International Journal of Industrial Organization 48 (2016) 118–142

Contents lists available at ScienceDirect

International Journal of Industrial Organization

www.elsevier.com/locate/INDOR

Convenient flight connections vs. airport congestion: Modeling the 'rolling hub'

Jan K. Brueckner [a,*], Ming Hsin Lin [b,1]

[a] *Department of Economics, University of California, Irvine, 3151 Social Science Plaza, Irvine, CA 92697, United States*
[b] *Faculty of Economics, Osaka University of Economics, 2-2-8 Osumi, Higashiyodogawa-ku, Osaka 533-8533, Japan*

ARTICLE INFO

Article history:
Received 31 October 2015
Revised 1 April 2016
Accepted 2 June 2016
Available online 16 June 2016

Keywords:
Rolling hub
congestion
layover
hub-and-spoke

ABSTRACT

This paper provides the first analysis of the trade-off between convenient flight connections and airport congestion, a fundamental but untreated element in the economics of hub-and-spoke networks. A continuous spatial model illustrates this trade-off in a framework where a small gap between flight operating times raises congestion while also shortening a connecting passenger's layover time. When the passenger's cost per unit of layover time rises, the monopoly airline chooses to narrow the gap between its flights, yielding shorter layovers but more congestion. A discrete spatial model, where flights congest one another only if they operate in the same discrete period, makes this layover-cost effect discontinuous: the monopoly carrier concentrates (deconcentrates) its flights when this cost is high (low) relative to the costs of congestion. When fringe carriers are present, however, the hub carrier always concentrates its flights, either partially or fully. But the presence of a second hub carrier leads to an equilibrium mirroring the monopoly outcome: the carriers concentrate their flights in different periods when the layover cost is

* Corresponding author. Tel.: +1 9498240083.
E-mail addresses: jkbrueck@uci.edu (J.K. Brueckner), linmh@osaka-ue.ac.jp (M.H. Lin).

[1] We thank Yongmin Chen, Jiawei Chen, Achim Czerny, Ricardo Flores-Fillol, Tomohiko Kawamori, Kangoh Lee, and a referee for helpful comments. Any errors, however, are ours. Financial support from JSPS KAKENHI Grant Number 16K03681 (to Ming Hsin Lin) is gratefully acknowledged.

http://dx.doi.org/10.1016/j.ijindorg.2016.06.004

high and deconcentrate them otherwise. The paper also presents a welfare analysis, showing that movement from the equilibrium to the social optimum typically requires greater carrier separation.

1. Introduction

After decades of operating hub airports with flight arrivals and departures concentrated in "banks" that facilitate short layover times for connecting passengers, American Airlines in 2002 "depeaked" its hubs, shifting to what it called a "rolling hub" concept. Starting with the Chicago hub, flight operations were spread out, lengthening layover times, with the goal of reducing congestion and improving operational performance, thus saving costs. At the time, American's CEO Donald Carty stated that "[o]ur Chicago experience has improved customer service, reduced costs, improved productivity and allowed us to fly the same schedule with the equivalent of five fewer aircraft and four fewer gates." But Mary Fagan, an American spokesperson, noted that "[if] you're connecting, it may mean an [extra] delay of 10 to 12 min," pointing to longer layovers (both quotes are from Carey, 2002).

While Delta and United Airlines followed American's lead in adopting rolling hubs, recent years have seen a reversal of this trend. Hub carriers have mostly "rebanked" their hubs, abandoning the rolling-hub concept. Current American CEO Scott Kirby, quoted by Jean (2015), stated that "although the continuous [rolling] hub lowered operating costs, the lost revenue outweighed the savings," with the revenue losses apparently due to the lower number and timeliness of possible connections. Indeed, Marilyn DeVoe, vice president of American's Miami hub, stated that "[o]ur hubs are all about connecting people, and rebanking allows us to do that more effectively" (Jean, 2015).

Although there is now a large theoretical literature on airport congestion,[2] analytical treatment of the trade-off underlying the rolling hub (connection convenience vs. airport congestion) is mostly absent. Since this trade-off is a fundamental element in the economics of hub-and-spoke networks, the omission constitutes a major gap in the network literature. While Mayer and Sinai (2003) argue that hub congestion is the price we pay for convenient connections, and Katz and Garrow (2014) provide evidence on the cost and revenue consequences of depeaking, more work is needed.[3]

The purpose of the present paper is to provide such an analysis. The goal is to develop formal frameworks where the rolling-hub trade-off is clearly illustrated and to explore the implications of the resulting models. The paper constructs and analyzes two related

[2] Following Daniel (1995) and Brueckner (2002), the literature in the area has expanded substantially. See Basso and Zhang (2007) for a survey.

[3] Brueckner (2005), Flores-Fillol (2010), and Lin (2013) analyze congestion in hub-and-spoke networks without considering the layover-time issue.