Case study on the application of TOTEX benchmarking model in Germany

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Agenda

- Introduction to Bundesnetzagentur (BNetzA)
- Principles and building blocks of incentive regulation
- TOTEX benchmarking in detail and insights from current benchmarking practice
- Conclusions
Introduction to Bundesnetzagentur (BNetzA)
- independent higher federal authority in the scope of business of the Federal Ministry of Economic Affairs and Energy
- mission: promote **effective competition in the regulated areas** and ensure non-discriminatory access to networks
  - Telecommunications and Posts (since 1998)
  - Electricity and Gas (since 2005)
  - Railways (since 2006)
  - Electricity and Gas network planning (since 2011)
- **Ruling Chambers** (Beschlusskammern) competent for regulatory decisions and enforcement
- **overall headcount** for all sectors: ca. 2700 staff
  - 200 staff in energy regulation
  - 240 staff for network planning & expansion
BNetzA’s tasks in energy regulation (1)

- generation - exploration
  - unbundling

- monopolistic bottlenecks
  - electricity and gas networks
  - 4 TSOs electricity and 16 TSOs gas
  - ~800 DSOs electricity and gas each

- supply - consumer
  - unbundling

- incentive regulation

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BNetzA’s tasks in energy regulation (2)

- **BNetzA**
  - 'traditional' regulation
    - access regulation
    - tariff * regulation
  - network development
    - network planning
  - general sector-specific tasks
    - authorisation
    - system security
  - renewable energy tasks
    - RES plant register
    - renewable levy calculation
    - REMIT enforcement
    - tendering

* incentive regulation incl. benchmarking
Regulation and federalism

Bundesnetzagentur (Federal Network Agency)

- competent authority for all large (≥ 100,000 connected customers) and trans-regional network operators
- benchmarking for all network operators (except DSOs in simplified procedure)
- responsibility agreement for authorities in five federal states

State Regulatory Authority

- competent authority for DSOs with less than 100,000 customers connected
Building blocks of incentive regulation
Main features of German regime (1)

- objective: enhance the monopolist’s focus on **efficiency** and **quality of supply** and provide for an **adequate investment environment**
- **revenue-cap-regulation (not price cap)**
- **no volume risk**, instrument of ‘regulatory account’ captures significant changes in volumes transported
- regulatory periods of **five years**
- **equity return** on capital invested is based on a regulatory decision, determined by the Ruling Chamber 4 based on transparent and sound methodology
- incentive regulation **reform** as from 3rd regulatory period with CAPEX true up*, efficiency bonus*, more transparency

* only for DSOs
benchmarking

- compare efficiency among network operators
- mimic competition
- “x ind” as individual efficiency target (catch up to best in class)
- inefficiencies must be reduced within five years

“x gen” as general productivity factor to reflect technological progress and sector specific price developments in the network industry
3 building blocks of incentive regulation

1. Cost approval
2. Benchmarking
3. Determination of revenue cap (budget for TOTEX)
   - CAPEX substraction (as from 3rd regulatory period)
   - Annual CAPEX true up
   - CAPEX in period top up
   - Budget only for OPEX

Network operator sets network charges (method codified in ordinance)
Principles of incentive regulation

1. Cost approval
   - 1st regulatory period
   - 2011 base year
   - Costs (TOTEX)
   - Additional profit
   - Non-controllable costs

2. Benchmarking
   - 2nd regulatory period
   - 2014 base year
   - Total costs (TOTEX)
   - Additional profit
   - CAPEX
   - OPEX

3. Annual CAPEX true up
   - 3rd regulatory period
   - 2023 base year
   - Costs (TOTEX)
   - Additional profit
   - OPEX budget
Cost approval
Cost approval: main steps

- basis: profit and loss account
- check costs (TOTEX) of base year
- elimination of all costs with no relevance for network business
- OPEX: based on profit and loss account
- CAPEX: imputed costs (see slide 17)
- distinction between ‘non-controllable’ and ‘generally controllable’ costs within TOTEX (see next slide)
Cost approval: distinction

- **non-controllable costs**
  - not under the influence of the network operator, e.g. special HR costs, legal payment obligations, curtailment, operating taxes etc.
  - not subject to efficiency targets
  - defined in Incentive Regulation Ordinance
  - intra-periodic adjustment (deviation from budgetary approach)

- **generally controllable costs**
  - subject to efficiency benchmarking
  - under the influence of the network operator
Cost approval (key elements)

**OPEX**
- Based on income statement
  - Non-controllable costs
  - Generally controllable costs

**CAPEX**
- Imputed depreciation
  - Based on regulatory asset base
  - Generally controllable costs
- Imputed rate of return on equity
  - Based on regulatory asset base and capital structure
  - Generally controllable costs
- Imputed trade tax
  - Based on imputed ROR on equity
  - Generally controllable costs
- Income apart from network tariffs
  - Based on income statement

**TOTEX**

*Cost of debt classified as OPEX*
Benchmarking (in general)
Benchmarking: main features

- who?
  - all network operators (except those in simplified procedure)

- what is it?
  - comparing efficiency of individual network operator with its peers based on statistical methods (relative efficiency)
  - efficiency = cost efficient fulfillment of distribution task

- how?
  - building a ratio of inputs (generally controllable TOTEX based on cost approval) vs. outputs (parameters that reflect the distribution task of network business)
  - two statistical methods: Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA)
Benchmarking or no benchmarking

**electricity**
- International benchmarking*
- Relative reference grid analysis**

**gas**
- National benchmarking (DEA)

**TSO**
- Benchmarking (SFA, DEA)

**DSO**
- No benchmarking but simplified regulatory procedure
  - < 30,000 customers
  - < 15,000 customers

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* 2nd regulatory period: 22 TSOs from 17 countries, average efficiency 97.4%
** 3rd regulatory period; national approach
Benchmarking: key elements

input
generally controllable
TOTEX

model

individual x-factor for each network operator

output parameters
e.g. area supplied, customers connected;
environmental parameters

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Determination of revenue cap
- Determination individually per network operator
- Ruling Chambers 8 and 9 (and State Regulatory Authorities) issue revenue cap determination for each network operator (electricity and gas)
- Intra-periodic adjustment of non-controllable costs
- CAPEX true up as from 3rd regulatory period (DSOs only)
- Regulatory account captures differences between forecasted and actual volumes transported and forecast costs and actual costs
Benchmarking (in detail)
Benchmarking: building blocks

- **Data collection and approval**: (ruling chambers 8/9 for TOTEX and consultant/602 for output parameters)
- **Plausibility checks**: (602 and consultant)
- **Identification of cost drivers/model specification**: (consultant and 602)
- **First determination of efficiency score**: (consultant and 602)
  - DEA and SFA
  - TOTEX and sTOTEX
  - Best-of-four-value
- **Outlier analysis**: (consultant and 602)
  - Dominance and super efficiency analysis (DEA)
  - Cook’s Distance (SFA)
- **Final model evaluation**
- **Final efficiency scores and bonus**: (issued by ruling chamber 8/9 and Federal Regulatory Authorities with revenue cap decision)
Benchmarking: key elements in detail

input
- generally controllable
  - TOTEX

→ model

→ output parameters
  - e.g. area supplied,
    - customers connected;
  - environmental parameters

individual x-factor for each network operator
Defining inputs: main steps

1. Determination of total costs as per building block 1: cost approval

2. Total costs - non-controllable costs = generally controllable costs

- CAPEX: approved costs as per TOTEX
- OPEX: approved costs as per sTOTEX

standardized costs (age*)

* acquisition values

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Benchmarking: key elements in detail

input
generally controllable
TOTEX

model

output parameters
e.g. area supplied, customers connected;
environmental parameters

individual x-factor for each network operator
Output parameters describe the **distribution task of the network business** and environmental parameters for the area supplied.

- Parameters shall be mutually exclusive and collectively exhaustive.
- Parameters refer to different voltage levels.
- Determination of parameters by means of qualitative, analytical and statistical methods.
- Currently, a consultant carries out a "cost driver analysis" to identify relevant parameters.
Defining outputs: main principles (2)

- **performance parameters** may be:
  - connection/feed-in and withdrawal points
  - area supplied
  - DG (number, capacity installed)
  - kWh supplied/year
  - simultaneous annual peak load
  - network length
  - pipe volume
  - number of substations

- **environmental parameters** may be:
  - soil class
  - hillside situation
- Output parameters may come with a potential bias.

**DSO A** invests mainly in copper.

**DSO B** uses smart solutions and avoids network development.

**Benchmarking**: problematic if no output parameter for smart solutions. DSO A performs better than B as network length lower for B and no corresponding output parameter for smartness.

**Incentive regulation**: bias towards network length (CAPEX) due to annual CAPEX true up.
Benchmarking: key elements in detail

- **Input**: Generally controllable TOTEX
- **Model**: Individual x-factor for each network operator
- **Output Parameters**: E.g. area supplied, customers connected, environmental parameters
Data Envelopment Analysis (DEA)

- 1\textsuperscript{st} method: Data Envelopment Analysis (DEA)
- DEA measures relative efficiency of network operator by means of a non-parametric frontier over the sample
- inputs vs. outputs
- piece-wise approach to fit a linear hull over the sample
- hull forms frontier of the most productive firms
- efficient firm is assigned efficiency score of 100%
- 100%: firm performs best in minimizing its costs for a given level of outputs or vice versa

![Diagram](image)
2\textsuperscript{nd} method: Stochastic Frontier Analysis (SFA)

SFA measures relative efficiency of network operator by estimating a cost function (parametric)

difference between individual costs and efficiency frontier are divided into two components: inefficiency and error term

with SFA, network operators may only reach an efficiency close to 100%

cost function:
\[ X_i = f(Y_i; Z_i) + \alpha + v_i - u_i \]
DEA vs. SFA (sTOTEX)

DEA vs. SFA (sTotex, EVG2)

Effizienz DEA vs. Effizienz SFA
Advantages and drawbacks

- **Model:**
  - Flexible data adjustment
  - Differences are entirely explained by inefficiencies and "noise"
  - Risk when data is incorrect

- **Solution:** "Best of both worlds"
  - i.e., best of ranking in favour of network operator

- **Assumption on functional form**
- Differences are entirely explained by inefficiencies and "noise"
- Risk of incorrect model specification

**Diagram:**

- **High "noise"/inefficiency**
  - **Rel. Low**
    - **SFA**
  - **Rel. High**
    - **DEA**

- "Best of both worlds"
Benchmarking: key elements in detail

Input: generally controllable TOTEX

Model

Output parameters:
- e.g. area supplied,
- customers connected,
- environmental parameters

Individual x-factor for each network operator
The x-factor has a safety net

- efficiency factor assigned to network operator is based on best-of-four
  - highest value is taken from two runs with DEA and two runs with SFA, with and without standardized costs
  - lower cap: efficiency of 60%
- when a network operator can prove that specific features of his distribution task, which are due to specific structural circumstances, are not adequately reflected by the output parameters, the efficiency value will be adjusted
- when a network operator can prove that he is unable to reach its individual efficiency target, the target will be set differently
Do you tell me your x-factor?

- relevant benchmarking data are publicly available at Bundesnetzagentur’s website

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<td>average efficiency</td>
<td>92,2 %     +2,5 %-points</td>
<td>94,7 %</td>
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Specific features: efficiency bonus

- with the reform, efficient DSOs (100%, DEA) may obtain an efficiency bonus
- in that case, a super-efficiency analysis is carried out (DEA without eligible DSO, part of outlier detection)
- two runs, with actual costs and with standardized costs
- the superefficiency value is the difference between the result of the superefficiency analysis and the efficiency value from the regular benchmarking (100%), capped at 5% for both cost bases and averaged afterwards
- to determine the bonus, the super-efficiency value is multiplied by the temporarily non-controllable costs and split evenly over the duration (years) of the regulatory period
Lawsuits

- costs per costs approval
- indices
- methodology of cost driver analysis
- repetition of outlier analysis
- choice of parameters
- details of the SFA method (role of error term/influence on efficiency value)
Conclusions
Conclusions

TOTEX benchmarking is an established and accepted regulatory tool.

TOTEX benchmarking and bonus are technologically neutral, but OPEX-CAPEX bias through annual CAPEX true up and certain OPEX classified as non-controllable costs.

Bias in parameters may disincentivize alternatives to copper (importance of cost driver analysis). Issue increases with increasing smartness and heterogeneity of network operators.

Methodology is complex and provokes lawsuits.

Increased transparency is a pivotal asset for all parties involved.
Contact

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Backup
Principles of incentive regulation

1. Cost approval
   - 1st regulatory period

2. Benchmarking

3. TOTEX budget

- 3rd regulatory period

Costs, revenues:
- Revenue cap
- Additional loss
- Additional profit

Costs (TOTEX):
- 1st base year: 2011
- 2nd base year: 2014
- 3rd base year: 2018

Annual CAPEX true up

Cost approval

1. Cost approval
   - 1st regulatory period

2. Cost approval
   - 2nd regulatory period

3. Cost approval
   - 3rd regulatory period
The revenue cap formula FYI

\[
EO_t = KA_{dnb,t} + (KA_{vnb,t} + (1 - V_t) KA_{b,t} + \frac{B_0}{T}) (\frac{VPI_t}{VPI_0} - PF_t) + KKA_t + Q_t + (VK_t - VK_0) + S_t
\]

- **EO\(_t\)**: revenue cap
- **KA\(_{dnb,t}\)**: non-controllable costs
- **KA\(_{vnb,t}\)**: generally controllable costs
- **V\(_t\)**: inefficiency reduction per year
- **KA\(_{b,t}\)**: inefficiencies
- **B\(_0\)**: bonus
- **T**: duration of regulatory period (in years)
- **VPI\(_{t/0}\)**: CPI
- **PF\(_t\)**: Xgen
- **KKA\(_t\)**: CAPEX in period top up (DSO only)
- **Q\(_t\)**: bonus/malus for quality
- **VK\(_{t/0}\)**: volatile costs
- **S\(_t\)**: regulatory account
- **t/0**: time index/base year
# Plausibility checks structural parameters

## Checklist

Plausibilisierung Rohstrukturdaten Effizienzvergleich Verteilernetzbetreiber 3. Regulierungsperiode

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