrated provider of bus and tram services merges with a provider of mostly bus services and very few tram lines, ratio of bus and tram services is then more balanced in the merged company)

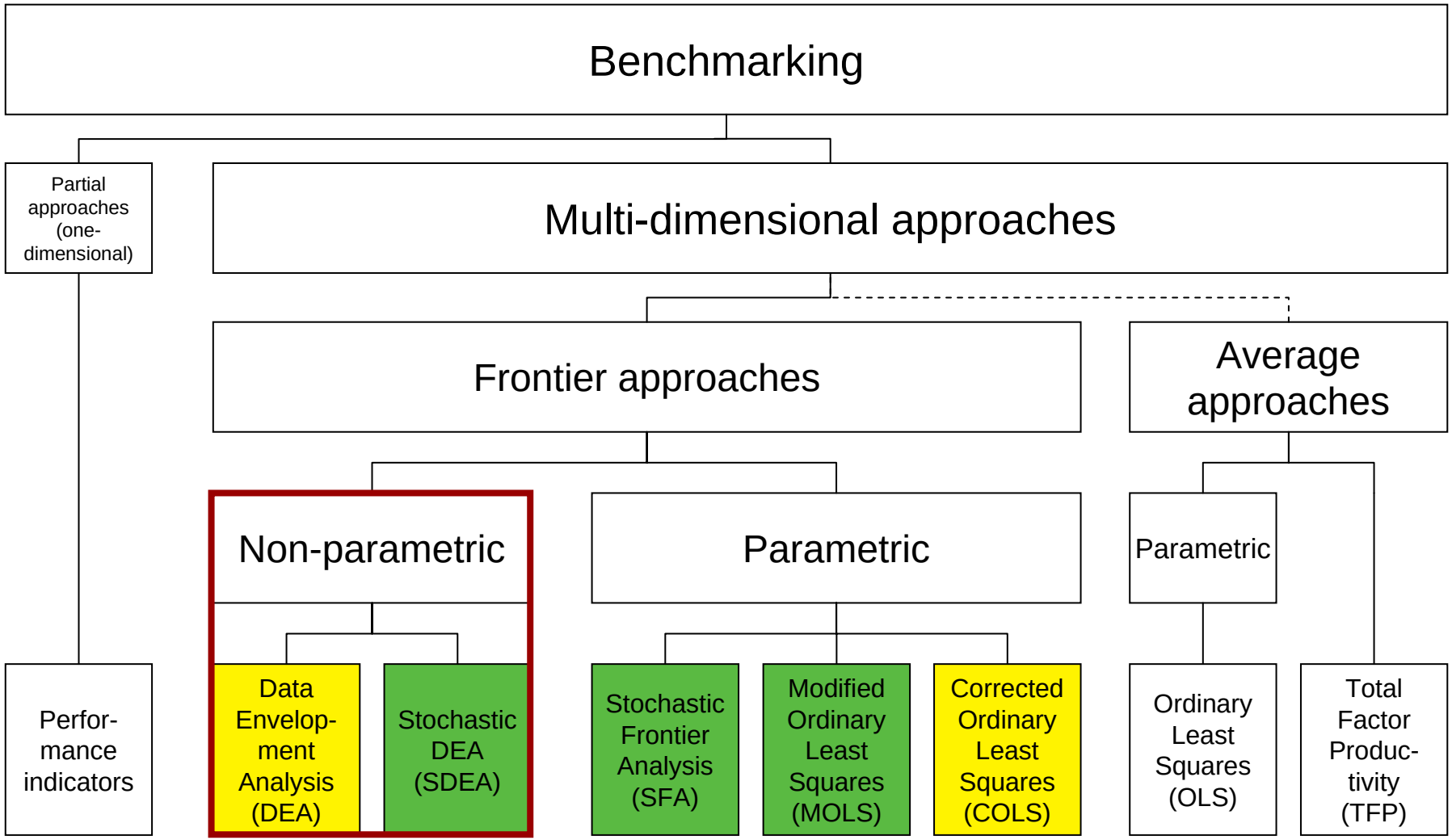
      3. Size effect: What is the gain from producing closer to the optimal size (e.g. through reduced fixed costs, joint vehicle scheduling, joint maintenance, joint reserve, joint administration)

NB Economic differentiation between synergy and size effect not always easy → interdependencies

Synergy + size gains = real merger gains, also called pure gains

(1) Bogetoft, P. and Wang, D. (2005) Estimating the Potential Gains from Mergers. Journal of Productivity Analysis, 23, 145-171

Overview of Benchmarking Techniques



Methods of interest: Deterministic: Stochastic ("es gibt weißes Rauschen"):

The real merger effects mainly rely on synergy effects with possible interdependencies to size effects

Merger gains decomposition[1]

	Merger	Synergy merger gains 1/(2n)	Synergy merger gains 1/n	Synergy merger gains 2/n	Size merger gains 1/(2n)	Size merger gains 1/n	Size merger gains 2/n
1)	Köln, Bonn	0.87	0.84	0.83	0.95	0.98	1.00
2)	Duisburg, Düsseldorf, Krefeld, Neuss	1.02	0.97	0.95	0.92	0.97	0.99
3)	Mülheim, Essen, Oberhausen, Moers	0.98	0.93	0.90	0.97	1.02	1.05
4)	Dortmund, Hagen	0.94	0.89	0.90	0.96	1.01	1.00
5)	Bochum, Herne	1.02	0.97	0.95	0.93	0.98	1.00
6)	Wuppertal, Ennepetal	0.96	0.94	1.17	1.23	1.24	1.00
7)	Aachen, Geilenkirchen	0.92	0.91	1.20	1.31	1.32	1.00
8)	Detmold, Extertal, Bielefeld	1.20	0.97	0.89	0.74	0.90	0.99
9)	Troisdorf, Euskirchen, Düren	1.03	0.97	0.95	1.21	1.29	1.31
10)	Gummersbach, Remscheid, Solingen	1.03	1.00	0.99	1.00	1.03	1.04
11)	Dormagen, Gladbach, Viersen	1.06	0.98	0.95	1.05	1.13	1.00
12)	Hamm, Kamen	1.06	1.00	0.98	0.93	0.99	1.00
13)	Monheim, Leverkusen	1.00	0.93	0.91	0.91	0.98	1.00
14)	Gütersloh, Soest	1.05	0.98	0.96	0.91	0.97	1.00

(1) For Variable returns to scale (VRS), i.e. acknowledging that there is an optimal firm size

Literature Review: Efficiency analysis of local public transport

- **On an international level**
  - **Single output bus companies: Numerous studies with SFA as well as DEA**
    - **For a good overview see De Borger et al. (2002)**
    - **Modelling with incorporation of unobserved heterogeneity by Farsi et al. (2006)**
  - **Multi output companies (bus, tram and other services): Only few studies**
    - **SFA: Estimation of economies of scale and scope by Farsi et al. (2007)**
    - **Viton (1992) looked at the potential gains from mergers in the San Francisco Bay Area using SFA**
    - **DEA: -**
- **In Germany**
  - **Single output bus companies: Few recent, Hirschhausen and Cullmann (2008) found increasing returns to scale**
  - **Multi-output: -**