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Designing Hub and Spoke Transportation Systems for a Competitive Environment ⋆

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Abstract

In this paper, we consider the design of large-scale hub-and-spoke transportation networks in a competitive environment. We adopt the hub arc location model that locates arcs with discounted transport costs connecting pairs of hub facilities. Two firms compete for customers in a Stackelberg framework where the leader firm locates hub arcs to maximize its revenue, given that the follower firm will subsequently locate its own hub arcs to maximize its own revenue. Two mechanisms are presented to allocate traffic between the two firms based on the relative utility of travel via the competing hub networks. Results with up to three hub arcs for each competing firm show the role of a competitive environment in designing transportation systems.

Key words: Location, Transportation, Competitive Hub Location

1 Introduction

Hub-and-spoke networks play an important role in many transportation systems. These networks provide efficient transportation between many origins and destinations (e.g., cities) via a set of hubs that serve as switching and flow consolidation points, hub arcs that connect two hubs with a discounted travel cost, and access arcs that connect the non-hub nodes and hubs. Hub networks use fewer arcs than in a point-to-point network and thus can reduce transportation costs by exploiting the economies of scale from consolidated flows. The large, and growing, literature on hub location research is summarized in Alumur and Kara [1] and Campbell et al. [2]. Nearly all hub location research has been directed at finding an optimal (or near-optimal) hub network for a single firm to serve a given set of demand specified as flows between many origins and destinations.

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