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Competition at "Duopoly" Airline Hubs in the U.S.

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Abstract

This paper examines the effect of hub competition on route competition and indirectly on yields at concentrated airports. Previous research has found that yields on routes to or from hubs dominated by one or two carriers are higher than yields on routes to or from non-concentrated airports. It is not apparent, however, from this research whether there are differences in yields between those airports dominated by one carrier (hub monopolies) and those dominated by two carriers (hub duopolies).

This study found that there are significantly more competitors on routes to and from hub duopolies than there are on routes to or from hub monopolies. As well, greater numbers of competitors lead to significantly lower yields at the airports in our studies. As a result, it was possible to conclude that hub duopolies contribute, indirectly, to lower yields.

Previous research has found that the existence of airport hubs contribute to lower costs for airlines and more convenient flight schedules for passengers. These conclusions, combined with the results from our paper, suggest that an appropriate public policy may be to reduce airport barriers (such as size constraints and gate and slot restrictions) which limit the formation of hub duopolies.

I. Introduction

Much has been written recently, both by academics and government agencies, about the possible anti-competitive aspects of airport domination by a single carrier - the so-called "fortress hub" effect. The papers have argued that airport domination has contributed to the ability of carriers to earn higher yields or premia on routes with an endpoint at the dominated hub. A number of solutions have been proposed for reducing the anti-competitive aspects of fortress hubs. These include (Mead, 1989, pp. 20-26): reducing long-term control over airport gate leases by dominant airlines; easing noise restrictions at dominated airports to facilitate entry; changing the method by which slots are allocated to facilitate their purchase by non-dominant carriers; reducing carrier control over computer reservation systems; and, modifying rules governing frequent flier plans, code-sharing arrangements and travel agency commission overrides to promote competition.

The policy options for reducing the anti-competitive effects arising from the fortress hubs are designed to encourage carriers to increase their flights into and out of hubs dominated by other carriers, not necessarily to eliminate the existing hubs. The existence of hub and spoke systems provide many benefits for both air carriers and the travelling public through increased frequencies, lower costs and lower prices as a result of increased densities (Morrison and Winston (1986), McShan and

Windle (1989), Caves, Christensen and Tretheway (1984)). It is quite clear that the travelling public would not benefit from the elimination of hub and spoke systems.

But would there be any additional benefits if public policies encouraged a second carrier to operate a hub from an airport previously dominated by a single carrier? In a number of recent studies on the negative effect of hub dominance, no effort was made to differentiate between those airports dominated by one airline ("hub monopolies") and those dominated by two carriers ("hub duopolies"). It was assumed that both types of hubs, equivalently, would lead to hub premia. The major purpose of this paper is to examine the differences in service and prices between hub duopolies and hub monopolies.

There are a small number of major U.S. airports which currently are, or have recently been, hub duopolies (e.g., O'Hare in Chicago with United Airlines and American Airlines and Atlanta's Hartsfield Airport until recently with Eastern Airlines and Delta Airlines). This paper proposes to examine airline operations at the hub duopolies to determine what benefits, if any, can be gained from having two competitors at a hub instead of a single dominant carrier. Specific questions that will be addressed include: What is the extent of competition at the duopoly hubs? Is there more competition on routes at the duopoly hubs than at the fortress hubs dominated by a single carrier?

Are prices lower on average on routes from the duopoly hubs than from the single carrier dominated fortress hubs?

In order to answer these questions, the paper is structured as follows: Section II reviews the literature on hub dominance, especially with regards to the effect of competition at hubs on prices and service. Section III presents the model used to test the effect of hub competition on service levels and prices and the results from analyzing the model. Finally Section IV draws conclusions from this study and discusses possible policy implications from the findings.

II. Literature Review

There have been a number of academic papers published which test the effect of hub dominance or "airport market power" on airline prices, including Borenstein (1989) and Morrison and Winston (1989). In general, the papers support the contention that a U.S. domestic route with one or more endpoints as a hub or highly concentrated airport will have significantly higher yields than other routes, all other things being equal. Government documents which provide similar results include, the U.S. General Accounting Office (GAO, 1991), and the U.S. Department of Transportation (DOT, 1990).

Papers which specifically examined prices or service characteristics at routes with one or more endpoints at a duopoly hub include the U.S. Department of Transportation (1990), the U.S. General Accounting Office (1988) and Huston and Butler (1989). The latter two papers looked specifically at fares and service levels at Lambert - St. Louis International Airport before and after the merger of the airport's two hub carriers Trans World Airlines and Ozark Air Lines in 1986. Both studies found that fares increased significantly after Lambert lost its hub duopoly. The GAO (1988, p. 13) also found that the number of routes originating in St. Louis which received service from only a single carrier increased by forty-two percent while the number of routes served by two or more carriers dropped by forty-four percent.

The DOT (1990) compared fares at hubs dominated by a single carrier to fares at duopoly hubs and to industry average fares for the year 1988. The DOT (1990a, pp. 16-19) found that fares at the monopoly hubs were higher than fares at the duopoly and other airports, especially for short to medium distance routes (up to 750 miles). However, when the DOT (1990, pp. 18-23) controlled for route density, much of the premium disappeared.

In summary, it would appear that the literature regarding price and service characteristics at duopoly hubs supports the contention that number of hub competitors matters; that is that the addition of a hub carrier should result in lower average prices for routes into and out of the hub, either directly or due to an increase in carrier competition on routes. However, the extent of monopoly hub fare premium (compared to the fares at duopoly hubs) may be exaggerated if other factors, such as route densities, are not considered.

In the remainder of this paper we will examine the evidence with regard to competition and yields at a sample of dominated hubs and a sample of competitive or duopoly hubs. The findings will help to determine if policies which encourage hub competition translate into actual route competition.

III. Model, Data and Results

A. Model

The model used is derived from more general work conducted by Borenstein (1989a) in which he shows that hub market share and carrier route share are related and from a number of studies which show that route competition is related to yields. Our model is as follows:

$$\text{Yields} = f(\text{Route Competition, Control Variables}) \quad (1)$$

$$\text{Route Competition} = g(\text{Hub Competitors, Control Variables}) \quad (2)$$

where the control variables are factors which may affect route competition or yield, such as route density, or route stage length. Our model will show if the addition of a hubbing carrier at an airport leads to greater route competition and indirectly, therefore, to lower yields, holding other factors, such as route density, constant.

B. Data

The data used for this paper come from the Department of Transportation's ten percent ticket survey of airline passengers for the third quarter of 1987 (U.S. Department of Transportation, 1987). We chose to examine competition and yields on routes originating or terminating at the three largest dominated airports (Detroit, Minneapolis, and St.Louis) and the four largest competitive duopoly airports (Atlanta, Chicago, Dallas-Fort Worth and Denver).[1] Some studies, such as the U.S. General Accounting Office (1990) have considered airports to be dominated regardless of whether or not they are dominated by one or two carriers.[2] Our analysis differentiates between those airports dominated by one carrier and those dominated by two.

In constructing our data base only routes either originating or terminating in the hub city were included. This allows us to focus on the routes most likely to be adversely affected by hub dominance. In addition our analysis is limited to same plane,

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[1]In cities where there are two or more commercial airports, the data are for the largest airport, for example, O'Hare in Chicago and Dallas Ft. Worth International in Dallas Ft. Worth.

[2]The GAO study (1990, p. 15) considered an airport to be concentrated if one carrier handled at least 60 percent of enplaning passenger or if two carriers handled 80 percent or more of the enplaning passengers. Included in this category were two of our duopoly hubs, Atlanta and Denver.

round trip tickets. This ensures that service levels (at least with regard to travel time) are comparable across carriers serving the same route. All flights with fewer than 30 sample observations (approximately 3 passengers per day) were eliminated from the data set. The small number of observations would provide a questionable estimate of the average yield on the route. In addition, all tickets were screened for unreasonable prices.[3] Table 1 lists the number of routes from each of the seven airports that meet the above criteria.

C. The Effect of Route Competition on Yields

Our model predicts that competition at hubs will affect yields indirectly, through route competition. That is, the number of hubbing carriers will affect the number of competitors on a route which will in turn influence route yields. The second part of the model, the effect of route competition on yields is examined first.

There are many factors that determine the average yield from any airport. Previous researchers (Borenstein (1989), Morrison and Winston (1989)) have attempted to explain fares as a function of competition, potential competition, distance, frequency, equipment used on the route, slot controls, frequent flier

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[3]Tickets coded with a price of zero (frequent flyer tickets or airline employee travel) were eliminated and a screen for unreasonably high fares was utilized to reject obvious coding errors.

awards, hub dominance, etc. One consistent result of this research is that the greater the competition on a route the lower the fare.

In order to verify the relationship between number of competitors and yield for our data, the following model was estimated:

$$YIELD = \beta_0 + \beta_1 DISTANCE + \beta_2 DENSITY + \beta_3 NCOMP + \sum_{i=4}^{9} \beta_i CITY_i \qquad (3)$$

where:

- YIELD is the average price on a route;
- DISTANCE is the route stage length;
- DENSITY is the number of passengers on the route for the third quarter of 1987;
- NCOMP is the number of effective competitors operating on the route, an effective competitor having at least a 10 percent route market share;
- $CITY_i$'s are dummy variables for six of the seven airports in the sample.

The results of the estimation are presented in Table 2. It can be seen clearly that the results support the proposed model. The variable for number of competitors was negative and significant indicating that more carriers on a route translates into lower prices.

D. The Effect of Hub Competition on Route Competition

Our model predicts that increased hub competition should lead to increased route competition and therefore, indirectly, to lower prices. Figure 1 documents the number of competitors per route for each of the seven airports under consideration. The single carrier dominated airports are presented in the first three columns of Figure 1 and the two carrier hub airports are presented in the last four columns. This organization will be retained for all future figures. Figure 1 illustrates that all three single carrier dominated hubs have a higher proportion of monopoly routes than any of the four two carrier hubs. In both St. Louis and Minneapolis, 80 percent or more of the routes are served by a single carrier. In Detroit that percentage drops to 62 percent. In the duopoly hubs the percentage of routes served by a single carrier ranges from a low of 31 percent for Chicago to a high of 44 percent for Dallas-Fort Worth. Clearly the presence of a two carrier hub increases the average number of competitors per route.

It is possible that the presence of additional carriers on a route may be due to route characteristics rather than the presence of an additional hub carrier. In order to examine this possibility, Figures 2 through 4 report the number of competitors per route by three separate distance classes and Figures 5 through 7 report the number of competitors by three different passenger density classes. The size classes are: 0-400 miles, 401-800 miles, and over 800 miles. The passenger density classes are: 3-25 passengers per day, 26-100 passengers per day and over 100 passengers per day.

Figures 2 through 4 present the same trend for number of competitors as indicated in Figure 1. The single carrier hubs have a higher percentage of monopoly routes for all distance classes than the two carrier hubs. Figures 5 through 7 present virtually the same trend for all passenger density classes. The only exception being in the lowest density classification (3-25 passengers per day) where Figure 5 indicates that Dallas-Fort Worth has 92 percent monopoly routes and Minneapolis has 90 percent monopoly routes. The contrast between single carrier and two carrier hubs can be striking. Figure 8 presents information on the number of monopoly routes for short (less than 400 miles) and lightly travelled (3-25 passengers per day) routes. All three single carrier hubs have <u>no</u> competitive routes in this category, while the two carrier hubs may have a substantial number of competitive routes (e.g. 58 percent of Chicago's routes in this category are competitive).

It is difficult from the preceding figures to determine the actual increase in the number of competitors as a result of a duopoly hub. A simple regression to predict the number of competitors on a route is presented below in order to estimate the impact more precisely:

$$NCOMP = \beta_0 + \beta_1 DENSITY + \beta_2 DUO\text{-}HUB \quad (4)$$

where - DUO-HUB is an indicator variable coded 1 for observations on routes originating or terminating at a duopoly hub and 0 otherwise; and,

- the other variables are as described above.

The results of this estimation are presented in Table 3. It can be seen that the existence of hub competition in the form of duopoly hubs results in greater route competition. On average, there were 0.4 more competitors on a route originating or terminating at a duopoly hub than at a monopoly hub, holding density constant.[4]

IV. Conclusions and Policy Implications

The major conclusion that can be drawn from this paper is that hub competition directly contributes to increases in the number of route competitors and indirectly to lower yields on routes. To the extent that increased choice in carriers and lower prices are in the consumer's interest, it is therefore of benefit to consumers to have duopoly rather than monopoly hubs.

A number of suggestions were made in the introduction to

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[4]Another model was estimated with distance as well as density as a right-hand-side variable with similar results. The coefficient for the distance variable was not significant at the 90 percent confidence level.

this paper for reducing market concentration at hubs. Our paper would lend support to implementing those suggestions which may allow second carriers to hub at airports currently dominated by a single carrier. An example of such a policy would be prohibiting the renewal of long term leases on some of the gate facilities used by dominant carriers to make room for a new entrant.

References

Borenstein, Severin (1989), "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry", *Rand Journal of Economics*, Vol. 20(3), Autumn, pp. 344-365.

Borenstein, Severin (1989a), "The Competitive Advantage of a Dominant Airline", Institute of Public Policies Discussion Paper #278, The University of Michigan, March.

Caves, Douglas W., Laurits R. Christensen and Michael W. Tretheway (1984), "Economies of Density versus Economies of Scale: What Trunk and Local Service Airline Costs Differ", *Rand Journal of Economics*, Vol. 15(4), Winter, pp. 471-489.

Huston, John H. and Richard V. Butler (1989), "The Effects of Fortress Hubs on Airline Fares and Service: The Early Returns", *Logistics and Transportation Review*, Vol. 24(3), pp. 203-214.

McShan, Scott and Robert J. Windle (1989), "The Implications of Hub-and-Spoke Routing for Airline Costs and Competitiveness", *Logistics and Transportation Review*, Vol. 25(3), pp. 209-230.

Mead, Kenneth M. (1989), "Barriers to Competition in the Airline Industry", Statement to the Subcommittee on Aviation, Committee on Commerce, Science and Transportation, United States Senate, September 20, General Accounting Office Report GAO/T-RCED-89-65.

Morrison, Steven A. and Clifford Winston (1989), "Enhancing the Performance of the Deregulated Air Transportation System", *Brookings Papers: Microeconomics Series*, pp. 61-123.

Morrison, Steven A. and Clifford Winston (1986), *The Economic Effects of Airline Deregulation*, The Brookings Institution: Washington, D.C.

U.S. Department of Transportation (1987), *Origin and Destination Survey*, Databank 1a, third quarter.

U.S. Department of Transportation (1990), *Secretary's Task Force on Competition in the U.S. Domestic Airline Industry: Pricing*, February.

U.S. General Accounting Office (1988), *Airline Competition: Fare and Service Changes at St. Louis Since the TWA-Ozark Merger*, September, Document Number GAO/RCED-88-217BR.

U.S. General Accounting Office (1990), *Airline Competition: Higher Fares and Reduced Competition at Concentrated*

Airports, July, Document Number GAO/RCED 90-102.

U.S. General Accounting Office (1991), *Airline Competition: Effects of Airline Market Concentration and Barriers to Entry on Airfares*, April, Document Number GAO/RCED-91-101.

Table 1
Airport Route Counts by Number of Competitors

Airport	1 Carrier Routes	2 Carrier Routes	3 or More Carrier Routes	Total Routes
St. Louis	66	12	3	81
Minneapolis - St. Paul	64	13	3	80
Detroit	43	18	7	68
Dallas- Ft. Worth	50	44	18	112
Atlanta	44	49	14	107
Denver	40	59	8	107
Chicago	41	73	17	131

Source: Department of Transportation (1987).

Table 2
Estimation of Price

Variable	Estimated Coefficient	Standard Error
Constant	5.618*	0.014
Distance	0.307*	0.014
Density	-0.007	0.010
No. of Competitors	-0.062*	0.019
Atlanta Dummy	0.027	0.040
Denver Dummy	-0.079**	0.040
Detroit Dummy	-0.086**	0.044
Dallas-Ft. Worth Dummy	-0.065	0.040
Chicago Dummy	0.134*	0.039
Minneapolis-St. Paul Dummy	-0.014	-0.042

$R^2 = .455$ $F = 62.9^*$ Number of observations = 688

Note: All continuous variables were transformed into logs.

* Significant at the 99% confidence level.
** Significant at the 90% confidence level.

Table 3
Estimation of Number of Competitors
Estimation of Price

Variable	Estimated Coefficient	Standard Error
Constant	0.338*	0.038
Density	0.003*	0.000
Duopoly Hub Dummy	0.402*	0.046

$R^2 = .337$ F = 174.4* Number of observations = 688

Note: All continuous variables were transformed into logs.

* Significant at the 99% confidence level.

Figure 1
Number of Competitors Per Route
Pct. Monopoly, Duopoly and 3 or More

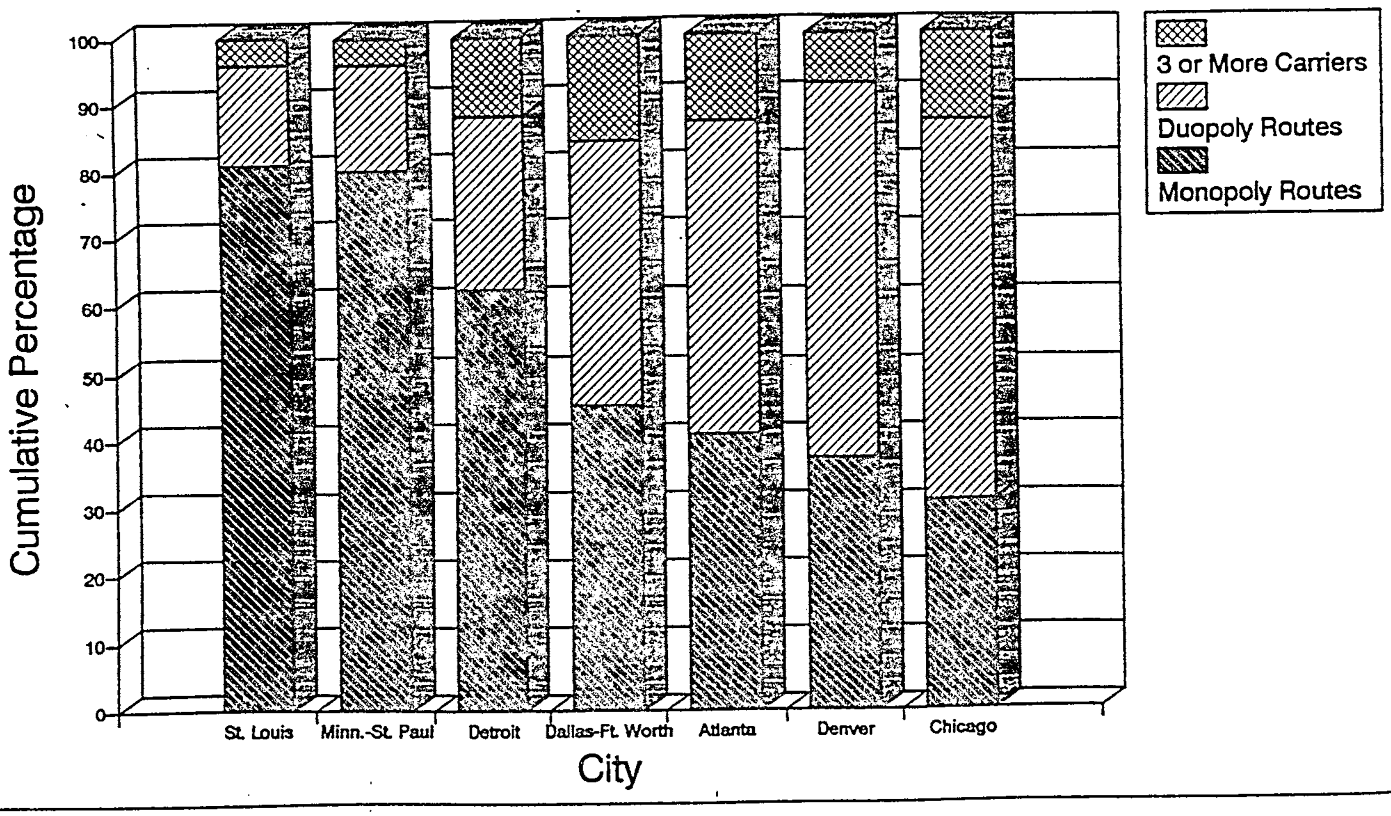


Figure 2
Number of Competitors Per Route
0 - 400 Miles

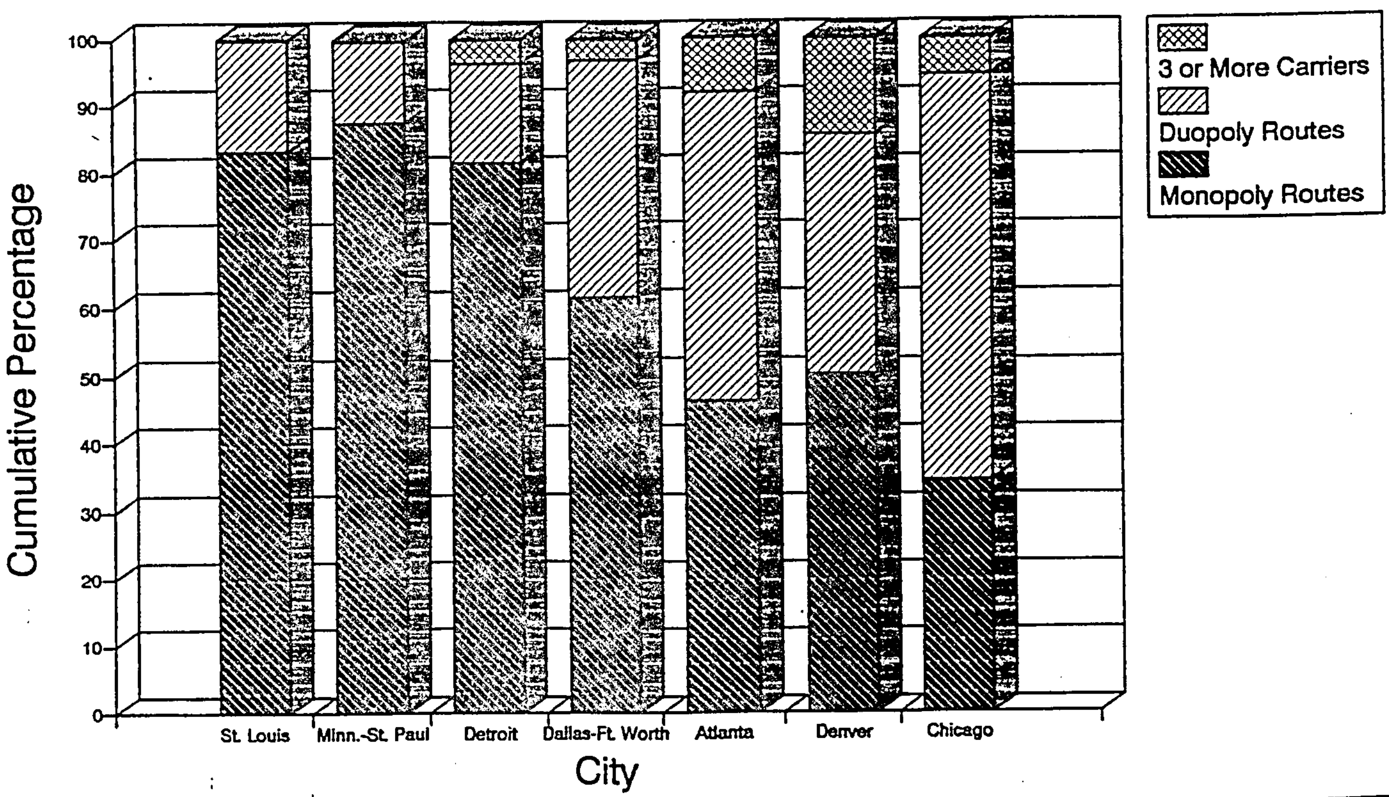
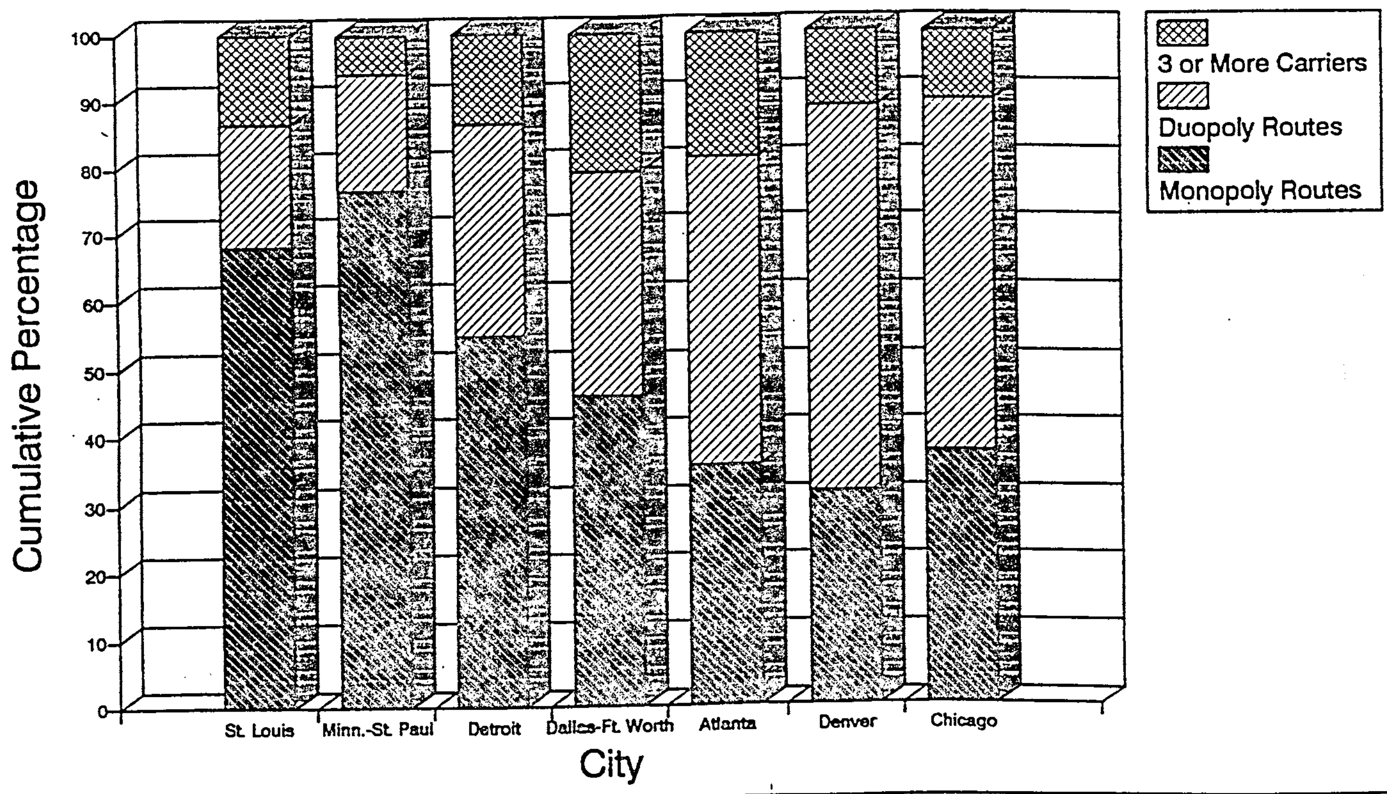


Figure 3
Number of Competitors Per Route
401 - 800 Miles



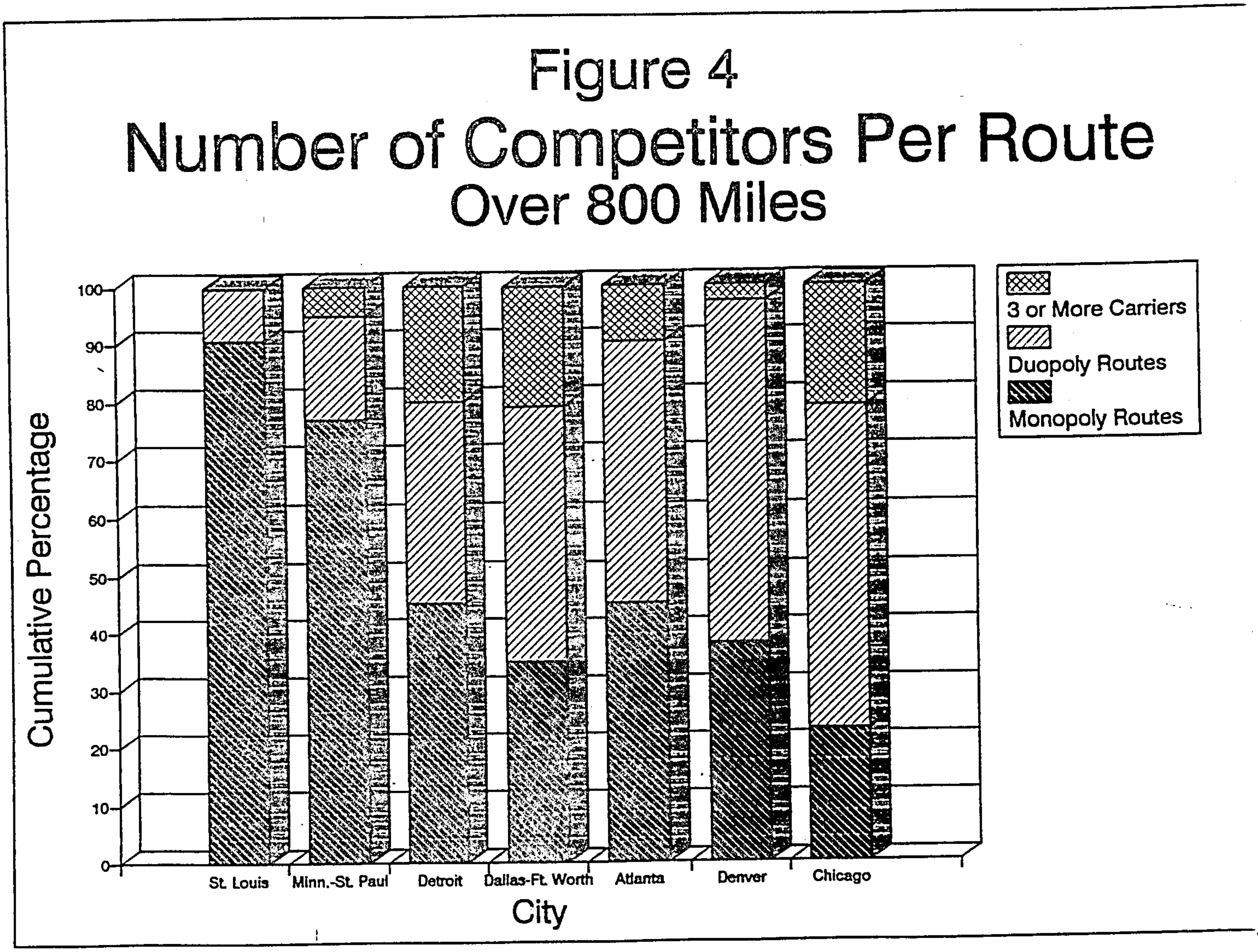


Figure 4
Number of Competitors Per Route
Over 800 Miles
Cumulative Percentage
100
90
80
70
60
50
40
30
20
10
0
St. Louis
Minn.-St. Paul
Detroit
Dallas-Ft. Worth
Atlanta
Denver
Chicago
City
3 or More Carriers
Duopoly Routes
Monopoly Routes

Figure 5
Number of Competitors Per Route
3 - 25 Passengers Per Day

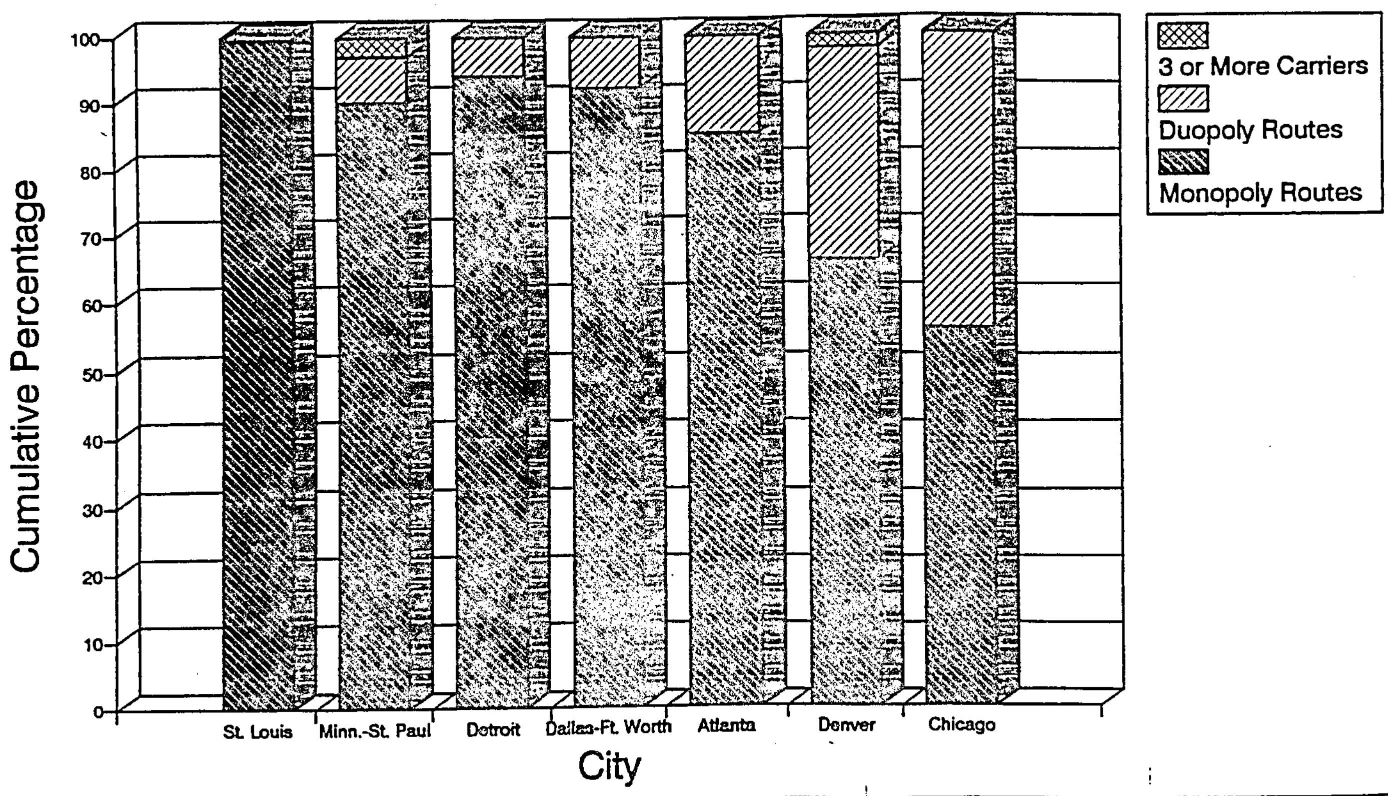
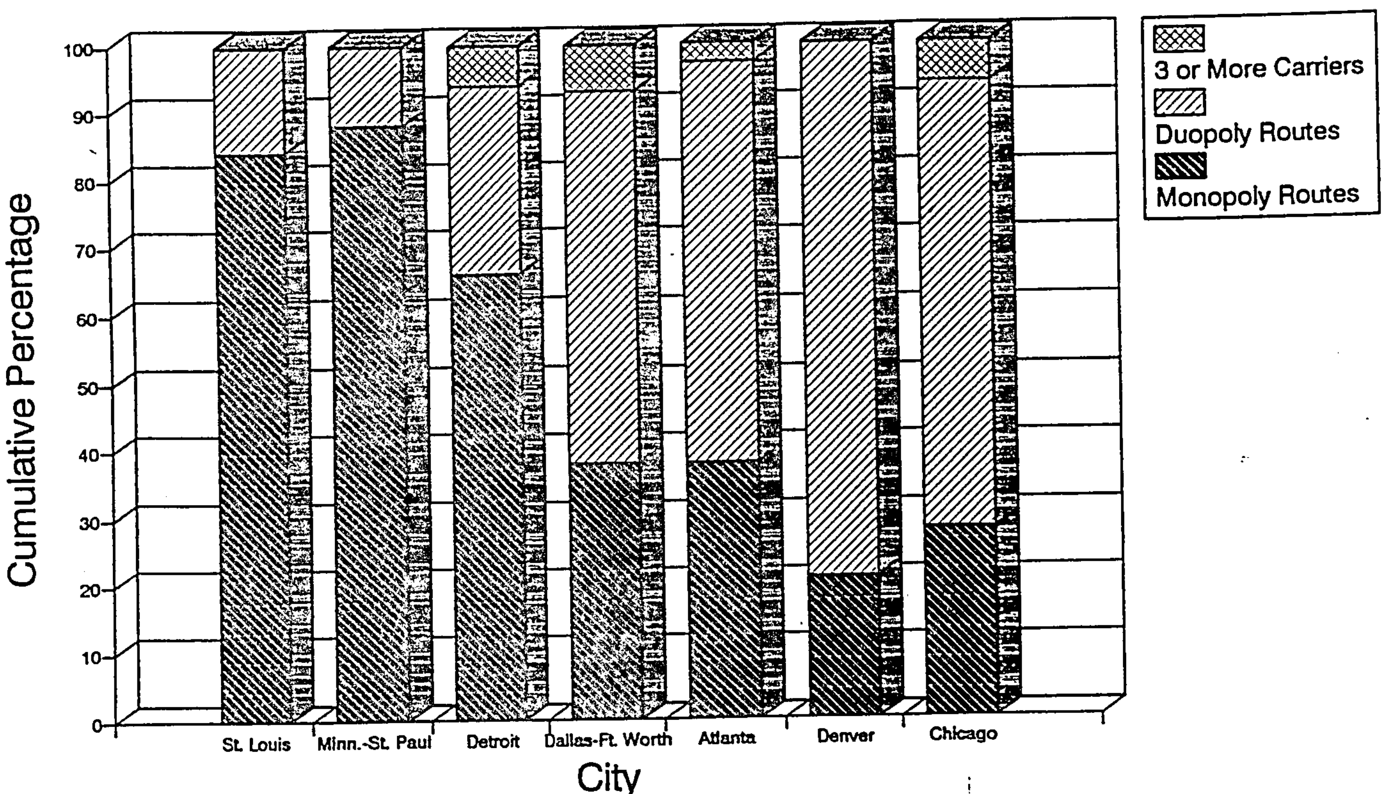


Figure 6
Number of Competitors Per Route
26 - 100 Passengers Per Day



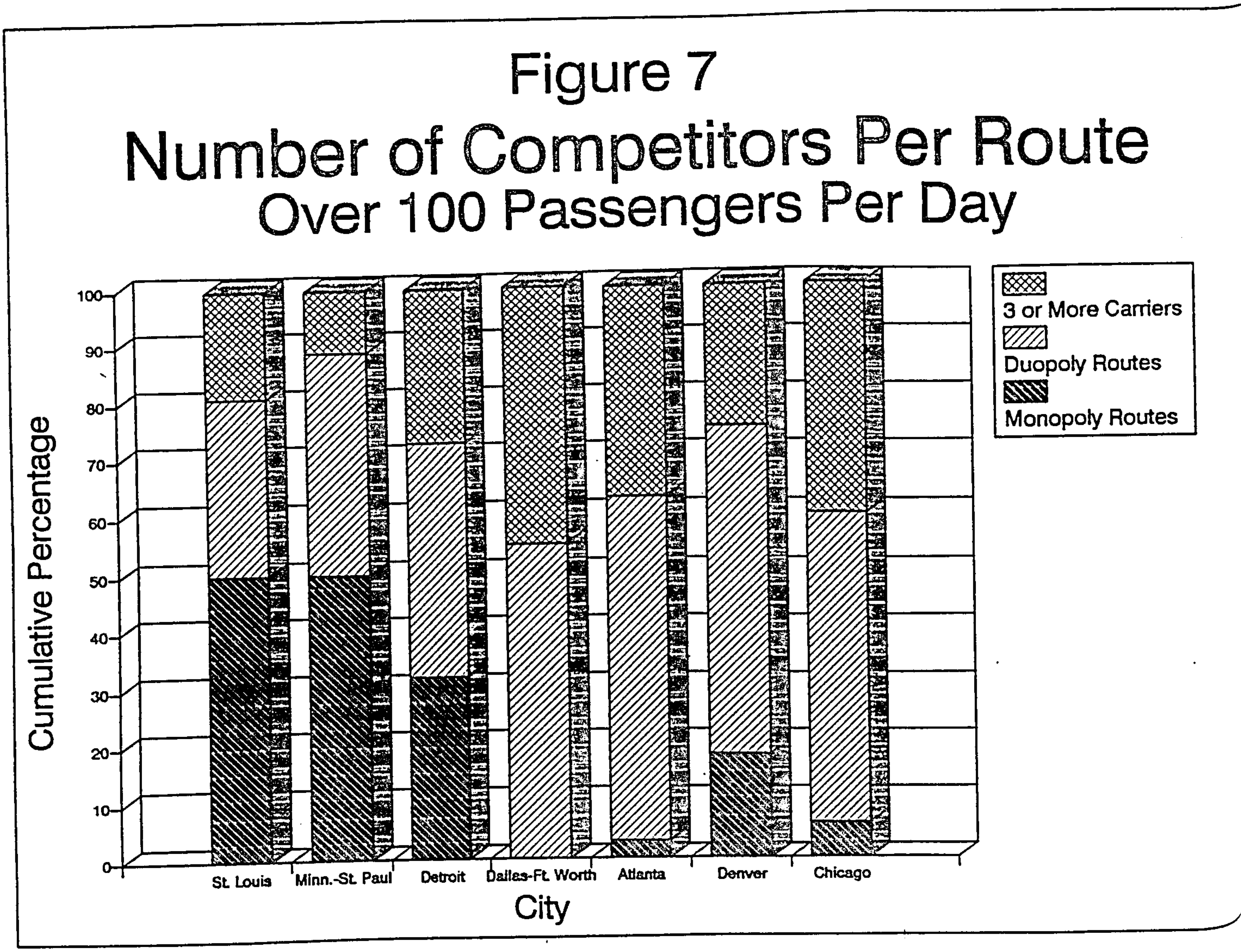


Figure 7
Number of Competitors Per Route
Over 100 Passengers Per Day
3 or More Carriers
Duopoly Routes
Monopoly Routes
Cumulative Percentage
0
10
20
30
40
50
60
70
80
90
100
St. Louis
Minn.-St. Paul
Detroit
Dallas-Ft. Worth
Atlanta
Denver
Chicago
City

Figure 8

Number of Competitors Per Route

Routes 0-400 Miles & 3-25 Pass/Day