

Universität Karlsruhe Institut für Wirtschaftspolitik und Wirtschaftsforschung



## Motorway User Charges for Heavy Goods Vehicles in Germany: Principles, Magnitudes and Expected Impacts

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#### Overview of cost calculation methodology

- Road asset and transport demand database in line with official German federal investment plan unitl 2015.
- Asset valuation based on current reinvestment costs and observed asset condition
- Cost calculation and allocation differentiated by road segment, region and 21 construction elements.
- Depreciation estimated by using statistical survival probabilities and indicators of traffic-dependent deterioration.
- Cost allocation based on gametheoretical considerations of cost causation and pre-requirements.
- Estimation of emission-depending charges based on dynamic vehicle fleet modelling.







#### **Layers and construction elements**

Binder + surface coarse (8+4cm)

Other main coarse (20cm)

Frost protection layer (ca. 45cm)

#### Underground/ Earthworks

Left: Road pavement scheme;

- Engineering works (considered in bridges database)
- Extra pavement for connecting lanes
- Additional land requirement

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





#### 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





#### **Current condition of concrete bridges** by year of construction



#### Zustandsverteilung kleiner Betonbrücken nach Baujal











### 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.







#### The concept of economic depreciation

 $ABS(t) = NV_{normiert}(t) \cdot W(t) - NV_{normiert}(t+1) \cdot W(t+1) + F_{replace}(t) \cdot W(t+1)$ 

where:

F<sub>replace</sub>:

t:

T:

- ABS: yearly amount of depreciation
- W: selling value for new asset
- NV<sub>norm</sub>: normalizing factor
  - replacement/reinvestment between two points of time
  - year considered.
    - Average life expectancy of the asset
- T<sub>rest</sub>: Remaining life expectancy of the asset

#### **Evolution of capital costs of selected assets with economic** depreciation



1. Equipment, Time-based depreciation.

2. Pavement: Load-based depreciation. Life expectency: 25 years



**3. Bridges: Time-based depreciation.** Life expectrency: 65 years 4. Earthworks/tunnels: Time-based depreciation, Life expectency: 90 years



Interest rate: 4%, price index: 1%, traffic growth 3% p.a.



#### **Composition of running costs**

The running costs correspond to expenditures, which can be taken from fiscal budgets/budget plans:

- Expenditures for current maintenance, repair and equipment
- Expenditures for administration,
- Expenditures for traffic police,
- Expenditures for traffic control (including: Federal Agency for Road Freight Transport) and
- Yearly costs of the payment system for the user (according to information of the MOT).



#### **Cost allocation scheme**







#### **Forecast of traffic volumes**

	2003		2005		2010	
	BAB	BS	BAB	BS	BAB	BS
Vehicle category	Billion v ehicle-km					
Pass. cars	164,7	99,9	170,7	100,3	188,7	105,5
Buses	1,4	1,0	1,5	1,0	1,5	1,0
Motor Bikes	2,1	3,4	2,2	3,5	2,3	3,7
Truck s	24,5	11,8	25,0	12,0	25,8	12,4
Articulated trucks	10,3	2,8	10,8	3,0	12,3	3,3
Other vehicles	2,1	1,9	2,2	2,0	2,5	2,2
Sum	205,2	120,8	212,4	121,7	233,1	128,0



#### **Results (1): Total and average costs by** road class and vehicle type

Cost item	2003	2005	2010
Total cost	7,51	8,03	9,30
Motorways [bill. Euro]			
Total cost	7,74	8,13	9,20
Federal Primaries [bill. Euro]			
Road track cos t HGV	3,40	3,62	4,13
Motorways [bill. Euro]			
Road track cos t HGV	2,28	2,44	2,45
Fed. Primaries [bill. Euro]			
Average cost	15,0	15,4	16,3
HGV, Motorways [ct/km]			
Average cost	29,9	31,1	34,1
HGV, Fed. Primaries [ct/km]			



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#### **Results (3): HGV motorway charges by environmental standard and axle configuration**

Year	Category A	Category B	Category C
2003	EURO-4, -5 + EEV*	EURO-2, -3	EURO-0, -1
2006	EURO-5 + EEV	EURO-3, -4	EURO-0, -1, -2
2009	EEV	EURO-4, -5	EURO-0, -1, -2, -3

\* EEV = Enhanced Environmentally Friendly Vehicle

Year	No. of axles	Category A	Category B	Category C
2003	up to 3	10	13	15
	4 and more	12	15	17
2005	up to 3	11	14	16
	4 and more	12	16	18
2010	up to 3	10	12	15
	4 and more	12	15	18



Payment System ''Toll Collect''















#### **Growth of Rail Freight Traffic Comared with the Reference**

#### Scenario 2010



SG = Goods with logistic Requirements, MG = Bulk Cargo, RV = Regional Transport, BFV = Domestic Transport, GFV = International Transport