

**Estimating the Economic Impact of Airline Service
Reductions at Regional Airports:
The Case of Tweed-New Haven Airport**

MARK PAUL GIUS
Quinnipiac College
Hamden, CT 06518

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In the current era of airline deregulation, reductions in airline services are occurring at numerous small, regional airports throughout the United States. Given increased competition from low-cost airlines, more and more major carriers are evaluating the profitability of flight schedules, especially when those schedules involve small or medium-sized markets, such as New Haven, Connecticut.

Although the elimination of nonprofitable flight services and routes is in the airlines' best interests, a reduction of flight services may have negative impacts on small regional economies. Unfortunately, very little empirical analysis has been done on the impact that a reduction in air services has on a regional economy. The purpose of the present study is to examine the effect of a reduction in commercial air services on a region served by a small or medium-sized regional airport. As an example of such a reduction in air services, the cancellation of United's jet service at Tweed-New Haven Airport is analyzed. Results of this study show that commercial air transportation has a significant impact on a region's economy. For Tweed-New Haven, the present study concludes that the loss of United's jet service cost the greater New Haven region almost \$29 million, using 1994 enplanement data.

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W. Paul Stillman School of Business

Seton Hall University

1. Introduction

On February 2, 1996, United Airlines announced that, effective April 1996, it would no longer provide jet service to Chicago from Tweed-New Haven Airport (*New Haven Register*, February 2, 1996). Given that the Chicago run was the only jet service provided at Tweed, local officials acknowledged that the loss of the United jet service would be a blow to the region's economy. United officials noted, however, that the airline was never able to show a profit at Tweed, having lost \$12 million over the nearly six years that it provided the jet service to Chicago (*New Haven Register*, February 2, 1996).

In the current era of airline deregulation, the above scenario is being played out at numerous small, regional airports throughout the United States. Given increased competition from low-cost airlines, more and more major carriers are evaluating the profitability of flight schedules, especially when those schedules involve small or medium-sized markets, such as New Haven, Connecticut.

Although the elimination of nonprofitable flight services and routes is in the airlines' best interests, a reduction of flight services may have a negative impact on small regional economies. Unfortunately, very little empirical analysis has been done on the impact that a reduction in air services has on a regional economy. (Benell and Prentice, 1993; Penn, 1994). If such information were available, it may shed light on the importance of modern air transportation on the economies of small and medium-sized markets. The purpose of the present study is to examine the effect of a reduction in commercial air services on a region served by a small or medium-sized regional airport. As an example of such a reduction in air services, the cancellation of United's jet service at Tweed-New Haven Airport will be analyzed. Results of this study will show that commercial air transportation has a significant impact on a region's economy. For Tweed-New Haven, the present study concludes that the loss of United's jet service cost the greater New Haven region almost \$29 million, using 1994 enplanement data. The following section discusses the methodology employed in the present study. Section 3 presents the data employed. Section 4 discusses the results and concluding remarks.

2. Methodology

The purpose of the present study is to determine the effect of a reduction in air services on a region's economy. This study examines only the benefits associated with having an airport; no assessment is made of the various costs associated with airports, such as noise pollution and congested roadways. The total benefit that accrues from having an airport in a given area can be segregated into two parts: a transportation benefit and an economic benefit. An examination of each of these benefits follows.¹

2.1 Transportation Benefit

The transportation benefit results from the savings in time and transportation expenses that result due to the existence of an airport in a given area. For example, given Tweed-New Haven exists, residents of the greater New Haven region do not have to travel to Bradley International Airport or another facility in order to obtain commercial or general flight service.

The Total Annual Transportation Benefit is estimated as follows:

$$2*[E(FGN + Y)(b/P + y/S - x/S - d/P) + (FGN + Y)(Q_b - Q_d)] \quad (1)$$

where,

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G: Itinerant operations per based aircraft per year:² 300

N: Number of based aircraft at airport A: varies³

d: Ground access distance to airport A (miles): varies⁴

E: Passenger time value (\$/hour):⁵ 13.96

F: Number of passengers per trip per general aviation aircraft:⁶ 2.5

P: Car speed (m.p.h.): 55

Q: Car costs, including amortization (\$/mile):⁷ .4927

b: Ground access distance to alternative airport C (miles): varies⁸

Y: Annual passengers in commercial service: varies⁹

x: Direct flight distance from origin airport A to destination airport B: varies

y: Alternative airport C to destination airport B flight distance: varies

S: General aviation or regional airline aircraft speed (m.p.h.): varies

O-C-B: distance from home to alternative airport C to destination airport B: varies

O-A-B: distance from home to airport A to destination airport B: varies

If it is assumed that $x = y$, equation (1) may be simplified as follows:

$$\text{Total Annual Transportation Benefit} = 2*[E(FGN + Y)(b/P - d/P) + (FGN + Y)(Qb - Qd)]^{10} \quad (2)$$

Equation (2) is used to estimate the transportation benefit of having an airport in a given region. In calculating equation (2), it is assumed that the transportation benefit exists only for passengers who are residents of the airport's primary market. The next section discusses the methodology employed to estimate the economic benefit of a regional airport.

2.2 Economic Benefit

The second part of the total benefit, the economic benefit consists of three parts: the direct benefit, the indirect benefit, and the induced benefit. The direct economic benefit consists of the consequences of economic activities carried out at the airport by airlines, airport management, and airport tenants. Expenses that may be incurred by airport organizations are as follows: payroll, off-site expenses, operations/maintenance, landing fees, rentals, other fees/taxes, fuel, supplies, equipment rental, advertising, and capital

The total of these expenditures equals the direct economic benefit of the airport on the local community. There are two important issues associated with this category. First, the above expenses must be incurred in the primary market of the airport. In other words, if an airline buys its fuel from a supplier outside the primary market, that expense should not be included in the direct impact. Second, the primary market must be explicitly defined before this exercise is undertaken.¹¹ Finally, in order to simplify estimation of the economic impact of changes in flight schedules, it is assumed that no economies or diseconomies of scale exist in airport operations.

The indirect economic benefit derives primarily from off-site economic activities that are attributable to the airport. Examples include tourists and business travelers. Expenses that may be incurred by area visitors are as follows: lodging, food and beverages, retail stores/souvenirs, entertainment, liquor, local surface transportation, and business-related goods/services

Only the expenses of nonresidents should be included in the estimation of the indirect economic impact. Using an estimated number of total nonresident passengers (NRP) and an estimated mean expenditure per nonresident passenger (MENP), the total indirect benefit can be estimated as follows:

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$$\text{Indirect Economic Benefit} = \text{NPR} \times \text{MENP}. \quad (3)$$

Regarding the indirect economic benefit, the following assumptions were made:

- (1) Only the expenses of nonresidents (air travelers whose primary residence is not the primary service market of the airport in question) are included in the estimation of the indirect economic impact.
- (2) The mean expenditure per nonresident passenger is assumed to remain constant, regardless of the number of air travelers.

The last part of the economic benefit, the induced economic benefit, results from the spending induced by the initial rounds of direct and indirect spending. Due to the existence of an airport, more money is spent in an area than would have been the case otherwise. This additional spending results in an increased demand for goods and services, which results in an increased demand for labor and other factors of production in the area. Hence, one dollar spent by the airport results in additional spending in the area. In order to estimate this induced spending, a multiplier factor is required. This multiplier factor is used as follows:

$$\text{Total Benefit} = (\text{Direct Benefit} + \text{Indirect Benefit}) \times \text{Multiplier Factor} \quad (4)$$

The induced impact can then be estimated as follows:

$$\text{Induced Benefit} = \text{Total Benefit} - (\text{Direct Benefit} + \text{Indirect Benefit}) \quad (5)$$

Since every regional economy is different, however, a multiplier factor designed specifically for the region in question should be employed. The next section discusses the methodology that was employed to construct a regional multiplier.

2.3 Multiplier Methodology

The multiplier employed in the present study is known as the location quotient multiplier.¹² In order to calculate a location quotient multiplier, an estimate is made of the share of the economy that is devoted to exports. This estimate is obtained by calculating the shares of the labor force employed in all industries at the national level, NS_i , and the shares of the labor force employed in all industries in the region in question, HS_i , where i denotes industry i . The following share differences are then estimated:

$$Ds_i = HS_i - NS_i \quad (6)$$

A coefficient of specialization (CS) is then calculated as follows:

$$CS = \sum_{i=1}^n DS_i \quad (7)$$

where $I = i, \dots, n$ denotes the n industries in the economy.¹³ The location quotient multiplier (LQM) is then calculated as follows:

$$\text{LQM} = 1 / CS \quad (8)$$

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The next section discusses the methodology employed to estimate the effect of changes in airline services and enplanements on the total benefit of an airport to a regional economy.

2.4 Estimating the Effects of Varying Enplanement Levels on Total Benefits

In order to estimate the impact of a change in air services on a regional economy, the following methodology will be employed. Regarding the transportation benefit, it is assumed that if commercial enplanements increase or decrease, the transportation benefit will increase or decrease at the same rate. In other words, if the number of commercial enplanements double, the transportation benefit will double. In order to estimate the transportation benefit, equation (2) will be employed. The only variable that will vary is Y, total annual resident passengers; for various projected future enplanement levels (FEL), the following equation is utilized:

$$Y = \text{FEL} \times (1 - \text{NRPROP}). \quad (9)$$

where NRPROP denotes the share of enplaning passengers who are not residents of the primary service market of the airport.¹⁴

For the direct economic benefit, expense per employee (EE) and employee per enplaning passenger (EP) ratios are calculated given the current level of service. EE is calculated as follows:

$$\text{EE} = \text{Total Costs of All Airport Organizations} / \text{Total Number of Employees} \quad (10)$$

EP is calculated as follows:

$$\text{EP} = \text{Total Number of Employees} / \text{Total Number of Enplaning Passengers} \quad (11)$$

For projected future commercial enplanement levels, assuming no economies or diseconomies of scale, the direct economic benefit can then be estimated as follows:

$$\text{Direct Economic Benefit} = \text{FEL} \times \text{EP} \times \text{EE} \quad (12)$$

In order to estimate the indirect economic benefit, the mean expenditure per nonresident passenger (MENP) is multiplied by the future enplanement levels of nonresident passengers as follows:

$$\text{Indirect Economic Benefit} = \text{FEL} \times \text{NRPROP} \times \text{MENP} \quad (13)$$

The induced economic benefit is then estimated as previously shown.

3. Data

As an example of a reduction in flight schedules at a regional airport, the case of the elimination of United's jet service to Chicago at Tweed-New Haven Airport is examined. The reason for using this case as an example is because the author was given access to confidential and proprietary data about airport operations at Tweed-New Haven and was allowed unconstrained access to air travelers at the airport.

In estimating the impact of the reduction in the flight schedule at Tweed, all of the data utilized in the present study are for calendar year 1994. Since enplanements at Tweed do not vary

dramatically from year to year, it appeared to be reasonable to use 1994 data and to estimate the impact of the airport on New Haven both with the jet service to Chicago and without the jet service to Chicago. This analysis was possible because the author was provided with information on 1994 monthly enplanements levels, segregated by airline and route.

Before proceeding with a discussion of the data employed in the present study, it is necessary to note two important assumptions that were used in estimating the economic impact of Tweed on New Haven:

(1) For all aspects of the study, it is assumed that the primary market of Tweed-New Haven Airport is the New Haven-Meriden MSA.

(2) Tweed-New Haven and Bradley are close enough such that the difference in air distance between Tweed-New Haven and airport C and Bradley and airport C is negligible; given this assumption, $x = y$. See equations (1) and (2).

In order to calculate the direct economic benefit, information on the costs of the airport, airport tenants, such as rental car companies, and airlines was required. This information was obtained by use of a questionnaire and follow-up interviews. This information gathering process was conducted in the Spring and Summer of 1995. A copy of the questionnaire given to airport management is presented in Appendix A. A copy of the questionnaire given to airport tenants and airlines is in Appendix B. The response rate from airport management, airport tenants and airlines was 100%.¹⁵

In order to calculate the indirect economic benefit, information on the expenses of tourists, visitors and business travelers to New Haven was required. This information was obtained by questioning randomly-selected enplaning passengers at Tweed-New Haven about their expenditures while visiting the New Haven area. This survey was conducted in the Spring and Summer of 1995.¹⁶ A concerted effort was made to obtain a random sample. A copy of the passenger survey is presented in Appendix C.

According to information supplied by airport management, in 1994, there were 127,601 commercial enplanements, of which 57,848 were for United's jet service to Chicago. Concerning the passenger surveys, 500 air travelers were surveyed. Of those 500, 172 or 34.4% (NRPROP) of total enplaning passengers were not residents of the New Haven-Meriden MSA. Based on information obtained from the passenger surveys, it was also estimated that the mean expenditure per nonresident passenger (MENP) was estimated to be \$568.91. Finally, according to information supplied by airport management, airport tenants, and airlines, the total costs of the airport were estimated to be \$7,929,176 in 1994, and the total number of employees was 172.

Finally, the location quotient multiplier was estimated for the New Haven-Meriden MSA using 1992 Census data. This multiplier was estimated at the 3-digit SIC industry level. The LQM for the New Haven-Meriden MSA was estimated to be 2.11. The information used to construct this multiplier is available upon request. The next section presents the results and concluding remarks.

4. Results and Concluding Remarks

Results are presented on Table 1. Using equation (2), the total transportation benefit, at 1994 service levels of 127,601 commercial enplanements and including United's jet service to Chicago, was estimated to be \$8,880,252. Excluding United's jet service, this transportation benefit drops to \$5,955,147.

The direct economic benefit was estimated by summing the expenses of airport management, airport tenants, and the airlines; these expenses were obtained from the airport and airport tenant questionnaires. At 127,601 enplanements, total expenses were \$7,929,176, and the total number of employees was 172. The estimated expense per employee (EE) is \$46,099.86. According to United officials, in 1996, due to the elimination of the jet service, 22 employees would be transferred

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from Tweed to other United facilities. Assuming no other reductions in employment would occur at the airport, it is assumed that the level of employment in 1994 that would have prevailed without jet service is 150. Multiplying this number by the expense per employee, one obtains a direct economic benefit of \$6,914,979. The indirect economic benefit was estimated from collected passenger surveys. At a service level of 127,601, the indirect benefit is estimated to be \$24,972,159. Excluding jet service, this value drops to \$13,651,014. Using the methodology discussed in section 2, the induced economic benefit at 127,601 enplanements and using a multiplier factor of 2.11, is estimated to be \$36,520,482. Excluding jet service, this benefit falls to \$22,828,252. The total economic benefit in 1994 including jet service is thus estimated to be \$69,421,816. Without jet service, the total economic benefit would have been \$43,394,245.

Table 1
Total benefit of tweed-new haven airport

Total Economic Benefit			
Direct Economic Benefit			
Enplanements	Employees	Direct	
127601	172	\$7,929,176	
69753	150	\$6,914,979	
Indirect Economic Benefit			
Enplanements	Non-CT Pass	Indirect	
127601	43895	\$24,972,159	
69753	23995	\$13,651,014	
Induced Economic Benefit			
Enplanements		Induced	
127601		\$36,520,482	
69753		\$22,828,252	
Total Economic Benefit			
Enplanements	Total Economic		
127601	\$69,421,816		
69753	\$43,394,245		
Total Transportation Benefit			
Enplanements	CT Pass	Transportation	
127601	83706	\$8,880,252	
69753	45758	\$5,955,147	
Total Benefit of Tweed-New Haven Airport			
Enplanements		Total Benefit	
127601		\$78,302,068	
69753		\$49,349,392	

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The total benefit of Tweed-New Haven Airport to the New-Haven Meriden MSA in 1994 including jet service is estimated to have been \$77,914,975. Excluding jet service, the total benefit of Tweed in 1994 would have been \$49,089,805, a reduction of \$28,825,170. This is a substantial loss for any small or medium-sized market. In addition, as noted in the introduction, United claims to have lost \$12 million over the six year period in which they had provided jet service at Tweed. If United had eliminated this service in 1994, the New Haven-Meriden MSA would have lost almost \$29 million in that one year alone. Hence, the reduction of services at small and medium-sized airports may apparently have disastrous effects on the local communities. In the case of Tweed-New Haven, this loss is much greater than the loss experienced by the airline that precipitated the reduction in services. Although the conclusions of the present study are specific to Tweed-New Haven Airport, the information provided in the present study about the costs of operating an airport and the average visitor expenditures should prove useful to researchers attempting to conduct economic impact studies of airports with similar enplanement levels.

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Appendix A

*Tweed-New Haven Airport
Economic Assessment Project*

*This questionnaire pertains to expenditures incurred directly by
Tweed New Haven Airport. Airport tenant expenditures
should not be included in these totals.*

Quinnipiac College is conducting a survey to develop information concerning aviation's economic impact upon our community. All information will be kept completely confidential.

Please use calendar year 1994 data. If data are for another time period, please note the time period next to the relevant question.

- 1.) Number of employees at Tweed New Haven Airport

- 2.) Total employee payroll

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3.) Total airport expenditures for the following items:

fuel _____
 material _____
 equipment rental _____
 capital _____
 advertising _____
 other _____

4.) Of the above expenditures, how much was spent in the New Haven area?

fuel _____
 material _____
 equipment rental _____
 capital _____
 advertising _____
 other _____

5.) Fees and taxes paid by airport tenants (other than airlines)

6.) Fees and taxes paid by airlines

7.) Annual passengers in commercial service

8.) U.S. Mail and freight enplaned

9.) Number of general aviation aircraft based at Tweed

10.) Average speed of general aviation aircraft based at Tweed

11.) Are there any other items of economic significance that we haven't asked, but you feel we should understand? Please explain.

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Appendix B

*Tweed-New Haven Airport
Economic Assessment Project
Airport Tenant Questionnaire*

*This questionnaire pertains to expenditures incurred directly
by tenants and airlines at Tweed-New Haven Airport*

Please use calendar year 1994 data. If data are for another time period, please note the time period next to the relevant question.

1.) Employees at the airport

2.) Annual payroll at the airport

3.) Do you employ additional people away from the airport who support your airport operation?

Yes

No

4.) If so, what was cost of that support

5.) How much did you pay to the airport for:

Operations/Maintenance	_____
Landing fees	_____
Rentals	_____
Other fees/ taxes	_____

6.) How much did you spend in the New Haven area for the following:

Fuel	_____
Supplies	_____
Equipment	_____
Rental	_____
Advertising	_____
Capital	_____

7.) Are there any other items of economic significance that we haven't asked, but you feel we should understand? Please explain.

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Appendix C

*Tweed-New Haven Airport
Economic Assessment Project*

Airport Passenger Survey

*We Are Conducting A Survey In Order To Serve You Better, And We Are
Asking For Your Help By Completing This Questionnaire*

1.) What city or town do you live in?

City/Town _____ State _____

2.) What is your final destination today?

City/Town _____ State _____

3.) What is purpose of your current trip?

(Please circle all that apply)

- | | | | |
|---------------------------------|-----|-----|----|
| A. Business | | Yes | No |
| B. Vacation | | Yes | No |
| C. Visit family or friends..... | Yes | No | |
| D. Attend conference | Yes | No | |

4.) Would you have traveled to the New Haven area if Tweed Airport did not exist?

Yes _____ No _____

5.) Approximately how much money did/will you spend on each of the following items during the ENTIRE LENGTH of your stay?

- | | |
|----------|---------------------------------|
| \$ _____ | Lodging |
| \$ _____ | Food and Beverages |
| \$ _____ | Retail Stores/Souvenirs |
| \$ _____ | Entertainment |
| \$ _____ | Liquor |
| \$ _____ | Transportation (or Rental Car) |
| \$ _____ | Business related goods/services |

Endnotes

¹The methodology employed in this study was obtained from *Estimating the Regional Economic Significance of Airports, September 1992* which was prepared by the National Technical Information Service of the U.S. Department of Transportation.

²Aircraft based at airports with air traffic control towers averaged 302 itinerant operations in 1985. This is the most recent data that are available.

³According to airport officials, the total number of aircraft based at Tweed-New Haven in 1994 was 84. Approximately 50% of those aircraft were used for non-leisure activities; hence the number of based aircraft for the purposes of the present study is 42.

⁴For the purposes of the present study, the distance to Tweed-New Haven is measured from New Haven Green; that distance is five miles.

⁵The average wage in Connecticut for 1994 was used as an estimate of the value of Connecticut airline passenger time. This data were obtained from the *Survey of Current Business*, August 1995.

⁶The average number of passengers per trip is as follows:

1.4 for single engine piston aircraft with 3 seats or less

2.4 for single engine piston aircraft with 4 seats or more

3.0 for multi-engine piston aircraft.

⁷According to the American Automobile Association, an automobile driven 10,000 miles a year cost \$0.4927 per mile to operate in 1994.

⁸For the purposes of the present study, the alternative airport is Bradley International Airport. The distance to Bradley is measured from New Haven Green; that distance is 53 miles.

⁹Y refers to only those passengers who are residents of the primary market. In order to estimate Y, the following equation is utilized:

$$Y = \text{ENPLANEMENTS} \times (1 - \text{NRPROP}).$$

where NRPROP denotes the share of enplaning passengers who are not residents of the primary service market of the airport.

¹⁰This transportation benefit is multiplied by two in order to capture both legs of the journey. For example, if the primary airport is ten miles away and the alternative airport is fifty miles away, the total trip for the primary airport will be 20 miles while the total trip for the alternative airport will be 100 miles. In order to capture this effect, the total annual transportation benefit is multiplied by two.

¹¹With regards to the first issue, at Tweed-New Haven, it appears as if most, if not all, materials were purchased in the airport's primary market. This information was obtained from extensive interviews with the various airport organizations. With regards to the second issue, for the purposes of the present study, the primary market is considered to be the New Haven-Meriden MSA.

¹²The multiplier methodology employed in the present study was derived from "The Location Quotient Approach to Estimating Regional Economic Impacts," *Journal of the American Institute of Planners*, vol.43, no.1, pp33-41.

¹³ If DS_i is less than zero, it is not included in the above calculation.

¹⁴It is assumed that the level of general aviation activities will remain constant, regardless of the level of commercial enplanements.

¹⁵In order to protect the confidentiality of the information, only airport totals are provided.

¹⁶Even though the passenger survey was conducted in 1995, it is assumed that the spending patterns of visitors to the New Haven area do not change dramatically from year to year; hence, it appears reasonable to assume that the mean expenditure per nonresident passenger did not vary between 1994 and 1995.