A bilevel modelling approach to service network design and pricing: Application to intermodal transportation

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Owing to its ecological and economic potentials, intermodal freight transportation has drawn a wide interest in the scientific and political community. Nevertheless, it remains strongly challenged in the EU market, failing to attract the desired customer levels, with vital research questions remaining overlooked.

In this work, we examine the intrinsically related problems of designing freight carrying services and determining their associated prices as observed by the shipper firms, in the context of intermodal networks. More specifically, a path-based bilevel model is proposed for a medium-term planning horizon. At the upper level, in the quest of profit maximization, an intermodal operator jointly selects the frequencies and prices of his services, whilst, at the lower level, the shippers optimally react by deciding on their demand volumes to send over the intermodal itineraries and an always available all-road alternative. Frequency delay constraints are considered as well, in order to capture the impact of the service reliability on the market penetration.

Finally, to increase the realism of our study, we integrate behavioral concepts in the expression of the lower level as a logistics costs minimization problem. In particular, a random utility model is adapted for this purpose, based on results coming from specially designated revealed preference exercises. Exact tests are invoked on real-world instances to demonstrate the feasibility of the presented approaches.

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