Grant Hoffman

The University of Vermont

Airlines Improve Economies of Density by Diverting Flights and Adding Connections

Airline Merger Effects on Airline Network Characteristics and Flight Fares

The Delta-Northwest Airline Merger of 2009

MOTIVATION: The airline industry has become increasingly oligarchic after several airline mergers have taken place as industry regulatory pressures have lessened. Airlines have since been able to rationalize their routes and gain more price setting power. Evidence of what the mergers have done to airfares is important in providing clarity for regulators and businesses.

BACKGROUND: Delta announced their merger with Northwest Airlines in 2008 and completed it in 2009. This project analyzes the effect of the merger as an extension of four other works; Brueckner and Spiller 1991, Bruckner et. al. 1992, Hüschelrath and Müller 2014, and Kawamori 2013

METHODS:

- Quarterly data on domestic flights from 2007Q1 – 2011Q4 given by DOT D1B1 Survey
- Network created with airports as nodes
- Different network for each quarter of flights
- Network is directional and is weighted by number of passengers.
- Eigenvector centrality is calculated for each airport in each route for each quarter
- Differences-in-Differences model is estimated with fixed effects on time and origin-destination pair
- Market fare and market fare growth are dependent variables
- Regression controls for route competition, market share at each stop, and the interaction between stop market share and eigenvector centrality

RESULTS:

- Regression results indicate that changes in eigenvector centrality result in significant changes in fares.
- Fares are raised or lowered based on where along the route the eigenvector centrality is increased.
- If the centrality of the origin or destination airports is increased, market fares increase, reflecting increased demand.
- If the centrality of the layover airport is increased, market fares decrease, reflecting improved economies of density.

Table (1) Market Fares Regression Analysis

	Origin-Destination Pair and Time Fixed Effects			
	Market Fare[1]			Market Fare Growth[2]
	(1)	(2)	(3)	(4)
Passengers[3]	0.10* (0.05)	0.06 (0.05)	0.80*** (0.07)	0.02*** (0.001)
Competition[4]				
Direct	−10.62 (35.50)	−22.82 (35.30)	−14.52 (34.98)	−0.47 (0.67)
Delta Better	−1.86 (35.12)	−16.68 (34.93)	−5.63 (34.63)	−0.30 (0.66)
Northwest Only	−18.93 (38.33)	−6.00 (38.14)	−3.20 (37.76)	−0.26 (0.72)
Northwest Better	−24.43 (35.67)	−38.03 (35.48)	−29.47 (35.14)	−0.77 (0.67)
Market Share[5]				
Origin		−0.02** (0.01)	−0.01** (0.01)	−0.001*** (0.0001)
Destination		−0.01* (0.01)	−0.01 (0.01)	−0.0005*** (0.0001)
Layover		−0.06 (0.36)	−0.20 (0.40)	−0.001 (0.01)
Eigenvector Centrality[6]				
Origin		35.09*** (6.09)	52.84*** (6.17)	0.77*** (0.12)
Destination		29.37*** (6.10)	47.21*** (6.18)	0.67*** (0.12)
Layover		−41.72*** (6.19)	−39.13*** (8.49)	−0.79*** (0.16)
Centrality * Market Share[7]				
Origin			−10.12*** (1.30)	−0.16*** (0.02)
Destination			−10.82*** (1.29)	−0.16*** (0.02)
Layover			1.36 (4.17)	0.02 (0.08)
Observations	9,855	9,855	9,855	9,855
R^2	0.001	0.02	0.04	0.03
Adjusted R^2	−0.14	−0.12	−0.10	−0.10
F Statistic	2.43**	13.17***	25.02***	21.08***

Note: *p<0.1; **p<0.05; ***p<0.01

1. Average market fare for any flight with each OD pair for each quarter
2. The natural log of average market fare.
3. The average number of passengers per itinerary for each OD-pair
4. Competition type dummies with *Delta Only* as the default
5. Market shares for each airport in the itinerary for the OD-pair
6. Eigenvector centrality of each airport in the itinerary for the OD-pair
7. The interaction term for market share and eigenvector centrality

Figure 1:

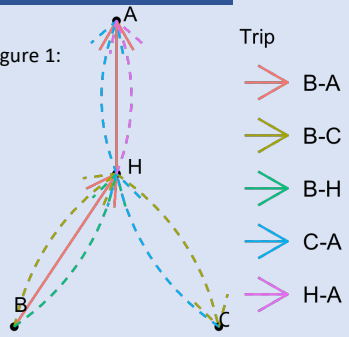
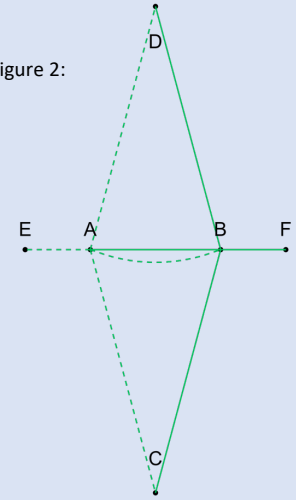
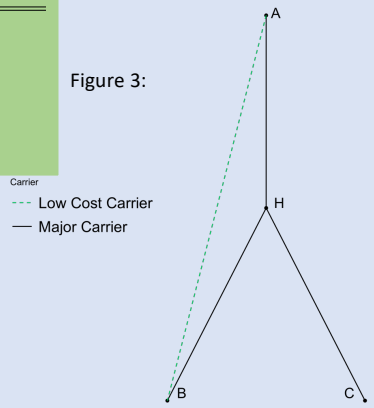


Figure 2:



Carrier 1 2

Figure 3:



Take a picture to download the full paper

EIGENVECTOR CENTRALITY, ECONOMIES OF DENSITY, AND THE HUB-SPOKE MODEL

Economies of Density:

- Describes the gains made from increasing density of use
- Many costs associated with offering a flight are not per passenger but per flight:
  - Plane
  - Crew
  - Gate rents and other fees, etc.
- Increasing passengers per flight decreases costs per passenger

The Hub-Spoke Model

- Airlines may attempt to adopt a hub-spoke model to take advantage of economies of density.
- Figure 1 shows a simple hub and spoke model.
- Using the model, the carrier offers only flights to and from the hub H.
- Travelers going from B->A, B->H, and H->A are now on the same two flights B->H->A
- Travelers going B->C and C->A are also tacked on the first and second legs respectively.
- By using the model, the number of flights has decreased from 24 to 18.
- However, because travelers often prefer direct flights competitors can undercut these plans. As detailed in figures 2 & 3.

Eigenvector Centrality

- Eigenvector centrality is a measure of network prominence.
- Essentially, it is a weighted sum of all the connections that a particular node has.
- Each node is weighted by its weighted sum of connections in an iterative process.
- The more eigen-central the node the better it will be at improving economies of density as the hub.