CONGESTION PRICING POLICIES: ANALYSIS AND DESIGN FOR THE REAL CASE STUDY OF ROME

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"Pricing Policies" are all those measures that require motorists to pay a sum to use a road space.

**Main objective** → to link road transport externalities directly to travelers producing them.

Road pricing policies can be classified according to different aspects, such as:
METHODOLOGY

1. Definition of the scenarios in terms of the project variable (FEE)
2. Scenario simulation (based on a multimodal transport assignment)
3. Computation of Network Statistics (RM, VEH-KM, VEH-H, V_m, E)
4. Definition of O.F & comparison between K scenarios

O.F.: $C_{TOT,k} = \gamma \cdot CA_k + \alpha \cdot E_{tot,k} + \beta \cdot C.CONG_k \quad k=1,2,...,K «scenarios»$

with:
$CA_k(VEH-KM_{pubTr}, VEH-H_{pubTr}, C_{management})$  $C.CONG_k (VEH-KM_{priv}, VEH-H_{priv})$
STUDY CASE (CITY of ROME)

<table>
<thead>
<tr>
<th>VEHICLE</th>
<th>ROME</th>
<th>PROVINCE</th>
<th>TOT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOPED</td>
<td>50.2%</td>
<td>65.1%</td>
<td>50.2%</td>
</tr>
<tr>
<td>Pub.T. VEHIC</td>
<td>15.4%</td>
<td>8.5%</td>
<td>15.4%</td>
</tr>
<tr>
<td>PEDESTR.</td>
<td>28.8%</td>
<td>25.8%</td>
<td>28.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% VALUES</th>
<th>ABSOLUTE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL TRIPS</td>
<td>577,424</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T. AREA [KMQ]</th>
<th>POP.</th>
<th>EMPLOY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROME</td>
<td>1285</td>
<td>2.9 M</td>
</tr>
<tr>
<td>PROVINCE</td>
<td>4071</td>
<td>1.4 M</td>
</tr>
<tr>
<td>TOT.</td>
<td>4.3 M</td>
<td>4.3 M</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPEED AVERAGE [Km/H]</th>
<th>MIN</th>
<th>MAX</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROME</td>
<td>10</td>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>PROVINCE</td>
<td>56</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

Figura 4.2 Rappresentazione flussi di scambio (hdp mattina); fonte: PGTU di Roma
HYPOTHESIS OF CORDONS:

Area of Cordon 1 = 22 km² ca.
7% Inhabitants, 22% Employees

Area of Cordon 2 = 40 km² ca.
14% Inhabitants, 34% Employees
### ASSESSMENT of the POLICY EFFECT (in terms of MODAL SHIFT):

- $\Delta% \, D_{VEH} \, \text{inside the Ring}: \, -15\%$  
  (in the Urban Context)
- $\Delta% \, D_{VEH} \, \text{inside the Ring}: \, -16,5\%$  
  (in the Provincial Context)
- $\Delta% \, D_{VEH} \, \text{City of Rome}: \, -2\%$
- $\Delta% \, D_{VEH} \, \text{Province of Rome}: \, -1\%$
- $\Delta% \, D_{VEH} \, \text{Suburban Zones}: \, +1\div2,5\%$  
  (in a single zone)
NETWORK EFFECTS
## SINGLE FEE FOR ALL USERS (CORDON 1 & CORDON 2)

\[ FEE = 4 \times FEE_{BASE \ YEAR} \]

\[ FEE = FEE_{BASE \ YEAR} \]

\[ FEE = \frac{FEE_{BASE \ YEAR}}{4} \]

## PRICING FOR C2 + PENALTIES FOR USERS WITH HIGH ACCESSIBILITY (RAIL RING)

Only users served by Rail System:

- Penal. = \( 4 \times FEE_{BASE \ YEAR} \)
- Penal. = \( 3 \times FEE_{BASE \ YEAR} \)
- Penal. = \( 2 \times FEE_{BASE \ YEAR} \) (for ALL users)
DEFINITION OF OTHER SCENARIOS

ZONING WITH AREAS SERVED BY RAIL SYSTEM:

[Description of the map showing different zones and areas served by the rail system]
RESULTS

COMPARISONS IN TERMS OF MODAL SHIFT: ATTRACTED TRIPS (URBAN RAIL RING: Cordon 2)

- **MODAL SHIFT (%) - PRIVATE MODE**
  for ATTRACTED TRIPS (C2)

- **MODAL SHIFT (%) – PRIVATE MODE**
  for ATTRACTED TRIPS inside C2

- **MODAL SHIFT (%) - TRANSIT MODE**
  for ATTRACTED TRIPS (C2)

- **MODAL SHIFT (%) – TRANSIT MODE**
  for ATTRACTED TRIPS inside C2
RESULTS

COMPARISONS IN TERMS OF MODAL SHIFT: GENERATED TRIPS (URBAN RAIL RING: Cordon 2)
RESULTS

COMPARISONS IN TERMS OF «O.F.» VALUES:

\[ O.F.: \ C_{TOT,k} = \gamma \cdot C A_k + \alpha \cdot E_{tot,k} + \beta \cdot C.CONG_k \]

\[ k=1,2,...,K \text{ «scenarios»} \]

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**OF TREND (Urban Rail Ring – C2)**

Increase of private modal shift

- «Auto» for those OD pairs located on opposite sides with respect to the pricing area;
- «Moped» on short distances;

**despite a total reduction can be observed at whole province level.**

**In order to appreciate the same phenomenon in the railway ring, the fee should be further increased.**
RESULTS

COMPARISONS IN TERMS OF «O.F.» VALUES:

**OF TREND: C₂ + PENALTIES FOR OD WITH HIGH ACCESSIBILITY**

\[ F.M.O.: C_{TOT,k} = \gamma \cdot C_A + \alpha \cdot E_{tot,k} + \beta \cdot C_{Cong_k} \]

**C. CONG. TREND: C₂ + PENALTIES FOR OD WITH HIGH ACCESSIBILITY**

\[ C_{Cong_k}(VKM_{tot}, VH_{tot}) \]

**E TREND: C₂ + PENALTIES FOR OD WITH HIGH ACCESSIBILITY**

**CA TREND: C₂ + PENALTIES FOR OD WITH HIGH ACCESSIBILITY**

\[ C_{Ak}(VETT-KM, VETT-H, C_{gestione}) \]
Assessment on policy effectiveness, in terms of modal shift, showed that:

- the adoption of the fee essentially affects the pricing zones and the effect is the greater the higher the amount of the fee applied;

- in external areas, especially for high distance origin-destination pairs, there is an increase in private demand, due to the unloading of vehicle’s flow on specific routes;

  The FO study indicates that the problem is complex !!

In terms of reducing atmospheric emissions, the overall benefit for the city is quantified:

- in 2% of reduction if analysed in the whole city;
- in 25% of reduction if analysed in the downtown areas subject to charging.
CONCLUSIONS & DISCUSSIONS (2/2)

Additional aspects that should be taken into account to ensure that such a mobility management application is effective include:

- the ability to implement the pricing policy for concentric areas by modulating the amount of the fee;
- the possibility of charging even the mopeds, so as to avoid a modal split towards this type of vehicle;
- the possibility of reorganizing public transport lines and the upgrading of urban rail lines to a metro service, especially in peripheral areas;
- the ability to use new technologies so that the amount of the fee can be varied according to the actual trips that the user makes.
Thanks for the attention!