Internalisation of Freight Transport External Costs in the Paris-Amsterdam Corridor

Hugues Duchâteau (Stratec)
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1. Context and overview of the study
**Context**

- **New Eurovignette Directive:**
  - Allows the Member States to include external costs in the charge levels (on top of infrastructure costs)
  - and to differentiate the charge levels according to the congestion level
- TEN-T Seine-Scheldt project (project nr 30),

**Furthermore:**
- High priority for decarbonising transport
- Objectives for reducing air pollution, noise and accidents
- Objectives for modal shift from road to IWW and rail
Study overview: aim and scope

Aim:
- Assess the impacts of transport pricing schemes based on social costs
- Strategic EU freight corridor: Paris – Amsterdam (and related regions)

Scope:
- Road, rail and inland waterway transport
- Interurban HLV traffic
- France, Belgium and the Netherlands
The Paris-Amsterdam corridor – 2020 road, rail and IWW networks
The Seine-Scheldt project (TEN-T project 30)

Source: www.seine-scheldt.org
Study overview: funders, partners, timing

Study co-funded by:
- the European Commission (DG MOVE)
- Voies Navigables de France, Réseau Ferré de France (France)
- Service Public de Wallonie, Waterwegen en Zeekanaal (Belgium)
- Ministry of Transport of The Netherlands

Partners involved: two consortia of consultancies:
- Environmental external costs: CE Delft, Alenium, Infras and Max Herry
- Modelling: Stratec and Setec
- plus a Scientific Committee

Timing: September 2009 - December 2010
Study overview: overall approach

- **Overall approach:**
  - Overview of environmental and infrastructure costs
    - *Environmental costs considered are: climate, air pollution, noise, accidents, congestion and ‘upstream’*
  - Overview of existing taxes, charges and subsidies (→ BAU scenario)
  - Development of a freight transport model, which includes:
    - *a mode choice model*
    - *an assignment model able to calculate multimode User Equilibrium as well as System Optimal Equilibrium*
  - Definition of pricing scenarios
  - Scenario simulations and impact analysis
2. The pricing scenarios

- A set of 5 scenarios, including an optimal scenario, two realistic scenarios and an accentuated target-oriented scenario
Scenario overview

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<th>BAU</th>
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<td>Business-as-usual</td>
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<td>Marginal Social Cost Pricing (MSCP)</td>
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<td>Eurovignette extended – Boiteux values</td>
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Note: only the HGV’s are charged, not the light vehicles (private cars and light freight)
Scenario overview: BAU and MSCP

- **BAU- Reference scenario (2020 and 2050):**
  - Current taxes and charges
  - Needed to see the impacts of internalisation policies

- **Scenario 1 – MSCP (Marginal Social Cost Pricing):**
  - Marginal Social Cost for all modes
  - Congestion charges based on model calculations: System Optimum Equilibrium
  - Optimal pricing according to the economic theory (Pigou, Hotelling, ..)
Scenario overview (cont.): Eurovignette

**Scenario 2 – Eurovignette proposal:**
- Based on 2008 Commission proposal (at the time of the study) and in line with the Eurovignette Directive adopted in June-July 2011 (Parliament/Council)
- Focus on road: charging for total infrastructure cost plus air pollution and noise
- Congestion charges based on IMPACT values
- No charges for IWT and rail (BAU situation)
- **Realistic proposal for short term**

**Scenario 3 - Eurovignette proposal – extended:**
- Same as scenario 2 with additional carbon tax on fuel for all modes
- Congestion charges based on model calculations (averages)
- Marginal infrastructure cost + air pollution and noise charges for rail and IWT (like for road – noise only for rail)
- **More collaborative and realistic for medium term**
Scenario overview (cont.): Target oriented

- Scenario 4 - Target oriented
  - Carbon tax of €40 (2020) and €85 (2050) per t CO₂; doubled for road
  - Km-charges for road: twice all infrastructure and external costs: air pollution, noise and accidents
  - Congestion charges for road based on congestion model output
  - Marginal infrastructure and external costs for IWT and rail
  - To test the impact on modal shift of a maximum pricing of road according to the future IWW capacity

- Scenario 5 – Eurovignette proposal – Boiteux values
  - Same as scenario 3, but with French default external cost values from Boiteux (while in scenario 3: external cost values from the IMPACT Handbook)
Methodology for the external costs

- External costs (CE Delft):
  - Climate, air pollution, noise, accidents, congestion and ‘upstream’
  - Unit cost values: corridor values in line with IMPACT handbook (2008)
  - Data on fuel consumption, emissions and load factors made consistent with the traffic model (improvements in 2020 and 2050)
3. The model

- A comprehensive model

- Able to calculate the optimal pricing scenario (Pigovian) against which other scenarios could be assessed
Model overview

- Mode choice model: multinomial logit model (road/rail/IWW) (*shippers behaviour*) – shipper utilities as a function of cost and time – estimated on SP and RP data
- Network models: NODUS (rail and IWW) and SATURN (road) softwares – path choice (*transport operators behaviour*) – transport cost functions depending on transport time and distance
- Demand segmentation in 14 good categories
- Congestion modelling in the Saturn traffic model
Model overview
Saturn road traffic model

- Saturn assignment: equilibrium approach

- Two types of assignment:
  - **User Optimal Equilibrium**: reflects the actual behaviour of the user (each user tends to minimise his generalised transport cost)
  - **System Optimal Equilibrium**: reflects how it would be if each user is charged with his Marginal Social Cost, i.e. the value of the time losses that he causes to all other road users + other external costs
Mode choice and road congestion models

Simulation procedure including the **user optimal** assignment in Saturn

**Preload**
- Road network: Links, nodes, speed-flow curves, tolls, type of region etc.
- Road cost functions (baseline)

**SATURN User Optimal Assignment**
- Link volume, speed and time

**Route choice**
- Costs: Internal costs and BAU taxes, charges and subsidies

**Route Choice**
- Cost and time

**Mode choice** (logit model)
- Updated road O-D demand
Mode choice and road congestion models

Simulation procedure including the **system optimal** assignment and the calculation of the optimal congestion charges

- **Preload**
  - Road network: Links, nodes, speed-flow curves, tolls, type of region etc.
  - Road cost functions (without taxes and subsidies)

- **SATURN System Optimal Assignment** (Wardrop equilibrium)
  - Link volume, speed and time
  - Optimal congestion tolls

- **Route choice**
  - Costs:
    - Internal costs
    - Marginal env + infra costs
    - Congestion costs

- **Skim matrices**
  - Cost and time

- **Mode choice** (logit model)
  - Updated road O-D demand
4.1 Simulation results: congestion cost

Summary

- The marginal congestion costs (MCC) are highly differentiated both spatially and temporally.
- The MCC averaged on the whole network and the whole year (peak hours and off-peak hours) leads to a rather low value ($\approx 3$ Eurocents/HGV-km).
- But in congested areas, the MCC is the highest component of the external costs (MCC $\approx 65$ Eurocents/HGV-km in the Brussels area).
4.1 Simulation results: MSCP scenario
MCC by road section in France - 2020
Motorways – peak hour
MCC by road section in Belgium - 2020
Motorways – peak hour
MCC by road section in The Netherlands - 2020
Motorways – peak hour
Marginal external cost in 2020 for bulk (source: CE Delft + Stratec for the congestion cost)

→ Conclusion: In (highly) congested areas, the congestion cost is by far the largest component of the road external cost.
4.2 Simulation results: scenario impacts

Summary

- Significant modal shift:
  - about 15% increase in IWW and rail volumes (tons) in the Eurovignette scenario
  - up to +30% tons by IWW and 25% by rail in the target-oriented scenario
- Significant reduction in CO$_2$ emission:
  - about 20% in the Eurovignette scenarios
- Significant reduction of external costs:
  - up to 14% in the Eurovignette scenarios
- Higher revenues
  - twice BAU revenues in Eurovignette scenarios
Impacts on the modal repartition (tons) in the corridor in 2020

- SC1 - MSCP
- SC2 - Eurovignette
- SC3 - Eurovignette extended
- SC4 - Target oriented
- SC5 - Eurovignette extended with Boiteux values

Relative change in tons compared to BAU:
- IWT
- Road
- Rail
Impacts on traffic volumes (vehicle-km) by mode in the corridor in 2020

![Graph showing relative change in veh-km compared to BAU for different SC scenarios in IWT, Road, and Rail.]

- SC1 - MSCP
- SC2 - Eurovignette
- SC3 - Eurovignette extended
- SC4 - Target oriented
- SC5 - Eurovignette extended with Boiteux values
Impacts on CO₂ emissions in 2020

Reduction in CO2 emission (well-to-wheel) : -17% and -21 % in the Eurovignette scenarios, -39 % in the target-oriented scenario

Source: CE DElft
Impacts on external costs in 2020

Source: CE DElft
Conclusions

About methods:
- Availability of tools to simulate optimal pricing scenarios and then compare politically/technically feasible scenarios to the optimum

About policies:
- Pricing policy fits well in long term strategy for reducing environmental damages due to transport (among others, for decarbonizing transport) and other external costs