CONGESTION PRICING: A SOLUTION OR A PROBLEM?

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1. Objectives

- Discuss the nature of Road Congestion from the operational and efficiency point of view;
- Discuss the nature of Congestion as an externality and the eventual justification of Road Pricing based on that nature;
- Discuss the right approach to define a new paradigm and institutional framework to deal with congestion:
  
  “Road & Land Use Congestion Pricing”
2. What is indeed Road Congestion?

**A. Operational approach**

System effectiveness is guaranteed and/or acceptable till LOS E and F are reached.

**B. Efficiency approach**

System may be inefficient even in LOS A, if Price=MCost is not guaranteed from the beginning.
3. Congestion charges: individually priced, but a collective endeavour?

Price = Individual Social Marginal Cost?

In the name of Economic Efficiency? ...
Assuming:

- Price must be defined at the individual level;
- At that level the delays imposed by each of us over the other road users have characteristics of externality – that’s true!

Having in mind that:

- First order impacts of congestion are not an external cost for the Society, because all costs are supported inside the Road Users Group (unlike Air Pollution, for instances).

A big question arises:

- Who is the owner of the Propriety Rights of the ‘efficiency Revenue’;
- Who should decide and benefit from Road Pricing Revenue, as there is no Damage Cost to recover!
Example (Using the Bureau of Public Works function (BPR, USA)):

Data:
- Motorway
- Free-flow speed = 120 km/h
- Capacity = 2,400 pcu/h
- Flow = 2,000 pcu/h
- Speed = 112 km/h
- Total travel time = 53,6 min

\[
V(q) = \frac{V_0}{1 + \alpha \left( \frac{q}{\text{Cap}} \right)^\beta}
\]

Results:
- Average Delay Time (ADT) = \( T/T_0 \) = 3,6 min
- Marginal Delay Time (MDT) = ADT \( \cdot \) \( \beta \) = 14,4 min

- Using a composite Value of Time (VOT_c) = 17,5 Euros/hour

- Average Delay Cost (ADC) = ADT \( \cdot \) VOT_c = 1,05 €/100 vkm
- Marginal Delay Cost (MDC) = ADC \( \cdot \) \( \beta \) = 4,20 €/100 vkm

- Using MDC for Road Pricing purposes > Revenue (4 hours x 220 days) = 7,392,000 €/100km.y

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Example (cont.)

Additional flow regimes:

A. High quality for users - LoS A
- Flow = 300 pcu/h
- Speed = 120 km/h
- Total travel time = 50 min
  (no delays at all!)

F. Saturated and unstable flow - LoS F
- Flow = 1200 pcu/h
- Speed = 18 km/h
- Total travel time = 5 h and 41 min
  (only occurs very occasionally, like in the 1st of August)

Results:
- Average Delay = Marginal Delay = 0
- No congestion cost or pricing at all

Results:
- ACT = 291 min  /  MCT = 441 min
- ACC = 84,99 €/100 vkm  /  MCC = 120,11 €/100 vkm
  - It’s better not to present global pricing results!
(On the branch F the Greenshield function was used as the BPW function is not possible to use)

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Example - generalization

Using a generalization of Bureau of Public Works (BPR, USA) function:

\[
V(q) = \frac{V_0}{1 + \alpha \left( \frac{q}{Cap} \right)^\beta}
\]

Where:
- \(V_0\) is the free-flow speed
- \(q\) is the traffic flow
- \(Cap\) is the capacity
- \(\alpha\) and \(\beta\) are constants

### Table: Type of Road

<table>
<thead>
<tr>
<th>Type of Road</th>
<th>Free-flow Speed (V_0) (km/h)</th>
<th>Capacity (pcu/h)</th>
<th>(\alpha)</th>
<th>(\beta)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Routes (IPs) and motorways</td>
<td>100</td>
<td>2000</td>
<td>0.42857</td>
<td>3</td>
</tr>
<tr>
<td>Other Complementary Routes (ICs) and quality</td>
<td>90</td>
<td>1800</td>
<td>0.42188</td>
<td>2.7</td>
</tr>
<tr>
<td>National Roads (EN's)</td>
<td>70</td>
<td>1200</td>
<td>0.7</td>
<td>3.5</td>
</tr>
<tr>
<td>Other National Roads and quality Regional Roads</td>
<td>50</td>
<td>900</td>
<td>0.65217</td>
<td>3.5</td>
</tr>
<tr>
<td>Other Regional (ER's) and Municipal Roads (EM's)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(PETS, 1999)

Very simple – everyone can compute marginal cost. For a trip:

1. Identify de free-flow travel time \((T_0)\) – for instances, by travelling at night;
2. Identify de peak-hour travel time \((T)\) – not difficult!
3. Average Delay Time (ADT) = \(T - T_0\)
4. Marginal Delay Time (MDT) = \((T - T_0) \times \beta\)
5. To obtain costs one have just to multiply by the Value of Time (VoT)

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4. What kind of global paradigm?

Where to start from and what are the complementary and contrary principles?
Different (opposite?) Pricing Principles …

**A. BAU Motorway Pricing Principles …**

Motorway seen as a Value Added service:
- Improved travel time;
- Improved safety;
- Improved comfort

Simple to understand * simple to accept

**B. Road Pricing as an efficiency tool …**

Each time Demand grows:
- Travel time deterioration;
- Loss of comfort and reliability
- Improve Economic efficiency;
- Release Environmental pressure

Not understandable (counterintuitive) nor accepted by Users
Quality of Service (QoS) main drivers:

- Traffic Level of Service (LoS A, ..., F);
- Trip reliability targets (very important for freight);
- Safety targets;
- Comfort and Quality Pavement targets;
- Operational effectiveness (improving overall mobility);
- Energy targets;
- Environmental targets;
- Economic efficiency targets (marginal cost pricing);
- Financial targets (transport accounts and cross-subsidisation).
Traffic Quality driver – *Levels of Service (LoS)*

LoS A  LoS C  LoS E

LoS B  LoS D  LoS F

HCM, (2000)
Operational (user) paradigm:
1. Maximize users Utility (fast travel!)

Efficiency (MCCost) Paradigm:
1. Marginal cost almost null
2. Marginal cost and revenues very significant
3. Marginal cost will be unacceptably high – almost impossible to apply

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LoS A
LoS C
LoS E
LoS B
LoS D
LoS F

2. Maximize Volume (flow) and Network Mobility
3. Unstable saturated flow; Unpredicted trip arrival

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5. Will Congestion Pricing become an acceptable and even interesting solution for road transport?

- **Inter-urban and Rural Transport**
  - Pricing ruled by Quality of Service contractual targets;
  - Users must understand price as a compensation for Value Added services

- **Urban Transport** (more complex)
  - Road Pricing implies cost amounts very high (individual and global);
  - There is the need to find new solutions
- Directions to explore (next research steps):
  - Find solutions to transfer part of Congestion obligations from Road Users to Real Estate and Propriety, relieving pressure from Roads (and Road Pricing).
  - Share Road Pricing obligations between Travel and Land Use >> new concept: “Road & Land Use Pricing”;

- Opportunity to introduce a new taxation paradigm allowing:
  - “Road & Land Use Pricing” optimization, using Land Use as congestion generation seeds and for shared accountability;
  - Introduction of structural changes in taxes and charges for these economic sectors to fit the new concept of “Road & Land Use Pricing” and eventually to find new solution for the inevitable transition from fossil fuels to renewable energies.
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THANK YOU!

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