Engel, Fischer, and Galetovic, "Toll Competition Among Congested Roads."

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Main Points

- Show a simplified, linear version of the model.
- Discuss conclusion: in oligopoly, tolls are socially too high, meaning congestion is socially too low.
- Discuss some other applications beyond competing toll roads.

Social Optimum: MB = MPC + all externalities

- Generalized travel cost on road $i = toll plus travel time: p_i+c_i(q_i)$
- Note road 2 could be longer, narrower, etc. (c₂ would be higher)
- Cars flow onto all roads to equalize *market* travel demand with each road's cost: $B(Q) = p_i + c_i(q_i)$ for all i





Assignment: Demand

- Let $B(Q) = I q_1 q_2$
- Let costs be $c_1(q_1)=0.3q_1$ and $c_2(q_2)=0.5q_2$
- Then market "flow" onto the roads implies

$$I - (q_1 + q_2) = 0.3q_1 + p_1$$
$$I - (q_1 + q_2) = 0.5q_2 + p_2$$

Solve simultaneously for demand functions

$$q_1(p_1,p_2) = 0.53 - 1.58p_1 + 1.05p_2$$

 $q_2(p_2,p_1) = 0.32 - 1.37p_2 + 1.05p_1$

Assignment: Oligopoly Tolls

- Each firm maximizes profits $\Pi_i = p_i q_i$
 - Note that costs are for consumers
- Firm I reaction function is

 $p_1(p_2) = (0.53 + 1.05p_2)/3.16$

- Note, strategic complements
- Optima are p₁ = 0.24, p₂ = 0.21, q₁ = 0.37, q₂ = 0.28
- So TMC on road I is $p_1 + 0.3q_1 = 0.24 + 0.11 = 0.35$

Social Optimum

- A social planner would maximize
- $\int B(v)dv q_1c_1(q_1) q_2(c_2)$
- i.e. total benefits to all drivers minus total congestion costs
- Social planner FOCs are
- $B(Q) c_1(q_1) q_1c_1' = 0 \Rightarrow B(Q) = 0.3q_1 q_1 \times 0.3 = 0$
- $B(Q) c_2(q_2) q_2c_2' = 0 \Rightarrow B(Q) = 0.5q_2 q_2 \times 0.5 = 0$
- So at oligopoly equilibrium with $q_1=0.37$, the external congestion cost on road 1 is $q_1 \times 0.3 = 0.111$.
- Thus, the toll is too high, and congestion is too low.

Other Applications

- Are competing toll roads likely?
- Other infrastructures where people/goods "flow" based on congestion
 - Railroads, airlines, electric grids, pipelines, communication networks
- Facilities where people dislike congestion
 - Golf clubs, swimming pools, beaches, amusement parks, nature parks, etc.
- Maybe some natural resources like fisheries, oil patches where overuse/overextraction raises everyone's cost
- Maybe some medical and other public service facilities where waiting is a big part of the cost