The Experience with Motorway Tolling in Germany

Werner Rothengatter

Universität Karlsruhe (TH)
The Experience with Motorway Tolling in Germany

- Infrastructure Costing as a Baseline
- Differentiation of the Charges
- Observed and Modelled Impacts on the Environment
Payment System "Toll Collect"
- Fully Allocated Infrastructure Costs of HGV
- Average Costs as Benchmarks (1999/62 EC; 2006/38 EC)
- Differentiation according to Congestion and Environmental Performance of Vehicles
Fully Allocated Costs of the Infrastructure

Basic Principles

- Assumption of a Public Enterprise to Finance and Manage the Infrastructure
- Long-term Assurance of Infrastructure Quality
- Cost = Future Expenditures for Investment, Rehabilitation and Operation (Life Cycle Approach) + Opportunity Costs (Interest on Capital)
- Fairness Principles
## Fairness Principles

### Fair Allocation to Vehicle Categories:
- Causality
- Responsibility for Design Elements
- Participation in Overhead Cost Recovery
- Territoriality Principle

### Fair Allocation to User Generations
- No Shift of Present Costs to Future Generations
- No Shift of Future Costs to Present Generation
Costing Principles

- Bottom-up Life Cycle Analysis
- Compatibility with Long-term Investment Planning
- Compatibility with Optimal Maintenance Programmes
- Compatibility with Long-term Forecasting of Traffic
Right: Level-free intersections are treated as meta-objects, comprising of:
• Engineering works (considered in bridges database)
• Extra pavement for connecting lanes
• Additional land requirement

Left: Road pavement scheme;
• Engineering works (considered in bridges database)
• Extra pavement for connecting lanes
• Additional land requirement
Assessment of net capital value

Databases used:

- ZEB (Zustandserfassung der Bundesfernstraßen) for asset condition of pavement layers and bridges
- Road network and HGV traffic forecasts of the federal investment plan (BVWP)
- Opening dates of motorway sections and tunnels
- GIS-Maps of land use and terrain formation
Statistical Distribution of Asset life Expectancy

- Functional form of probability-distributed life expectancies: Weibull-distribution used in engineering science for quality tests.
- Influencing parameters: Mean and standard deviation of the life expectancy of new assets and age and condition at the beginning of the forecast period.
Cost Elements

- Land Value
- Earth Works
- Layers
- Tunnels, Bridges, Intersections
+ Parking/Resting Facilities
+ Investment Planning and Project Management
+ Update of Land Values to the Base 2005
**Capacity costs**

Earthworks
- New construction
- Major renewal

Base course
- New construction
- Major renewal

Binder course
- New construction
- Major renewal

Surface course
- Major renewal

**Planning, compensation measures, police, winter maintenance ...**

**Runnin costs**

**Axle load costs**

Allocation by equivalent axle loads (vkm weighted by AASHO factors)

**Capacity costs**

Allocation by capacity requirement (vkm weighting factors considering: length of vehicles, acceleration, clearance distance)

**System Auto**

Allocation by axle-kilometres within each system (Auto / HGV)

**System HGV**

Allocation to vehicles by unweighted vehicle Kilometres (vkm)

**1:1-Costs**

Allocation by axle-kilometres within each system (Auto / HGV)
Principles of Differentiation

- Congestion (not Used)
- Environmental Performance - Euro Classes (Used)
- Distance Travelled (Considered)
Development of the HDV Fleet Structure in Germany in the Reference Case 1995 - 2010

Expected development of HGV fleet composition until 2010

- Euro-0 (Pre-Euro)
- Euro-1
- Euro-2
- Euro-3
- Euro-4
- Euro-5

Share of mileage driven (all weight classes, all inter-urban road categories)
### Average Infrastructure Costs, Motorways

#### Tentative Values

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<tr>
<td>Cars and Vans</td>
<td>0.03</td>
<td>0.03</td>
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<td>LGV (-&gt; 3.5t)</td>
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<td>Buses</td>
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<td>0.08</td>
<td>0.09</td>
<td>0.09</td>
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<td>HGV (3.5t - 12t)</td>
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<td>HGV (&gt; 12t)</td>
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Cost Elements

- Kosten Prop.
- Kosten Kap.
- Kosten Sys.
- Kosten Gew.
- Kosten Erhebung

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<td>2005</td>
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<td>2012</td>
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## Differentiation of Tolls 2008

### Tentative Values

<table>
<thead>
<tr>
<th>Toll Category</th>
<th>Emission /Axle Category</th>
<th>€ cts/km</th>
<th>Mill. Veh. Km</th>
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<tbody>
<tr>
<td>Cat. A</td>
<td>EEV/E6/E5/1</td>
<td>13.00</td>
<td>620</td>
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<td>EEV/E6/E5/2</td>
<td>14.30</td>
<td>10,802</td>
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<td>Cat. B</td>
<td>E4/E3/1</td>
<td>15.60</td>
<td>460</td>
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<td>E4/E3/2</td>
<td>16.90</td>
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<td>Cat. C</td>
<td>E3/E2/1</td>
<td>19.50</td>
<td>390</td>
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<td>E3/E2/2</td>
<td>20.80</td>
<td>6,788</td>
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<tr>
<td>Cat. D</td>
<td>E2/E2/1</td>
<td>25.30</td>
<td>62</td>
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<tr>
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<td>E2/E1/2</td>
<td>24.60</td>
<td>1,080</td>
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<tr>
<td></td>
<td>E5/E4</td>
<td>E5/E3</td>
<td>E5/E2</td>
</tr>
<tr>
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<tr>
<td>Differential Charge cts/km; &gt;32 t</td>
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<td>Handbook EC</td>
<td>1.7</td>
<td>4.8</td>
<td>6.8</td>
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<tr>
<td>Progtrans/IWW</td>
<td>2.6</td>
<td>6.5</td>
<td>12.3</td>
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Break-even E3 -> E5 Handbook 80,000 km

Break-even E3 -> E5 Progtr/IWW 60,000 km

Break-even E4 -> E5 Progtr/IWW 50,000 km
Observed and Modelled Impacts on the Environment

- Observed: Change of Fleet Structure on Motorways Significantly Faster than Average
- Observed: Underlying Cost Structure of the Road Haulage Industry
- Observed: Break-even Points for the Change to Better Technology
Observed and Modelled Impacts on the Environment

- Modelled: Change of Vehicle Loading
- Modelled: Change of Logistic Pattern (More Bundling Points)
- Modelled: Diversion to Rail/IWW
Scen. I: Rail Bus. As Usual
Scen. Ila: Rail Bus. As Usual
Scen. Ilb: Rail Efficient
Toll on Motorways only
Toll on All Roads
Toll on all Roads
Observed and Modelled Impacts on the Environment

- Indications: Diversion from Motorways to Secondary Road System
- Indications: Diversion from HGV $\geq 12t$ to HGV $< 12t$.
- Indications: Increased Use of Old Technology on the Secondary Road System