Rethinking Hub versus Point-to-Point Competition: A Simple Circular Airline Model

Christopher Ball*
Department of Economics
Quinnipiac University

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Abstract:
This paper argues that, if consumers care about travel time, then for shorter routes point-to-point (P2P) structures are faster and thus more efficient than the hub-and-spoke (H&S) structure. This runs counter to most of the theoretical literature on airline networks which predicts P2P carriers can't compete with hub carriers. Some data on Southwest airlines, the most well known P2P carrier, is used to call into question the standard theoretical models. A simple circular airline model is presented which predicts that any P2P carriers could capture up to 64 percent of the market share and have higher profits. The model implies that by pursuing P2P routes small firm entrants can successfully compete against the larger players in the airline industry.

JEL Classification: L93 - Air Transportation, L10 – General: Market Structure, Firm Strategy, and Market Performance

* Christopher P. Ball, Department of Economics, Quinnipiac University, 275 Mount Carmel Avenue, Hamden, CT 06518-1965. Phone: 203-582-8745 , Fax: 203-582-8664; Email: christoher.ball@quinnipiac.edu
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Section 1: Introduction

Reading the recent theoretical literature on airlines leads one to think as follows. Economies of density lower costs for hubbed firms. Consequently the hub-and-spoke (H&S) structure emerges as the optimal choice in any framework where firms compete and can choose their structure (Reiss and Spiller, 1989, Hendricks, Piccione, and Tan 1995, 1997, 1999). Thus, H&S networks dominate the landscape of airline structures. A corollary to this is that non-H&S competitors, be they regional (Hendricks, et al., 1997) or point-to-point (P2P) (Hendricks, et al., 1999) cannot compete head-to-head with H&S carriers. The argument that densities lead to lower costs and thus H&S firms beat out P2P firms in competition is compelling. Pursuing that line of reasoning has been critical to our understanding of much of the modern airline industry.

But densities and hubs-and-spokes cannot be the whole story. The problem is that most major airlines have continually struggled and recently been on the verge of (or beyond) bankruptcy. The glaring exception is Southwest Airlines, a P2P carrier.

Southwest (SW) does not use a H&S structure, yet has long been recognized as the lowest unit cost airline, flying directly in the face of the density-leads-to-lower-costs argument. Severin Borenstein noted this anomaly in discussing the cost estimates of Caves, Christensen and Treheway (1984) when he wrote "Caves, Christensen, and Tretheway identify average flight length as the most significant cause of costs heterogeneity, but Southwest actually has shorter average flight length than USAir, implying that Southwest should exhibit higher costs" but does not (Boreinstein, 1992, p.61) This is common knowledge in the industry and among consumers as witnessed by reports from the popular press (Michaels and Trottman, 2004, Trottman, 2004, and Maynard, 2005) and the U.S. Department of Transportation (Office of Aviation and International Affairs, 2003). Nevertheless, many authors continue to appeal to Caves, Christensen and Treheway's work as one of the foundational pieces of evidence in support of the density and distance lead to lower costs arguments (see Berry, Carnall and Spiller, 1996, Oum, Zhang, and Zhang, 1995, Brueckner and Spiller, 1991, Hendricks, et. al, 1995, 1997, and 1999 for some prominent examples).

SW's P2P challenge could perhaps be dismissed if it had not been so successful over such a long period of time (since 1973). SW has persistently offered flights at much lower prices than its competitors and maintained these low prices for extended periods of time while earning positive accounting profits[1]. All of the densities-based arguments seem to overlook SW's use of a non-hub structure, its continued success and the current low-cost carrier "revolution" sweeping not only the US (e.g., Jet Blue and Spirit) but also worldwide (easyJet and Ryanair in Europe, Air Deccan and others in Asia, and Gol-Intelligent Airlines in Latin America).

It is thus problematic that most theoretical models begin by assuming densities of scale so that hubs will always turn out to be the lowest cost/highest profit choice. This eliminates the P2P option *a priori* so that these models aren't really models of network choice. Brueckner and Spiller's work is an early and cognizant example of this. "In the absence of economies of density, the airline would provide nonstop connections between each pair of cities. In the presence of such economies, however, the monopolist has an

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[1] "2004 marked Southwest's 32nd consecutive year of profitability" (Office of Aviation and International Affairs, 2004).

incentive to operate a H&S network." (Brueckner and Spiller , 1991, p. 326) They continue by focusing on H&S structures exclusively. Many other examples abound.[2]

When trying to model hubs, assuming densities of scale makes sense. In that regard the literature has been very helpful. The perspective of this paper is different. It takes the view that something may have been overlooked by focusing too much on hubs. Most hubbed firms have been in and out of financial ruin since deregulation. Over that same time period non-hubbed firms have slowly increased in number and SW in particular has climbed to a dominant, prominent and very profitable position. Furthermore, hubbed firms have begun to offer short-haul P2P flights in attempts to keep the P2P airlines like SW at bay. P2P structures appear today to be growing in popularity and dominance. That the H&S firms have repeatedly attempted to imitate the P2P firms – not the other way around as standard theory would suggest – ought to tell us something.

The objective of this paper is to offer a first step explanation of how an airline like SW, offering P2P service, can successfully invade the market of a hub-based airline. First, no density of scale assumption is made. Next, a simple circular network model is presented. It shows that if consumers care about flight time, then a P2P flight pattern is faster and thus preferred for short-haul flights while a H&S arrangement is faster and thus preferred for long-haul flights. Both carrier types exist in equilibrium.

The model is related to a circular-city model (Salop, 1979) by solution technique only. If we imagine that H&S airlines place their hub at the center of a circle, then they must fly passengers from points on the perimeter of the circle to other perimeter points by flying them first through the center. This means that the flight distance between any two of the perimeter cities is always twice the circle's radius. P2P firms fly along the perimeter and thus have a natural flight-time advantage for flights between any two cities that are close together. Flying to a central hub first would be slower than flying directly between the cities themselves.

Firms enter Bertrand competition when they compete and act as monopolies in markets with potential entrants otherwise. There are only two firms: one H&S and one P2P firm. Because of their structures one firm is always able to underbid the other in Bertrand competition in the sector where they have natural flight-time advantages. Thus, the H&S firm captures the long-haul market and the P2P firm captures the short-haul market, assuming marginal costs are otherwise equal. Different marginal costs could be

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[2] Hendricks, et al (1995, p. 84) ""...[I]f economies of density are sufficiently large, the total costs of satisfying a given set of travel demands may be lower in the hub-spoke network than in a point-to-point network. ... We then investigate necessary and sufficient conditions for hub-spoke networks to be a solution." Hendricks, et al (1999, pp. 1407-1408): "The focus in this paper is on competition between two large carriers who are unrestricted in their choices of networks. We investigate the conditions under which hub-spoke networks are equilibria." Yet, (Hendricks et al., p. 1408) "[e]conomies of density are modeled by assuming that a carrier incurs fixed costs in establishing a network and that these costs exceed the potential profits in a point-to-point network, even if the carrier is a monopolist. Consequently, carriers have to pool travelers with different origin and destination cities on the same flights in order to make a profit." Again, they assume their own conclusion and search for conditions to support it.

accommodated, but it is not clear to me which firm should be given the cost advantage in general and thus neither is.

While this model shows why SW can easily capture the short-haul market and why a H&S competitor is unable to Bertrand compete with it in that market, it does not explain why the H&S firm cannot change strategies and offer direct flights to compete with SW in the short-haul market. Indeed most of SW's major competitors have tried this. In 1994, for example, United Airlines openly attacked SW's western market by launching the "United Shuttle" which made direct flights. With the collapse of Russian Aeroflot, United Airlines was the largest airline in the world, was seven times the size of SW in terms of gross revenues per year and had appropriated $1,000,000,000 in on-hand cash available to cross-subsidize its efforts against SW. Despite this and similar attacks – all of which have failed – SW has maintained approximately 60% of any short-haul market in almost every nonstop city-pair market it serves and is the only US airline to earn a profit every year since 1973 (Freiberg and Freiberg, 1996).

The paper proceeds as follows. Section two provides a brief overview of Southwest Airlines. Section three develops a simple model and uses it to explain how a P2P firm can take a given percentage of a "circular" market dominated by a H&S firm. Section four concludes.

Section 2: The Southwest Challenge – Rethinking Hub Efficiency

This section presents some basic information about SW and its major H&S competitors. The intention is to review some of the evidence on which the "Southwest Challenge" to H&S dominance arguments is based.

SW started operations in 1971 as a regional Texas airline. According to *Southwest Online* (www.southwest.com), SW is also the largest US carrier based on scheduled domestic departures today. This kind of success is hard to reconcile with the claim that P2P structures are less efficient.

A brief look at some data is sufficient to call the claims of the pro-H&S model into question. As a first thought, if hub firms are more efficient and have lower costs than P2P carriers, then they should be able to charge lower prices. This is one of the theoretical arguments for why H&S firms drive their short-haul competitors out of the market. Graph 1 presents Department of Transportation price data from the third quarter of 1996 until the third quarter of 2004. The data gathered include flight routes, flight distance and the name of the lowest fare carrier for approximately 1,000 domestic flights. (Table A1 in the Appendix contains a data table with more airlines.)

[INSERT GRAPH 1]

SW always dominates. It is the lowest fare carrier more frequently than its major carriers. When compared to other H&S firms, the difference is even more stark[3]. The carriers included in Graph 1 were those with the next largest shares of low fares after SW. On average, from 1996 to 2004, SW's share of low fares is 113 percent higher than the carrier with the next largest share (lowest at 56 percent in 2000 and highest at 201 percent in 2004). Clearly the benefit of hubbing does not lie in the ability to charge low prices.

Graph A1 in the Appendix presents the frequency with which Jet Blue, the other prominent P2P carrier, was found to be the lowest fare carrier. Jet Blue started in 2000 and its share has been growing over time.

That hubbed firms don't always offer the lowest fares, however, is nothing new. As Borenstein wrote in 1992 (p. 54) " [t]he value of H&S networks for the cost savings they offered was recognized before deregulation, but few saw that hubs would also be valued for the market power that they permit." A firm with market power will not charge the lowest price possible, but rather the profit maximizing price. Market power should correspond to higher profits. Lack of evidence supporting the benefits of hubs in terms of low prices might even have been expected based on the market-power argument. But, the benefits should then show up in terms of higher profits.

Table 1 presents data from the Air Transportation Association on annual net profitability. Calculated here is simply the percent of the years 1987 – 2003 when the airline had *positive* net profits. Not necessarily large, just positive. The industry average (average of American, Continental, Delta, Northwest, United and US Air) is only 56% while SW's is 100%. That is, most of the industry's hubbed firms are profitable just more than half the time. Not only that, SW is the *only* carrier in the United States that has been profitable 100% of the time. Of course, if average profits were higher for hubbed firms despite a few bad years then the argument that high hub profits are behind their dominance could still hold. The last column of Table 1 indicates that this is not the case. For the major hub firms as a whole, average profits were actually negative. Not only aren't the market-power profits present, but standard economic theory would suggest that firms ought to be exiting this market or at least switching firm type.

[INSERT TABLE 1]

The New York Times (Maynard, 2005) reports that major hubbed airlines have increasingly struggled to compete in recent years and "major airlines have added 134 nonstop routes in the last year"[4]. They report that major airlines offering new nonhub routes are: Delta – 34, Northwest – 39, US Airways – 25, Continental – 16, and American – 10. P2P firms reported to be adding hubs this year – 0. It seems that hub firms are attempting to mimic the P2P carriers rather than the other way around. Perhaps enough years of negative average profits are having an effect.

This phenomenon is not restricted to domestic carriers. Low-cost, short-haul airlines are challenging formerly dominant hub firms world wide. In Asia there are Air

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[3] See: Table A1 in the Appendix.

[4] The author uses nonstop and nonhub interchangeably.

Asia (Malaysia), One-Two-Go and Thai AirAsia (Thailand), Valuair (Singapore), Lion Air (Indonesia) and Air Deccan (India). Europe has Ryanair (Ireland), easyJet (United Kindgom), and DBA (Germany). The trend is spreading to Latin America as well. Prior to Brazil's new short-haul P2P airline Gol Intelligent Airlines, starting up in 2001, its founder/chairman and chief executive visited operations at Southwiest and JetBlue in the United States and easyJet in Europe (Alva, 2005). They openly examined the hub versus P2P choice and chose the P2P structure.

A snapshot glance at the latest data confirm that the story continues in terms of costs, revenues and profitability. Table 2 presents data on the major hub and P2P carriers in the United States for 2004 and the first Quarter 2005. The quarterly numbers for 2004 are averaged for an annual figure.

[INSERT TABLE 2]

Table 2 shows that revenue per seat, sometimes used as a measure of output, was 36% lower on average for the P2P carriers than the H&S firms in 2004[5]. By this measure that the P2P carriers are smaller. The unit costs – 46% lower for P2P – and profits – 207% higher for P2P firms – suggest that the comparative story remains unchanged. When compared to P2P firms, revenues for the H&S firms are higher, costs are higher still and as a result profits are lower (actually negative). The claimed benefits of H&S simply are not present in any form.

When the airline market was deregulated in 1979, most major airlines began developing hubs. It was thus natural that economists should focus on understanding these structures. Our theory and empirical research since that time has striven to do so, but the data presented here suggests it is time to move beyond the focus on hubs and begin rethinking the hub vs. P2P choice. The following section presents a simple model that assumes no initial advantage to hubs in terms of costs or profits. It then looks at the results when a hubbed firm and a P2P firm compete in a Bertrand duopolistic market. The results seem to be in line with the data about SW and its H&S competitors.

The Model

Firms maximize profits by competing for consumer flyers. There are only two firms in this model. The first represents the traditional, H&S airline. The second represents the P2P airline. When both firms are in a market they engage in Bertrand competition.

The H&S firm is thought of as having a hub located at the origin *(0,0)* of a Cartesian plane where each spoke is a line extending from the origin. The P2P firm flies

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[5] Table 2 only presents the P2P low-cost carriers. The results hold in general for all 7 firms as presented in Appendix Table A2. The only exception is in the operating profit category where some of the non-P2P low cost carriers airlines suffered losses along with the non-P2P major airlines.

directly between cities without stop. The operating cost side of each firm is de-emphasized here. In particular, the H&S firm is not assumed to have lower costs due to economies of density. The P2P firm is likewise not assumed to have lower costs due to complementarities resulting from its simplified approach. This leaves neither firm with an operational cost advantage, allowing focus to be kept on other aspects of their competition.

Suppose these two firms, *a* and *b*, are competing for flights among *n* cities, each placed an equal distance apart along the perimeter of a unit circle. At each point on the circle, there are *1/n* cities. If consumers are interested in lower flight time, then the perimeter firm has an absolute advantage over the hub firm for short flights around the perimeter up to the point where perimeter flights have distance equal to *2*, which is the distance from any point to the center and then out again (i.e. twice the radius for a unit circle). Along the perimeter, the distance between any two cities is $2\pi/n$ where π is the number pi. Upper case pi, Π, denotes profits.

For short flights, consumers are indifferent between the two firms when

$$(1) \qquad P^{a1} + t\left(\frac{2\pi}{n}\right) = P^{b1} + 2t$$

where *t* is the transportation cost to consumers and superscripts *a1* and *b1* denote the prices firms *a* and *b* offer to fly one city away (hence the superscript "1"). Firms will bid P^{b1} to zero according to Bertrand competition. Setting P^{b1} to zero in equation (1) and solving for P^{a1} gives the price the perimeter firm offers as a function of the number of cities and *t*, transportation cost: $P^{a1}=2t(n-\pi n)/n$

At each city there are *1/n* consumers demanding to go *n-1* places. Thus, the demand at any given city to fly short flights with *n* cities is *(1/n)(n-1)* times 2 since flights go in both directions around the circle. Multiplying this by the price yields the perimeter firm's profits assuming zero marginal cost.

$$(2) \qquad \Pi^{a}(n) = 2t\left(\frac{n-\pi}{n}\right)\left(\frac{2(n-1)}{n}\right)$$

As an example, suppose there are 4 cities placed on a clock (i.e., one at noon, one at 3 o'clock, one at 6 o'clock, and one at 9 o'clock as shown in Figure 1). Then from noon, there are three cities to fly to, jumping one city at a time (and assuming no one flies to the city from which they also depart). This is true from each of the cities, so there are 12 possible flights. Plugging *n = 4* into profit equation (2) yields $\Pi^{a}(4)= 2t[(4-\pi)/4][2(4-1)/4]=.64t$.

[INSERT FIGURE 1]

The center firm, however, will capture the market for all those consumers wishing to fly directly across the circle. For the longer flight, price P^{a} will be bid to zero through Bertrand competition. The consumer is indifferent when

(3) $P^a + t\pi = P^b + 2t$

where π is the distance half way around the perimeter of the circle (i.e. ½ time 2π). Note also that the superscripts have been dropped denoting all flights more than one city away. Setting P^a to zero, we can solve for $P^b = t(\pi - 2)$.

There will be $1/(n-1)$ consumers wishing to cross through the hub, times the population at each point, $1/n$, times the total number of cities, n. Altogether this yields demand of $1/(n-1)$ for the center firm. Firm B's profit function is then

(4) $$\Pi^b = \frac{t(\pi - 2)}{n-1}$$

Again, for the case of $n = 4$, $\Pi^b(4) = (1/3)t(\pi-2) = .38t$.

Clearly then, for the $n = 4$ case, $\Pi^a > \Pi^b$. The perimeter firm actually earns a profit Π^a greater than Π^b for all $n \geq 3$. This can be seen by noting that the perimeter firm will always capture all of the market up to the point where the perimeter flight distance equals 2 (twice the radius or hub-flight distance). This can be found be solving for x in $x(2\pi) = 2$ where 2π is total distance and x is the percent of the market captured. Solving for x yields $x = 1/\pi = .32$ or approximately 32% of the market. Since consumers can fly in both directions, multiply this by 2 yielding approximately 64% of the market to the perimeter firm for n large.

The model thus predicts that both firms remain in existence and specialize in the markets where they have a flight time advantage. That both types exist and the P2P firm has higher profits is consistent with Table 1. The prediction that the P2P firm captures 64% of the market is surprisingly close to the 60% share that SW takes of any direct market it enters (Freiberg and Freiberg, 1996).

The model also suggests that the P2P firm should capture the shorter haul market by charging a lower price on those flights. Graph 2 (built from Table A3 in the Appendix) presents the percent share where SW was found to have the lowest fare broken down by flight distance.

[INSERT GRAPH 2]

On the shortest haul flights (0 – 200) SW has the lowest fare nearly 50 percent of the time. The percentage drops over distance in line with the predictions of the circular model. That the circular model is too simplistic is reflected in Graph 2 in two ways. First, the percentage of lowest fares isn't 100 percent and then dropping to zero after 1536 miles (64% of 2400 and disregarding longer flights) as in the model.. And, second, there is an increase in the percentage around the 1601 – 1800 mile marker. This increase remains entirely unexplained. It warrants future empirical and theoretical investigation.

The model also predicts that H&S firms should offer lower fares at higher distances. Graph 3 presents some data to this effect as well. The data here are from the major carriers minus SW. Again, the trend seems to be in the correct direction with the percent of lowest far offerings occurring for longer rather than shorter flights. The mirror image of SW's unexpected increase in shares around 1601 – 1800 miles is captured here as well by an unexpected downturn.

[INSERT GRAPH 3]

The model presented here is intended as a first step in rethinking hubs versus P2P competition. It is simple enough to keep the intuition clear and direct. Nevertheless, the predictions seem generally in line with the data. Further research and more sophisticated models are needed from here.

Conclusion

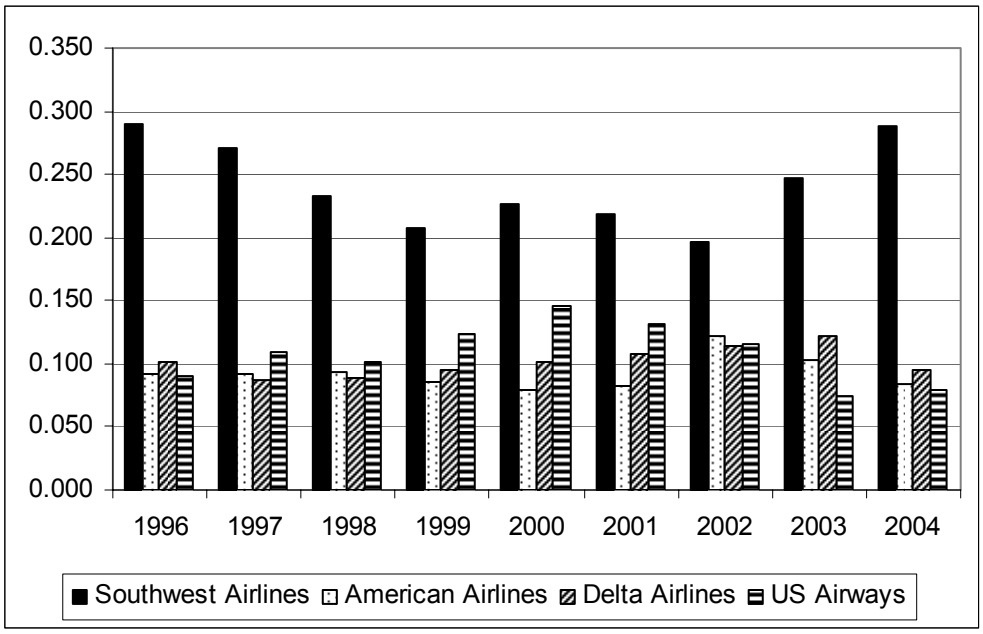
When the airlines were deregulated in 1979 few predicted that so many airlines would develop a hub and spoke (H&S) network structure. To understand the dominance of this structure, economists have focused much of their theoretical and empirical efforts on understanding the emergence of H&S dominance. This paper suggests that we might have been focusing so much on hubs that many of us have completely overlooked (or at least underestimated/predicted) the slow progression toward point to point (P2P) networks.

First some basic data was presented that calls into question the dominance of hubbing in terms of prices, costs, revenue and profits. It was argued that Southwest (SW), the best known of the P2P carriers, has outperformed the major hub firms by almost any measure. Additionally, hub firms tend to mimic P2P structures rather than the other way around as H&S theory would suggest. This was further evidenced by the emergence of an increasing number of short-haul, low cost carriers around the world, some of which have openly copied SW's operations.

A simple circular network model was then presented to demonstrate how P2P carriers can capture market share by exploiting their flight time advantage for short hauls. The model predicted that P2P carriers should capture approximately 64% of the market by offering lower prices for the shorter flights and have higher profits than H&S carriers. The P2P firm doesn't have an advantage for longer flights and the hub firm captures that portion of the market by offering lower prices. Some basic data were then presented showing that SW actually captures approximately 60% of any market it enters and that it tends to offer the lowest fare most often the shorter the flight distance while hub firms tend to offer the lowest fare more often the longer the flight distance.

Graphs and Tables

Graph 1: Percent Airline Was Lowest Fare Carrier By Year



Note: Constructed from Table A1. Data Source: Department of Transportation's Quarterly Passenger and Fare Information "Domestic Airline Fares Consumer Report" from 1996 Q3 until 2004 Q3.

Table 1: Net Profitability from 1987 – 2003

Airline	Percent of Profitable Years	Average Net Profits ($000)
American	65%	-$124,604
Continental	47%	-$134,592
Delta	53%	$31,794
Northwest	65%	$121,775
United	65%	-$284,951
US Air	41%	-$305,544
Southwest	**100%**	**$240,124**
Industry Average (less Southwest)	56%	-$116,020

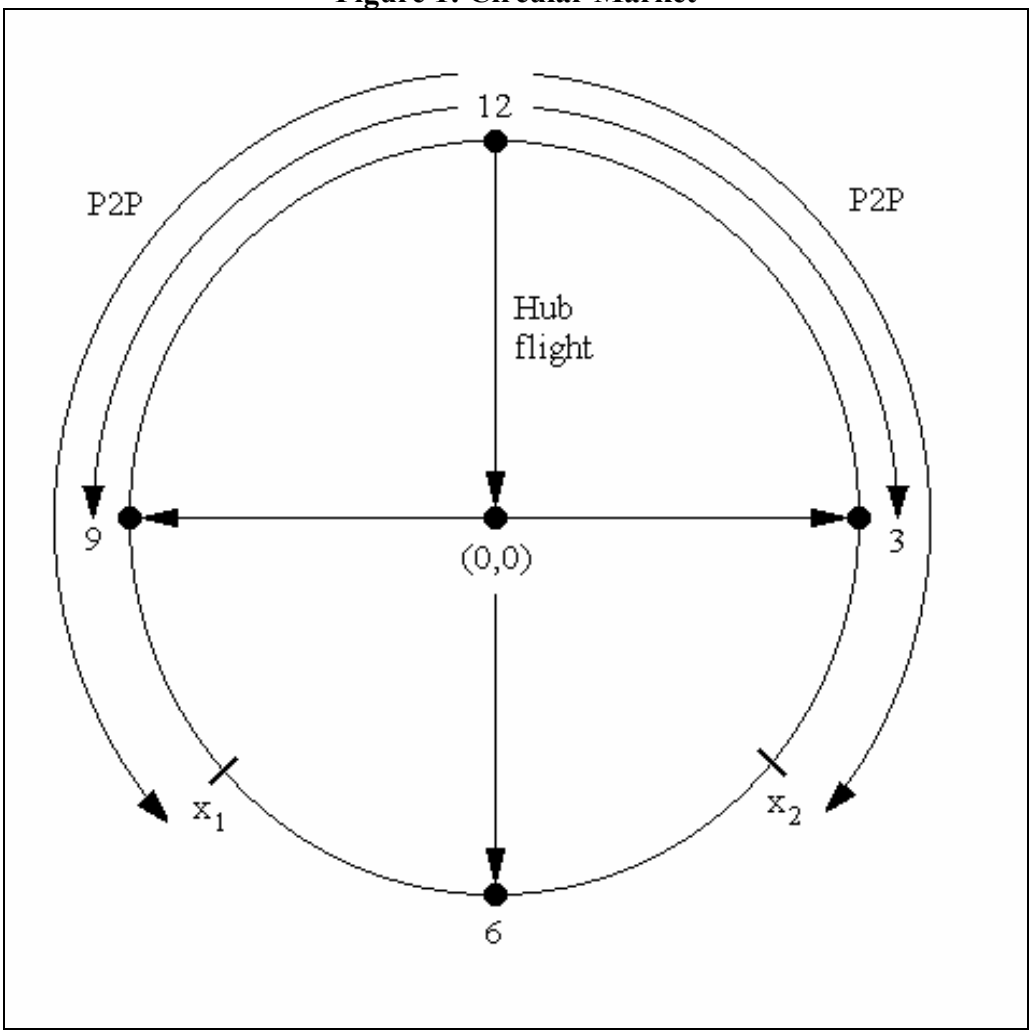
Source: Air Transport Association, Economic Reports 1988 – 2004. Calculations by author and based on Net Profits as reported by ATA.

Table 2: Hub vs. P2P Carriers in US, 2004 and Q1 2005

	Revenue per Seat	Unit Costs	Operating Profit (%)	Revenue per Seat	Unit Costs	Operating Profit (%)
	2004			Q1 2005		
	Network Carriers			Network Carriers		
Alaska	10.2	10.6	-3.8	9.9	11.4	-16.0
American	10.4	11.2	-8.8	10.8	11.3	-4.7
Continental	11.1	12.2	-9.2	14.1	15.8	-12.0
Delta	12.3	13.9	-12.5	12.0	13.7	-13.6
Northwest	13.7	14.0	-2.2	13.7	15.1	-10.4
United	11.2	12.6	-11.8	11.4	12.2	-6.9
US Airways	14.6	15.8	-8.4	13.0	14.8	-13.9
Average	**11.9**	**12.9**	**-8.1**	**12.1**	**13.5**	**-11.1**
	P2P Low-Cost Carriers			P2P Low-Cost Carriers		
JetBlue	6.8	6.2	9.1	7.2	6.7	6.9
Southwest	8.5	7.8	8.3	8.2	7.7	6.4
Average	**7.6**	**7.0**	**8.7**	**7.7**	**7.2**	**6.7**
% Difference	**-36%**	**-46%**	**207%**	**-37%**	**-47%**	**160%**

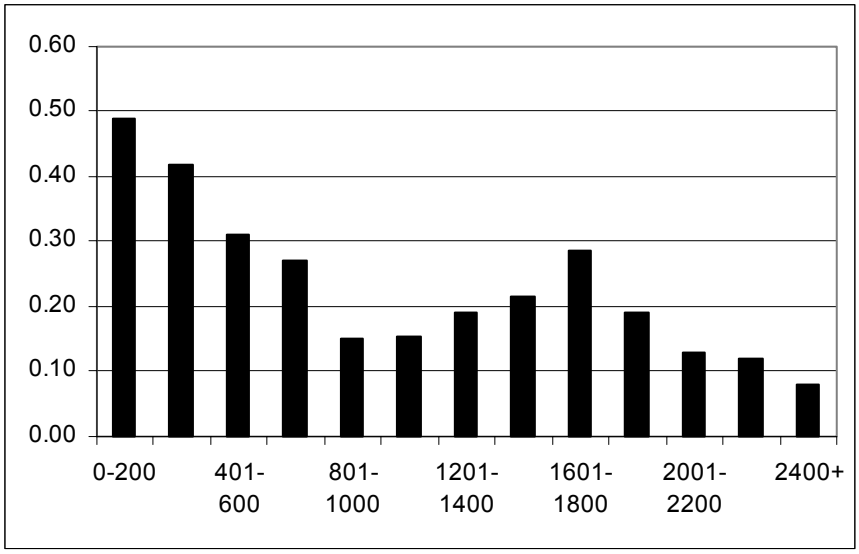
Notes: "Revenue per Seat" - Domestic Operating Revenue Per Available Seat Mile, "Unit Costs" - Airline Domestic Unit Costs (Cents per Mile), "Operating Profit (%)" - Domestic Operating profit/loss margin (% of Total Operative Rev). Sources: (Operating Profit Data): BTS, Form 41, Schedule P1.2 ; (Cost and Unit Revenue Data): BTS, Form 41, Schedule P1.2. T100; T2 Data.

Figure 1: Circular Market



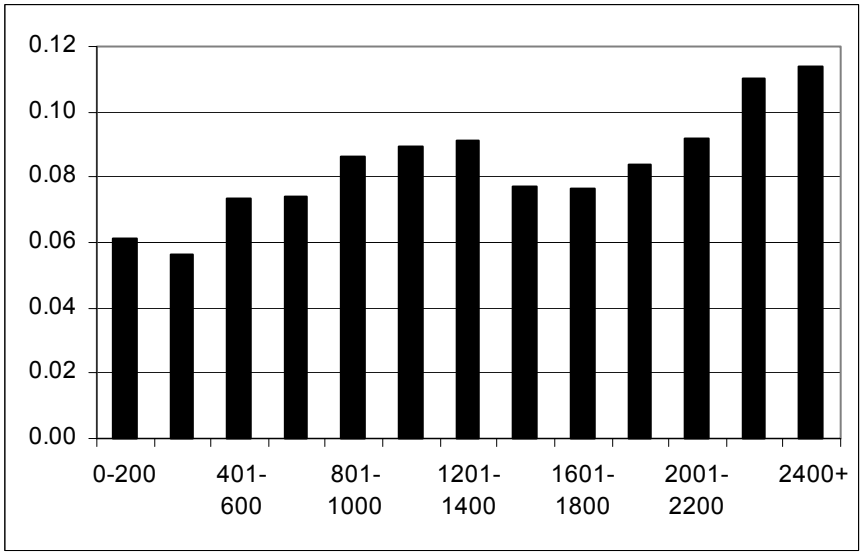
Starting at 12 o'clock, the P2P carrier can fly in both directions. The hub firm must fly through the center. The P2P carrier thus has a natural flight time advantage over the hub firm for all flights up to x_1 and x_2 which together constitute 64% of all flights.

Graph 2: Average Southwest Share of Lowest Fares by Distance, 1996 – 2004



Note: Constructed from Table A3. Data Source: Department of Transportation's Quarterly Passenger and Fare Information "Domestic Airline Fares Consumer Report" from 1996 Q3 until 2004 Q3.

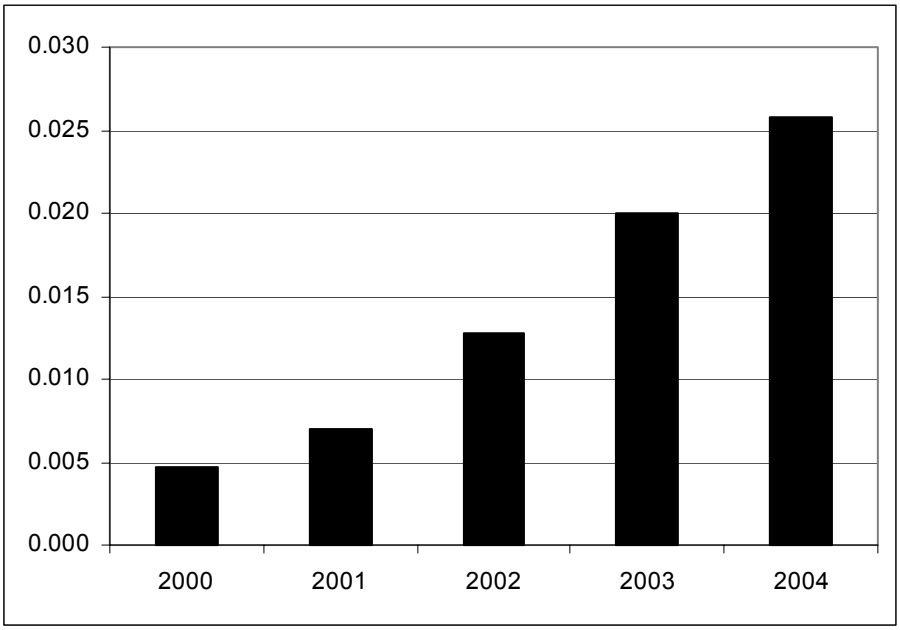
Graph 3: Average Major Carrier Share of Lowest Fares by Distance, 1996-2004



Note: Constructed from Table 4. Data Source: Department of Transportation's Quarterly Passenger and Fare Information "Domestic Airline Fares Consumer Report" from 1996 Q3 until 2004 Q3.

Appendix

Graph A1: Percent Jet Blue Was Lowest Fare Carrier By Year



Note: Constructed from Table A1. Data Source: Department of Transportation's Quarterly Passenger and Fare Information "Domestic Airline Fares Consumer Report" from 1996 Q3 until 2004 Q3.

Table A1: Proportion Airline was Low Fare Carrier by Year

	Southwest Airlines	*American Airlines*	*Continental Airlines*	*Delta Airlines*	*Northwest Airlines*	*United Airlines*	*US Airways*	*Jet Blue*	*Others*
1996	**0.290**	0.091	0.088	**0.102**	0.061	0.058	0.090	0.000	**0.220**
1997	**0.271**	0.093	0.078	0.088	0.060	0.047	**0.109**	0.000	**0.255**
1998	**0.234**	0.094	0.099	0.089	0.069	0.042	**0.102**	0.000	**0.271**
1999	**0.207**	0.085	0.097	0.096	0.065	0.045	**0.123**	0.000	**0.283**
2000	**0.226**	0.080	0.053	0.101	0.047	0.059	**0.145**	0.005	**0.284**
2001	**0.219**	0.083	0.061	0.108	0.050	0.060	**0.132**	0.007	**0.282**
2002	**0.196**	**0.122**	0.058	0.115	0.048	0.047	0.116	0.013	**0.286**
2003	**0.247**	0.103	0.051	**0.123**	0.050	0.063	0.075	0.020	**0.268**
2004	**0.288**	0.083	0.039	**0.095**	0.038	0.063	0.079	0.026	**0.289**

Data Source: Department of Transportation's Quarterly Passenger and Fare Information "Domestic Airline Fares Consumer Report" from 1996 Q3 until 2004 Q3.

Table A2: Complete BTS Table (Complete Version of Table 2 in paper)

	Revenue per Seat	Unit Costs	Operating Profit (%)	Revenue per Seat	Unit Costs	Operating Profit (%)
	2004			Q1 2005		
	Network Carriers			Network Carriers		
Alaska	10.2	10.6	-3.8	9.9	11.4	-16.0
American	10.4	11.2	-8.8	10.8	11.3	-4.7
Continental	11.1	12.2	-9.2	14.1	15.8	-12.0
Delta	12.3	13.9	-12.5	12.0	13.7	-13.6
Northwest	13.7	14.0	-2.2	13.7	15.1	-10.4
United	11.2	12.6	-11.8	11.4	12.2	-6.9
US Airways	14.6	15.8	-8.4	13.0	14.8	-13.9
Average	**11.9**	**12.9**	**-8.1**	**12.1**	**13.5**	**-11.1**
	P2P Low-Cost Carriers			P2P Low-Cost Carriers		
AirTran	8.7	8.4	3.0	8.5	8.7	-3.2
America West	8.2	8.4	-1.8	10.4	9.7	6.6
ATA	6.2	9.6	-55.9	5.8	16.4	-185.0
Frontier	9.6	10.1	-4.9	11.1	11.3	-1.3
JetBlue	6.8	6.2	9.1	7.2	6.7	6.9
Southwest	8.5	7.8	8.3	8.2	7.7	6.4
Spirit	7.7	8.6	-11.5	8.5	8.8	-3.8
Average	**8.3**	**8.0**	**4.2**	**8.8**	**8.6**	**4.0**
% Difference	**-31%**	**-38%**	**152%**	**-27%**	**-36%**	**136%**

Notes: "Revenue per Seat" - Domestic Operating Revenue Per Available Seat Mile, "Unit Costs" - Airline Domestic Unit Costs (Cents per Mile), "Operating Profit (%)" - Domestic Operating profit/loss margin (% of Total Operative Rev)

Sources: (Operating Profit Data): BTS, Form 41, Schedule P1.2 ; (Cost and Unit Revenue Data): BTS, Form 41, Schedule P1.2. T100; T2 Data.

Table A3: Annual Proportion Southwest was Lowest Fare Carrier By Distance

	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average
0-200	0.42	0.40	0.30	0.26	0.39	0.48	0.66	0.71	0.76	0.49
201-400	0.47	0.42	0.34	0.32	0.35	0.38	0.43	0.53	0.52	0.42
401-600	0.31	0.30	0.25	0.25	0.32	0.30	0.29	0.38	0.37	0.31
601-800	0.39	0.35	0.25	0.24	0.25	0.23	0.21	0.24	0.29	0.27
801-1000	0.22	0.21	0.18	0.15	0.13	0.12	0.08	0.10	0.16	0.15
1001-1200	0.21	0.19	0.16	0.10	0.14	0.13	0.09	0.15	0.21	0.15
1201-1400	0.26	0.23	0.20	0.16	0.15	0.18	0.16	0.16	0.21	0.19
1404-1600	0.26	0.29	0.30	0.21	0.21	0.20	0.13	0.14	0.20	0.21
1601-1800	0.34	0.33	0.34	0.27	0.26	0.26	0.16	0.24	0.39	0.29
1801-2000	0.19	0.18	0.24	0.21	0.17	0.16	0.16	0.17	0.24	0.19
2001-2200	0.10	0.11	0.13	0.12	0.17	0.11	0.10	0.11	0.20	0.13
2201-2400	0.08	0.08	0.12	0.10	0.14	0.10	0.09	0.16	0.22	0.12
2400+	0.00	0.01	0.08	0.13	0.13	0.07	0.03	0.13	0.14	0.08

Data Source: Department of Transportation's Quarterly Passenger and Fare Information "Domestic Airline Fares Consumer Report" from 1996 Q3 until 2004 Q3.

Table A4: Average Percent Other Major Airlines were Lowest Fare Carrier By Distance

	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average
0-200	0.06	0.07	0.10	0.10	0.09	0.06	0.03	0.03	0.02	0.06
201-400	0.05	0.05	0.07	0.08	0.07	0.06	0.04	0.04	0.04	0.06
401-600	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.06	0.06	0.07
601-800	0.07	0.07	0.08	0.08	0.08	0.07	0.07	0.07	0.06	0.07
801-1000	0.09	0.08	0.08	0.09	0.09	0.09	0.10	0.09	0.07	0.09
1001-1200	0.09	0.09	0.09	0.09	0.08	0.09	0.10	0.09	0.08	0.09
1201-1400	0.09	0.09	0.09	0.10	0.09	0.09	0.10	0.10	0.07	0.09
1404-1600	0.08	0.08	0.07	0.08	0.07	0.08	0.09	0.08	0.06	0.08
1601-1800	0.08	0.07	0.07	0.08	0.07	0.07	0.09	0.09	0.06	0.08
1801-2000	0.10	0.09	0.08	0.07	0.07	0.08	0.09	0.09	0.08	0.08
2001-2200	0.10	0.11	0.09	0.09	0.08	0.09	0.09	0.10	0.08	0.09
2201-2400	0.12	0.12	0.11	0.11	0.10	0.12	0.12	0.10	0.10	0.11
2400+	0.14	0.14	0.13	0.11	0.10	0.11	0.12	0.09	0.07	0.11

Data Source: Department of Transportation's Quarterly Passenger and Fare Information "Domestic Airline Fares Consumer Report" from 1996 Q3 until 2004 Q3.

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