Auctioning concessions for private roads

Barry Ubbels
Erik Verhoef

vrije Universiteit amsterdam

Background

- MD-PIT research project
- Institutional aspects of pricing: private versus public provision of infrastructure
- Conceptual analysis using small theoretical model, simple network
- Relevant: e.g. privately operated pay-lanes

Overview

- Investment in road infrastructure
- Theoretical simulation model to analyse various criteria in an auction organised by the government
- Sensitivity analysis
- Conclusion

Investment in road infrastructure

- Public involvement in financing and operation of roads is very large
- Renewed interest in private financing due to increased efficiency and public deficits
- Governments want to keep control: regulative measures such as maximum toll rates
- Alternative: regulation through auctioning

Previous Studies

- Simple network: one origin and one destination connected by one or more parallel roads
- Consequences of different pricing regimes (first-best, second-best, profit maximisation): e.g. Marchand (1968), Verhoef and others (1996)
- Capacity included (not only toll) by Yang and Meng (2000), focus on welfare consequences in BOT framework
- Tsai and Chu (2003) study two regulation alternatives (min. flow and max. travel cost) under BOT

Theoretical simulation model

- Analysis of private highway investment: auction for the right to operate road
- Welfare consequences of different criteria set by government in defining the auction
- Two link network (tolled and untolled route), capacity and toll free to choose
- Single demand function and two average user cost functions (free flow, congestion (varying with capacity) and toll)

Assumptions

- Government is unaware of optimal capacity and toll or exact demand and cost functions, but knows VOT of road users
- To concentrate on performance of different types of indicators:
  - Competitive bidding: zero profit for winning firm
  - Identical bidders
- Objective of government is to maximize social surplus
- Auction: firm's objective as specified by indicator

Numerical example

- Base case (current situation with only one road)
- First-best optimum
- Second-best optimum
- Maximum profits
- Index of relative welfare improvement: ω => welfare benefits of situation under study as a fraction of the maximum obtainable welfare benefits

Numerical example: Auctions

Zero (net) subsidy

- Auction 1:minimize generalized price (c+toll) on route T
- Auction 2: maximize capacity of route T

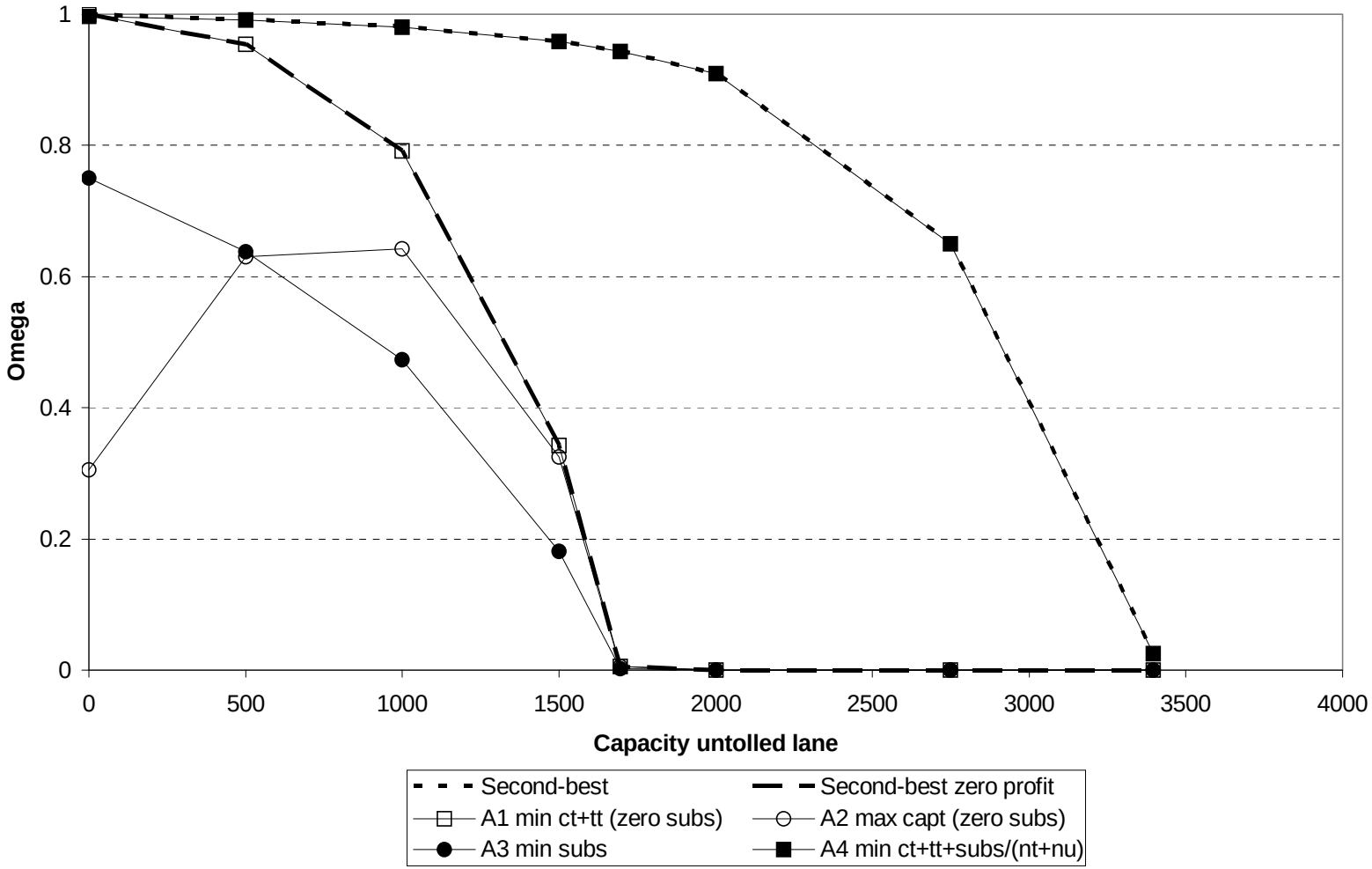
Non-zero (net) subsidy

- Auction 3: minimize subsidy
- Auction 4: minimize generalized price and subsidy divided by total traffic demand

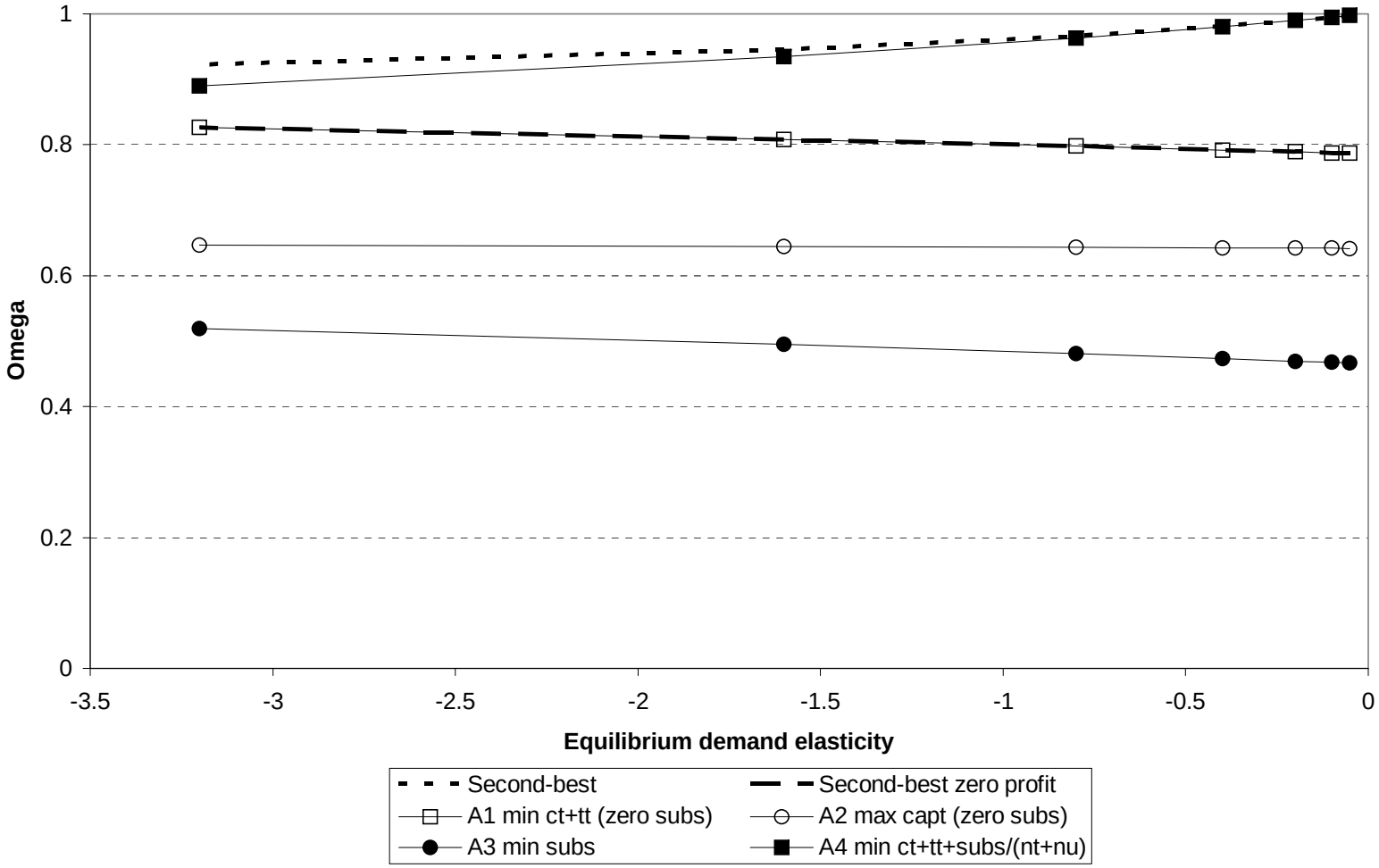
Outcomes

Scenario	N_t	N_u	cap_t	cap_u	W	π_t	t_t	t_u	sub	ω
Equilibrium	0	1000	0	1000	48000	0	0	0	-	-
First-best	757	316	2395	1000	57621	0	6.32	6.32	-	1
Second-best	786	345	2486	1000	57439	-4519	0.57	0	-	0.98
Second-best (zero profit)	441	632	1395	1000	55621	0	6.32	0	-	0.79
Profit maximization	221	816	697	1000	52553	811	10	0	-	0.47
Auction 1	441	632	1395	1000	55621	0	6.32	0	0	0.79
Auction 2	360	700	1800	1000	54180	0	10	0	0	0.64
Auction 3	221	816	697	1000	52553	0	10	0	-811	0.47
Auction 4	810	325	2561	1000	57430	0	0.17	0	4980	0.98

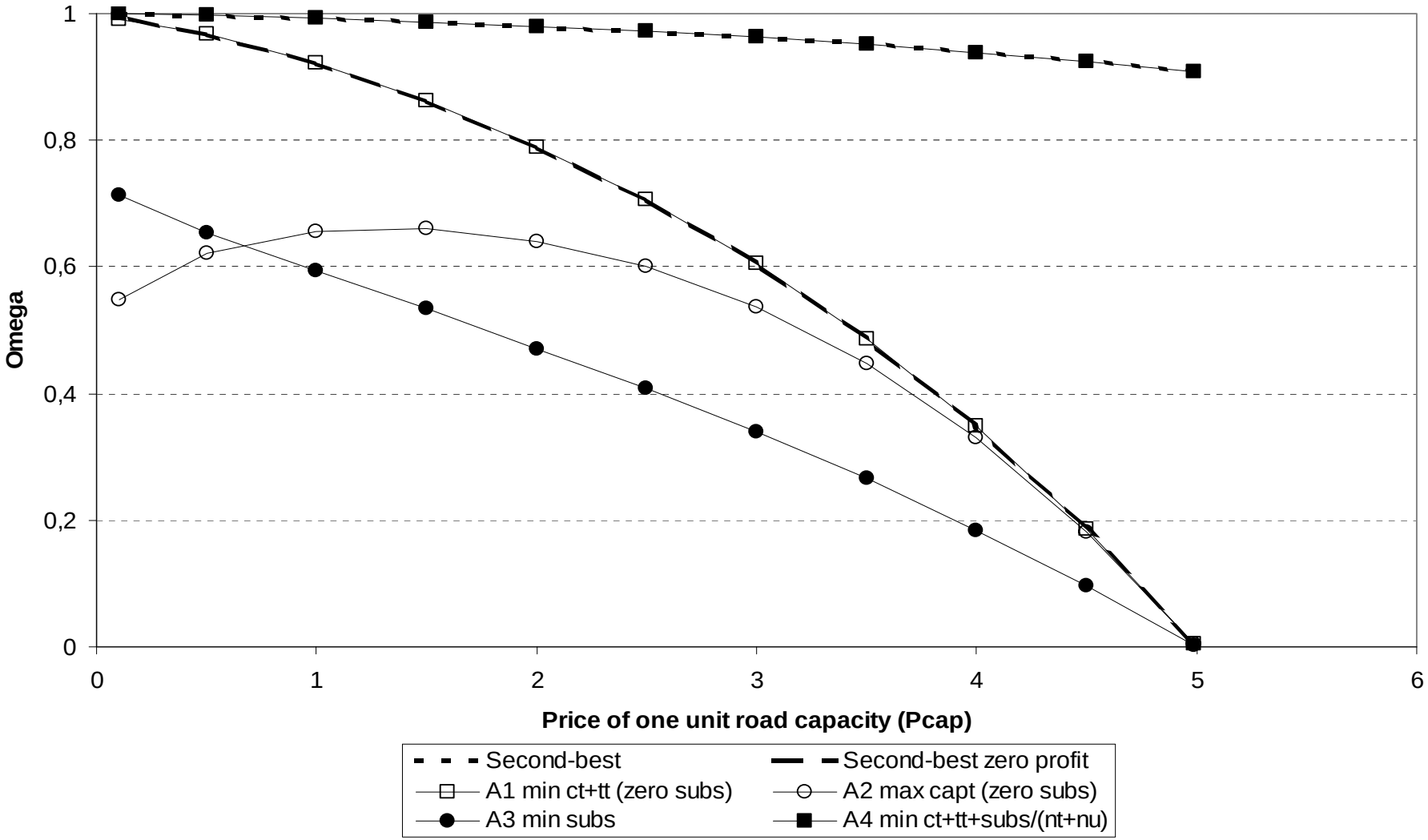
Capacity of existing (untolled) lane



Equilibrium demand elasticity



Varying the price of road capacity



Limitations of Analysis

- Static world
- Serious offers by private firms
- Equal firms with one price of capacity
- No collusion between firms

Conclusions (1)

- Design of auction ("indicator") major impact on relative performance
- Minimisation of travel cost and subsidy divided by total travel demand performs relatively best
  - very close to second-best
  - requires (as second-best) a positive subsidy
- Indicator should include travel times, toll level and lump-sum subsidy

Conclusions (2)

- The prevailing demand structure is not a crucial factor (robust results for different demand elasticities)
- High prices of capacity lead to lower welfare gains (lower capacities and less users); auction 4 performs best and may be particularly useful in urban areas
- When initial road capacity increases, relative efficiency declines for all cases
- Simplifying assumptions, but results remain relevant to governments organising auction