

FLIGHT TRANSPORTATION LABORATORY REPORT R 94-1

**ASSESSMENT OF THE POTENTIAL DIVERSION
OF AIR PASSENGERS TO HIGH-SPEED RAIL IN
THE NORTHEAST CORRIDOR**

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Assessment of the Potential Diversion of Air Passengers to High-Speed Rail in the Northeast Corridor

by

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ABSTRACT

The high level of intercity passenger travel in the Northeast Corridor is supported by densely populated metropolitan city-centers, the suitable distance between the urban areas, and the extent to which economic and social activities in these urban areas complement each other. Within the region, automobile and air travel account for the majority of the passenger traffic. The majority of the air passengers travel on the air shuttles operating in the Northeast. However, since the deregulation of the airline industry, there has been consistent traffic growth on regional carriers. The development of transport modes in the Northeast has been governed by the high level of competition which exists. A passenger's modal choice is influenced by the purpose of the trip. The majority of air shuttle passengers are non-discretionary (business) travellers, who are price insensitive and rely more on air travel because of its convenience and travel time.

In 1992, there were 2.41 million air passengers (including regional service) and 600,000 rail passengers travelling in the Boston-New York origin-destination market. The forecasted ridership for high speed rail in this O/D market (2010) is 2.15 to 2.25 million passengers. Of this number, 1.32 million passengers are expected to be diverted from air travel. Based on FAA forecasts for air travel between Boston and New York City in 2010, it is estimated that there will be a twenty-nine percent (29%) diversion of air passengers to high speed rail.

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Chapter 1

1.1 Introduction

The ability of ground transportation to compete effectively with air travel in the US domestic market has been inhibited by the lack of infrastructure to support high speed ground transport systems such as high speed rail (HSR) service. The introduction of high speed rail services might create an environment in which rail services could effectively compete with existing air services. At present, the US National Railroad Passenger Corporation (AMTRAK) is conducting studies on high speed rail, and has conducted test-runs with potential HSR trainsets on existing rail tracks in the northeast region (Washington DC to Boston, MA). The primary interest of this research project was to consider the potential of future diversion of air passengers to high speed rail in the Northeast Corridor.

1.2 Background

Within the Northeast Corridor of the US domestic market, air travel has become one of the dominant modes of transportation in the region. The existence of air shuttle services at Boston-Logan, New York-La Guardia, and Washington-

National account for between twenty to thirty percent of the total flight operations at each airport. At the same time, rail passenger service has maintained its presence in the region, accounting for approximately fifty percent of Amtrak's national passenger traffic. The high level of intercity passenger travel in the Northeast Corridor is supported by densely populated metropolitan areas, suitable distances between the urban areas, and the extent to which economic and social activities in these urban areas complement each other [10].

Heavy passenger demand on air travel has led to increased flight operations. This has resulted in severe air traffic control (ATC) problems which have a tremendous effect on the operations of scheduled airline carriers throughout the Northeast Corridor and the entire US domestic market. The existing ATC problems which have resulted from congested airspace around major airports could be alleviated by the introduction of improved ground transportation modes such as high speed rail, if they could divert a substantial number of air passengers. But such HSR systems would require large initial capital investments and their success would depend primarily on the volume of passenger ridership achieved in future years.

Ridership is the critical factor in determining the financial feasibility of a high speed ground transport system. It would determine the direct and indirect benefits of the system, and would be a major factor in planning and engineering the design and operational components [8]. In general, forecasting transportation demand focuses on the effects of modal factors such as trip time, cost, and frequency on an individual's choice regarding a particular travel mode. Often these market forecasts ignore total population and income trends, although these have been shown to play a major role in determining the actual traffic levels experienced in the Northeast Corridor [10].

The ability to accurately forecast passenger ridership for a new transportation system such as high speed rail in the Boston-NewYork origin-destination market is hindered by the limited data available, about existing rail service (such as the Washington DC-New York Metroliner service) which may be comparable to the proposed high speed rail (HSR) system. However, a number of research projects have focused on forecasting passenger levels for proposed high-speed rail projects for the northeast region by creating forecasting methods for an abstract transport mode endowed with a set of hypothetical modal factors.

Within the Northeast region, the existing transportation market is composed of automobile, air, railroad, and bus travel, but automobile and air dominate. The potential attractiveness of high speed rail services to the travelling public is questionable, as the current AMTRAK rail service does not have a significant modal share in the region. Advocates of high speed rail have argued that if a high-speed rail system is established in the US domestic market, most of its passengers will be diverted from the existing modes of transportation, with very little induced travel. The critical issue, then seems to be the estimates for diversion from automobile and air travel to some new form of high speed rail service.

The basis of market share estimates for competing travel modes are discussed in the *TRB Special Report 233 - In Pursuit of Speed: New Options for Intercity Passenger Transport* . The report states that for new high speed ground transport systems, the primary market potential in most travel corridors would be air passengers, although a number of travellers would be diverted from private automobiles and a small amount of new travellers could be induced. The factors affecting modal splits of passengers will include price, time, comfort, convenience, safety, and reliability.

A new high speed rail transport system could have a distinct advantage over air in some of these categories (comfort, convenience and reliability), possibly contributing to its enhanced market potential. However, it is difficult for the ground transportation system to be faster than air travel. Generally, the most important service characteristics of a transport mode are the travel time and the total travel cost (including the price of ticket for the access and egress to the mode) between the passenger's point of origin and final destination. The length of access and egress times (including wait times), are often more critical than the actual line-haul times, since they are associated with a higher level of inconvenience and physical effort. There is the issue of whether or not the new high speed rail system would offer better access/egress times.

The modal choice of a passenger is influenced by the purpose of the trip, as business travelers place a greater premium on travel time savings and have less schedule flexibility than leisure travelers. In the Northeast Corridor, the majority of air passengers are business travelers, who are price insensitive and rely more on air travel because of its convenience and travel time, rather than the other factors mentioned above. The potential for passenger diversion to high speed rail service is claimed to be greatest for existing air passengers, and thus the proposed rail service would have to match, if not surpass, the overall travel time of existing air services.

1.4 Structure of the Thesis

The first topic addressed in chapter two is a description of the existing modal service in the Northeast Corridor, with primary interest in rail and air transport services. Current rail services and a brief summary of Amtrak's activities in the region are discussed focusing on the development of high speed rail in the corridor. The development of air shuttle service between Boston-Logan and New York-La

Guardia is considered in this chapter. In addition, the growth of regular airline service in the region is presented with current statistics on the total number of airline flights offered to and from the three major metropolitan areas (Washington DC, New York, and Boston) in the region.

Chapter Three is a summary of current market demographics data, based on survey data collected by several transportation authorities in the region. Applicable data for the project were provided by Amtrak, Massport and the New York/New Jersey Port Authority. Information on rail services was derived from a report on Demand Model Estimation, published for Amtrak in 1989. The data analyzed in this report was collected in a survey conducted by Amtrak in 1986, and included information on rail, air and automobile passengers. The data were analyzed and there is a discussion of the major findings in light of existing market conditions.

In chapter four, the issue of modal split in the Northeast Corridor is considered in light of the market survey and passenger demographic data presented in chapter three. In addition, there is an analysis and discussion of the overall air passenger traffic levels between 1980 and 1992. Existing air travel markets in the region were examined, using the OD-PLUS database to retrieve the number of origin-destination passengers in each O/D pair market of interest in the region. Additional information was obtained from the Official Airline Guide (OAG) for August 1993.

In chapter five, forecasting high speed rail ridership is considered, with a primary interest in its application to the Northeast Corridor. The chapter contains a discussion of the problems in forecasting, as well as important issues associated with passenger ridership forecasts. The various types of forecasting techniques used are also discussed. A summary of available forecasts for high speed rail ridership is

presented, including a discussion of the assumptions made in the ridership forecast in light of past and existing market conditions.

In the final chapter, there is a summary of the conclusions drawn from the research project, along with a discussion of future market conditions. The assessment of the potential diversion of air passengers to high speed rail in the Northeast Corridor is considered. As a recommendation for future work on the topic, a passenger survey has been developed as part of the research project. A complete description of the Air Shuttle Passenger Survey is given in the Appendices. In addition, there is a discussion of the survey methodology and important issues related to the surveying process.

Chapter 2

Rail and Air Service in the NE Corridor

2.1 Existing Rail Service

Within the New York-Washington market, Amtrak's high speed electric rail (Metroliner) service has demonstrated that it can provide good public service. The existence of high-speed rail in the US domestic market has been limited to the New York-Washington segment (225 miles) of the corridor, where the company has made substantial investments in the infrastructure necessary to support such services. Currently, Amtrak offers a two and one-half hour premium "Metroliner" service between Washington DC and downtown Manhattan. This market is serviced by air shuttles as well as regularly scheduled flights originating at the three major airports (National, Dulles and Baltimore-Washington) which serve the metropolitan Washington area (including Northern Virginia and Baltimore).

In contrast, the enhancement of rail service between New York and Boston has been constrained by several technical limitations, such as the curvature of tracks and the lack of electrified tracks between New Haven, Connecticut and Boston. Under the Northeast Corridor Improvement Project, Amtrak has initiated a track modernization program which calls for the full electrification of rail tracks along the entire travel corridor. This will create the ideal environment for the introduction of high-speed electric rail service between New York and Boston (231 miles), a market with similar characteristics to the New York-Washington segment. The expansion of "Metroliner" service on this route is planned to reduce rail travel time to less

than three hours (station-to-station), compared to one hour (airport-to-airport) for the existing air shuttle.

Amtrak passenger rail service in the entire Northeast Corridor relies on railroad tracks which serve a mixture of intercity and commuter passenger trains, as well as freight trains, operating at speeds ranging from 60 mph to 125 mph with a broad variety of station stop patterns. Schedules on these heavily travelled lines, which comprise the Northeast Corridor, are optimized in order to minimize delay for all trains. Although several high speed proposals are based on the development of new dedicated lines, the realities of environmental issues, and extremely high construction costs for new lines will probably force new high speed train services to operate over existing rail lines. The introduction of regularly scheduled high speed rail service on existing tracks will have significant impacts on the overall rail operations of the Northeast Corridor.

The presence of high speed rail (Metroliner) service in the Washington to New York market is supplemented by conventional rail service. On weekdays, Amtrak offers seventeen (17) Metroliners and fifteen (15) conventional rail departures in each direction. This high level of service is achieved by using a four-lane rail track system between Washington-Union Station and New York-Penn Station. Metroliner fares are competitive with airlines, especially the air shuttles, which currently charge \$135 each way during the business week. The regular weekday Metroliner fare is \$93 with a discounted fare of \$75 on weekends. The price of a one-way trip on conventional rail service (just over three hours travel time) between Washington and New York is currently \$68.

Amtrak offers conventional rail service between Boston-South Station and New York-Penn Station along a coastal route, with scheduled stops at major cities

(such as Providence RI, New Haven CT, Stamford CT, and New Rochelle NY). During weekdays, there are approximately ten one-way rail trips offered between South Station and Penn Station, with two of these designated as the "New England Express" service (four hours and ten minutes time duration). The standard conventional rail travel time between South Station and Penn Station as published in the Amtrak Northeast Timetable is currently five hours. The published one-way fare ranges from \$52 to \$57 (for the express service). In contrast, current air shuttle one-way fares for one-hour travel between Boston-Logan and New York-La Guardia are \$135 with a special off-peak/youth fare of \$72.

The primary initiative of Amtrak's high speed program calls for the development of an electric trainset for use in the US domestic market, based on proven technology established in countries with years of operational experience with high speed rail systems. The US Railroad Corporation (Amtrak) is currently studying the Swedish built X-2000 high speed tilt "FASTRAIN" and the German built Intercity Express (ICE) high speed train for possible service on the Northeast Corridor including the Boston-New York segment of the route. Throughout 1993, Amtrak conducted demonstration runs of the X-2000 and the German ICE trainset in the Boston-New York and New York-Washington markets.

The X-2000 trainset utilizes a active hydraulic tilt system which contributes significantly to passenger comfort levels in high speed operations. The X-2000 train can sustain operational speeds up to 150 mph on this corridor, as it is designed to improve speed and performance on existing main line tracks without costly modifications of the alignment. The intercity express ICE train has a strong acceleration capability, a lightweight modular design, and a top speed of over 200 mph. It is suitable for the secondary high speed market , as well as dedicated HSR lines [16]. A secondary high speed market is generally defined as an origin-

destination market which is unable to financially support dedicated HSR lines due the marginal level of passenger traffic in the given market.

2.3 Northeast Corridor Improvement Project

The implementation of the Northeast Corridor Improvement Project (NECIP) by Amtrak will have a significant impact on existing rail services on the Boston-New York route. A discussion of the NECIP project in the report "Commuter-Intercity Rail Improvement Study" published by the Department of Transportation in May 1993 has been reviewed, and the major phases of the improvement project are outlined below. The primary purpose of the report was to identify and characterize costs and benefits of improvements which could be achieved in intercity and commuter rail service on the Boston-New York portion of the corridor [3].

The improvement project is divided into five major programs ranging from system rehabilitation to complete system improvements and electrification. In Program One, system rehabilitation calls for the replacement of out-dated major rail system elements to achieve improved operational safety. It would not include improvements in reliability nor reductions in travel time. The basic system improvement program (Program Two) would incorporate the activities of Program One along with improvements in service reliability and operating speeds. Program Three includes the complete electrification of rail tracks between Boston-South Station and New Haven Terminal, eliminating the need for engine change at New Haven [3].

In Program Four of the NECIP project, the realignment of tracks (to allow the operation of higher speeds on curves) would be implemented in the corridor,

especially between Providence RI and New Haven CT. The curve realignments will provide an additional reduction in trip time, decreasing the Boston-New York trip to potentially as low as two and one-half hours. The final stage of the project includes the construction of a shore line bypass track between New Haven and Providence. It would be a 50-mile long 150 mph right-of-way replacing the most curved section of the rail corridor [3].

Table 2-1 Estimated Rail Travel Time (Hr:Min) Between Boston-New York for Express (Metroliner type) Service

Source: Commuter-Intercity Rail Improvement Study (May 1993)

Program	1	2	3	4	5 *
Rolling Stock					
Current diesel/electric (NEC)	3:47	3:07	System	Fully	Electrified
Current diesel/electric Tilt	3:46	3:02			
Electric	System		2:52	2:41	2:29
Electric/Tilt	not		2:47	2:37	2:28
High Speed Electric	fully		2:46	2:35	2:22
High Speed Electric/Tilt	Electrified		2:41	2:33	2:21

Note: * Program Five includes the construction of a new by-pass track

Table 2-1 shows the estimated running time between Boston-New York for express (Metroliner type) service for each improvement program. The four system improvement programs yield projected Boston-New York trip times ranging from two and half to three hours, depending on the level of investment in the project and the type of trainset (rolling stock) used on the corridor. The values presented are based on a computer simulation plus a five percent schedule allowance for normal variations and operational delays. Travel time estimates assume the four

intermediate stops of Amtrak's present New England Express schedule (Back Bay, Route 128, Providence, New Haven). The travel times presented in the table are optimistic, requiring the validity of all assumptions and railroad operations which meet the highest standards in terms of precision and reliability. Practical running times would be several minutes longer than those shown in Table 2-1. For example, the 3:47 travel time shown for Program One currently gives scheduled times close to four hours.

2.4 Existing Airline Service

The existing air shuttle services in the Northeast Corridor were first established in the late 1960's as the economic, as well as social links between Washington, New York City and Boston experienced continued growth. Initially, these origin-destination markets were serviced by only one air shuttle carrier, but by the mid-seventies, there were two carriers offering air shuttle services between Boston-Logan and New York-La Guardia, and between Washington-National and New York-La Guardia airports. Each carrier offered hourly non-stop service in the origin-destination market, starting as early as 6.30 am, and having flights departing as late as eleven at night. The continued improvement of air shuttle services between the three metropolitan areas acted as a catalyst for the continued growth in economic and social relations.

Airline deregulation was noteworthy in the Northeast Corridor markets, as many airlines such as Peoplexpress (acquired by Continental Airlines in 1987) established new scheduled air service particularly into Newark, New Jersey, which due to its close proximity to New York City, serves as one of the three major airports for the city. Moreover, the years immediately after the deregulation act (1978) saw

the growth in regional air carriers, as many startup companies decided to enter the then lucrative airline industry, especially origin-destination markets such as Boston-New York and Washington-New York, which had high volumes of traffic annually. The growth of regional carriers was facilitated by the introduction of larger regional aircraft types such as the Aerospatiale ATR 42/72 and Saab SF 340. The ability of the regional carriers to compete more effectively with jet service improved since these new regional aircraft had much higher cruising speeds and required lower operating costs than prior regional aircraft.

Over the last decade, the airline industry has survived several mergers and acquisitions involving major airlines serving the northeast region. Although the number of carriers serving the market has decreased from its high early post-deregulation years, the number of available seats miles offered has remained more or less consistent, as the surviving carriers increased their frequency of service, and started using larger aircraft on the routes. These improvements in the quality of service have been more pronounced for the regional carriers.

In the Washington-New York origin-destination market, air shuttle operations using 150 seat aircraft exist between Washington-National Airport and New York-La Guardia Airport. At present, there are thirty-one (31) daily air shuttle departures (each direction) offered in the O/D market during the business week. The published one-way unrestricted air fare between the city pair is currently \$135, a substantial increase from the \$60 fares before domestic deregulation as passengers have shown willingness to pay greatly increased fares for the air service. These air shuttle services are complemented by regular air service between the three major airports in the metropolitan DC area and New York's three major airports. There are sixteen (16) additional daily jet departures from National, nine (9) jet departures

from Dulles and thirteen (13) jet departures from Baltimore-Washington airport, destined for the New York metropolitan area [D1].

Since deregulation, the origin-destination market between New York and Washington is now also serviced by a large number of regional carriers operating at the three Washington airports. The dominance of air shuttle services between La Guardia and National has limited the number of regional flights offered between the two airports. However, regional carrier operations account for a substantial percentage of the daily passenger flights between Dulles and the New York airports, and between Baltimore-Washington and the New York airports. In total, there are eighty-four (84) daily regional carrier departures from the Washington area to the three New York airports. There are thirty-one (31) regional departures from National, thirty-two (32) departures from Dulles, and twenty-one (21) from Baltimore-Washington [D1]. All of these frequencies substantially exceed the seventeen Metroliner and fifteen conventional rail services in the market.

Currently, the Boston-New York market is serviced by two air shuttles (Logan-La Guardia), as well as several other regularly scheduled major and regional carriers. In total, these carriers offer seventy (70) daily jet aircraft departures from Boston-Logan to New York's three major airports, along with forty-four (44) turboprop departures, again substantially exceeding the ten rail departures. The number of turboprop departures reflect the significant increase in the level of air regional traffic between the two cities, as many regional airlines have entered these lucrative markets. On a daily basis, there are thirty-four (34) air shuttle departures (150 seat aircraft) from Logan Airport to La Guardia Airport, which serves as a gateway for the two air shuttles serving the New York-Boston market.

Table 2-2 Summary of Airfares Offered in the Northeast Corridor
Source: *Airline Reservation Operators*

Destination	La Guardia (LGA)	John F Kennedy (JFK)	Newark (EWR)
Origin			
Boston			
14 AP SAT	\$104 - \$138	\$104 - \$138	\$128
7 AP SAT	\$140 - \$340	\$140 - \$340	\$155
3 AP SAT	\$100 OW	\$100 OW	\$161
14 AP NO SAT	n/a	n/a	\$194
7 AP NO SAT	n/a	n/a	\$236
3 AP NO SAT	n/a	\$98 - \$158 OW	\$309
Washington			
IAD/DCA			
14 AP SAT	\$128 - \$148	\$128 - \$148	\$128 - \$148
7 AP SAT	\$155 - \$210	\$155 - \$210	\$155 - \$210
NO AP SAT	\$161 - \$340	\$161 - \$340	\$161 - \$340
NO AP NO SAT	\$309 - \$340	\$309 - \$340	\$309 - \$340
Baltimore (BWI)			
14 AP SAT	\$118	n/a	n/a
7 AP SAT	\$169	n/a	n/a
No restriction	\$238	n/a	\$69* - \$138

Notes:

* Continental introduced the "peanut fare" structure in the EWR/BWI market.

n/a Airfare for specific origin-destination market not available.

AP Number of days advanced purchase required

SAT Saturday night stay required

All air fares are quoted for round-trip travel unless otherwise stated.

Airfares are based on phone inquiries conducted on November 13, 1993.

The range of airfares quoted incorporated fares offered by all airlines in each O/D market, based on listing in the Official Airline Guide (October 1993).

The air shuttle services are supplemented by thirty (30) jet departures to Newark and six jet departures to JFK. The majority of the forty-four turboprop departures serve the Boston-Logan to New York (JFK) international connecting travel market, and account for a minimal percent of the New York-Boston O/D passenger market [D1]. In addition, regional service exists between Boston-Logan and Long Island-Islip, Boston-Logan and White Plains, using turboprop aircraft.

In the 1980's, much larger 300 seat aircraft were used at peak times on shuttle routes, offering better economics, and a return to such practices could serve as a solution to future congestion problems. Due to various changes in the marketplace, (a second competitor and the development of regional service), these larger aircraft have disappeared, but they will return if there is future growth in the shuttle markets. As the reader will see in chapter four in the discussion of air market trends over the last decade, the total number of airline passengers in the Northeast region has varied as a result of economic and social conditions, as well as the aftermath effects of the airline deregulation act (1978).

Table 2-2 presents a summary of the current airfare offerings in the Boston-New York and the Washington-New York O/D markets. The variation in the cost of air travel in the region depends on several factors including requirements of advanced purchasing, Saturday night stay and the time of travel (example off-peak hours). The prices of regularly scheduled air services (excluding the air shuttles) are driven by market conditions, and are usually far less than the air shuttle price of \$135 (unrestricted) for each one-way segment. However, the diversion of air shuttle passengers to the cheaper flights is limited by the heavy restrictions which are often imposed on these fare offerings. The air shuttle services are thought to be highly profitable, and the price would easily be lowered if any mode was able to cause diversion. At present, they have a monopolistic position for business travellers.

Chapter 3

Market Surveys and Demographics

In this chapter, a review of available data on passenger demographics and travel demand within the Northeast Corridor is presented. Since 1986, there have been a number of surveys of passenger activity conducted by transport agencies in the region. Three such surveys are described below which include data on air shuttle services at Boston-Logan Airport and New York-La Guardia, as well as data on conventional passenger rail service in the corridor. They are the Amtrak Survey 1986, the La Guardia Airport Air Passenger Survey 1990, and the Massport Logan Airport Ground Access Study 1990.

3.1 Amtrak Survey 1986

The characteristics of the intercity passengers who travel within the Northeast Corridor (Washington DC to Boston) region, are influenced by the high level of economic and social interactions which exist amongst the major cities in the region. The interest of high speed rail in North America often focuses on this market, primarily because it is often considered to be the most likely transport corridor for a new high speed ground transport system to become economically viable [10]. In 1986, Amtrak commissioned a comprehensive analysis of travel patterns in the Northeast Corridor in order to develop a database which would be used for demand model estimation for the region.

The primary objectives of the 1986 Amtrak study were to develop a new travel database and to examine travel behavior for distinct market patterns. The collected data, which included trip choice data and passenger characteristics, were used to define modal choice models and to estimate appropriate coefficients of abstract mode passenger demand models. The information used in the demand modeling was obtained primarily from the analysis of an extensive traveller survey, and from secondary sources such as carrier records and government transportation agencies. The traveller survey was administered in two parts, with a household based survey and an enroute survey. The enroute survey was distributed on board Amtrak trains, at selected airports in the region and at screen lines on major highways in the corridor which were accessible by survey personnel [5].

The development of the modal split model required two modal characteristics, the access impedances and the linehaul impedances. In the Amtrak report, impedances are defined as the disutility or generalized economic cost of travel for a person in terms of time, cost or delay, that characterize a particular set of transportation mode choice for travelling between two points. Impedances include access characteristics to and from intercity terminals and major mode linehaul characteristics between cities. Model development consisted of establishing a model structure and estimating model coefficients through statistical estimation techniques [5].

The information presented is a summary of the major findings of the Amtrak study submitted to the National Railroad Passenger Corporation in July 1989. The overall traffic volumes for 1986 were determined from the travel surveys. Observed air trip volumes were obtained by combining annualized one-way passenger counts by origin and destination airport hubs from the 1986 ten percent sample CAB survey of certified airlines and the 1986 Commuter Air Carrier Activity data. Data on rail

trip volumes was obtained from fiscal year 1986 Amtrak one-way ticket counts by origin station and destination station. Traveller survey data were adjusted and converted to annual volumes, incorporating data observed Amtrak volumes and CAB airline volumes [5].

Table 3-1 Total Trip Volumes in the Northeast Corridor based on Survey Data
Source: *AMTRAK Final Report 1989*

A. Point of Origin: **Boston**

Destination City	Rail	Air	Auto
New York	209,650	1,213,395	2,598,918
Washington DC	27,229	555,152	287,425

B. Point of origin: **Washington**

Destination City	Rail	Air	Auto
New York	519,531	1,158,777	1,657,336
Boston	27,229	555,152	287,425

Indicated values represent the number of one-way passengers in the origin-destination market.

Table 3-1 shows the adjusted travel volumes between the three major cities along the Northeast Corridor. Although the traffic levels have varied considerably since 1986, it is anticipated that the modal shares amongst the competing travel modes have not changed significantly over the period. The corresponding modal splits for the Boston - New York market and the Washington DC - New York market are presented in Figure 3-1. In both origin-destination markets, the automobile accounts for the majority of the traffic, while rail has the lowest mode share in each market (15% Was-NY, 5% Bos-NY).

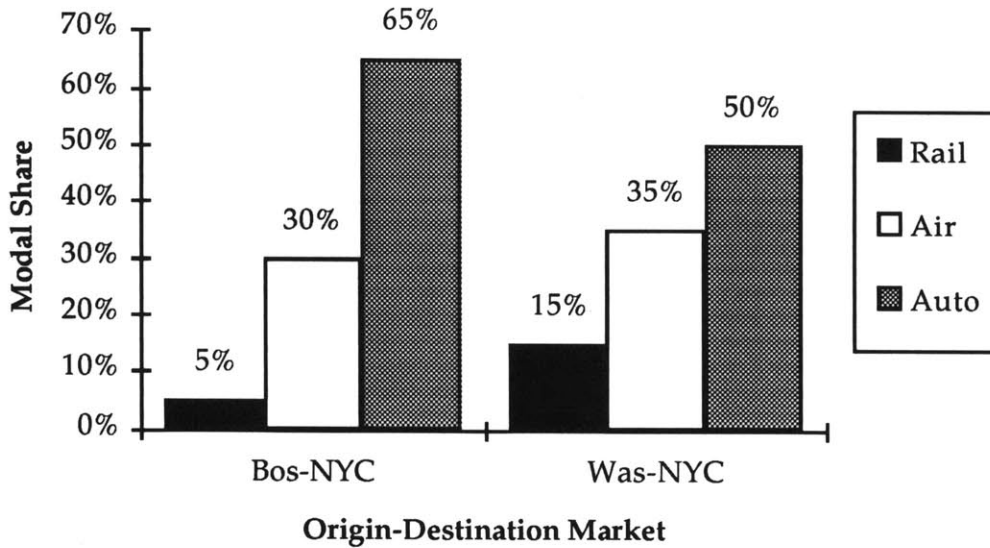
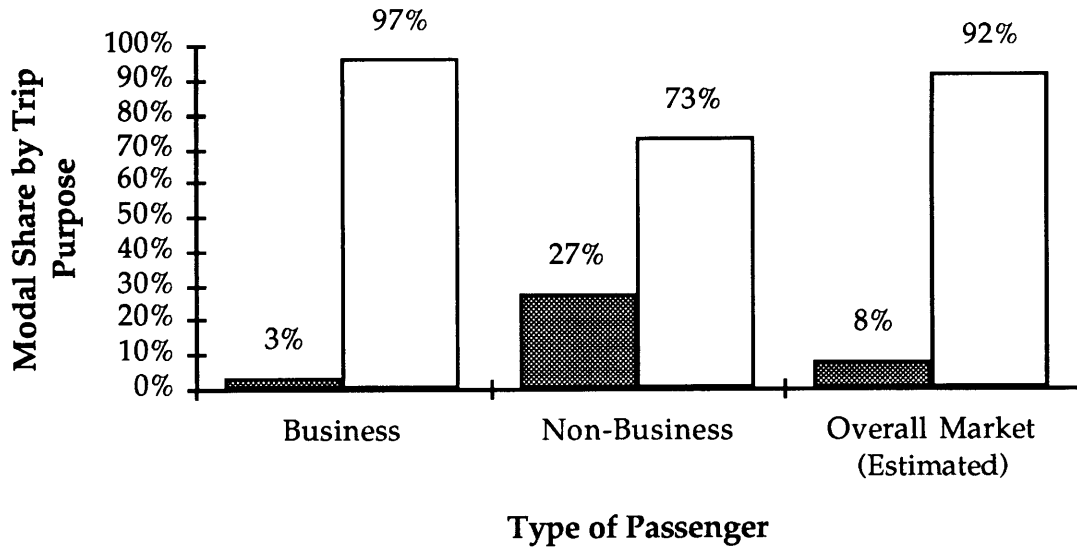


Figure 3-1 Modal Shares in Major Segments of the Northeast Corridor
 Source: AMTRAK Final Report 1989

The modal choice of a passenger is driven by the trip purpose, as well as several other factors. The estimated modal splits in the business and non-business categories for air and rail passengers are shown in Figure 3-2.

Within the Boston-New York market, almost all (97%) of the business travellers prefer the air mode over the existing rail option (see Figure 3-2). This mode preference is less pronounced for the non-business traveller where the air share is seventy-three percent versus twenty-seven percent for the rail. The modal split is somewhat different in the Washington DC - New York market, in which Amtrak operates a faster Metroliner train service which is more competitive with the air services between the two metropolitan areas. In the non-business market, the modal share is almost evenly split (rail 48% - air 52%) between the two modes. Within the business market, the air services still possess a dominating market share advantage over the rail option (rail 14% - air 86%).

Boston - New York Market



Washington - New York Market

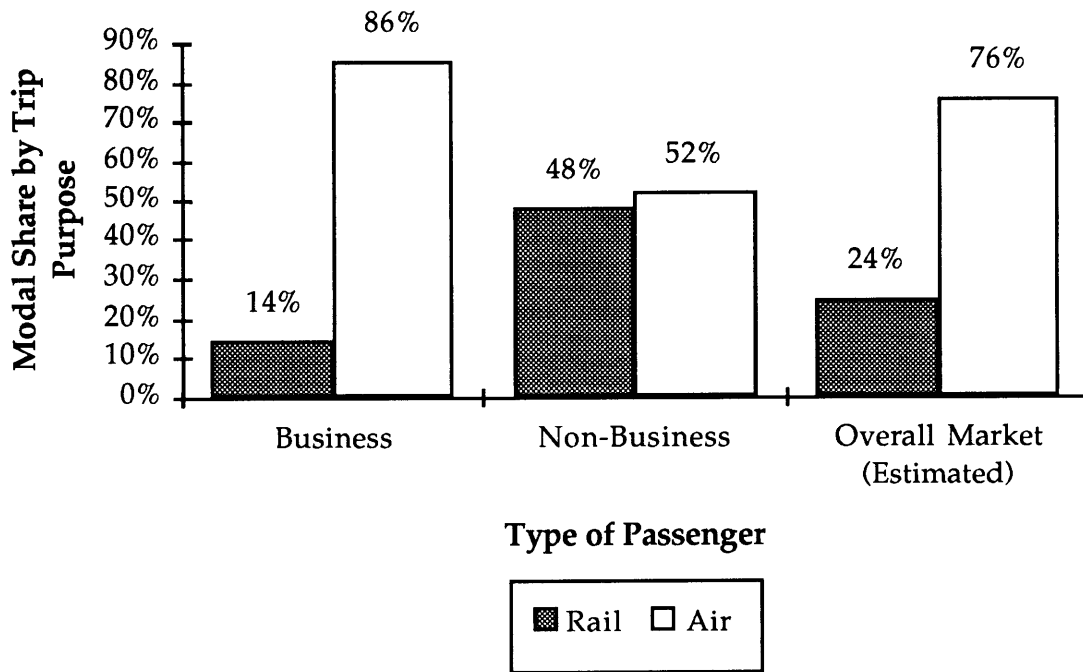


Figure 3-2 Modal shares of Common Carriers (Rail/Air) in the NE Corridor Distribution of Mode Choice Based on Trip Purpose.
 Source: AMTRAK Final Report 1989

Based on the data from the La Guardia Air Passenger Survey 1990 and the Massport Ground Access Survey 1990 (discussed in subsequent sections of this chapter) the percentage of business passengers in the Boston-New York market is 79%. By using these values, it can be estimated using the Amtrak survey data that approximately 92% of all the travellers using common carriers (rail and air) in the Northeast Corridor choose air services, compared to eight percent for rail travel. The number of business travellers using common carriers (rail and air) in the New York to Boston market was approximately 1.125 million passengers in 1986, compared to 298,840 leisure passengers in the same year.

Similar results were determined for the Washington-New York market where there was a 69.8% business to 30.2% leisure split in the survey data. It was estimated that close to 75.7% of all the passengers using common carriers choose air services over existing rail services between Washington-Union Station and New York-Penn Station. Based on the 1986 Amtrak study, the number of business travellers using common carriers (rail and air) in the Washington to Boston origin-destination market was approximately 1.172 million passengers, compared to 506,850 leisure passengers in the same time period.

By the end of the decade, the modal split between rail and air service in the Northeast Corridor was affected by the growth in regional carriers in the region. The market share of regional airlines has increased significantly from its negligible percentages in 1980. The increased presence of regional service has appeared to have had a greater impact on the level of air shuttle passenger traffic within the market. As a result, the market share of Amtrak's rail service between New York and Washington appears to have increased since the 1986 study. In 1992, Amtrak carried almost 43% (rail and air shuttle travel) of origination-destination passengers in the New York-Washington market, a six percent increase over 1990 levels [13].

3.2 La Guardia Airport Air Passenger Survey 1990

The following analysis and summary of air shuttle operations at La Guardia airport, are based on the final report of the "Air Passenger Survey 1990-1991, Volume 2: La Guardia Airport," prepared by the New York-New Jersey Port Authority. It was possible to isolate the air shuttle passenger data in this report, and these shuttle services between Boston and New York, and Washington and New York have been described in Chapter two. The data presented in this final report was collected via the Air Passenger Survey, conducted over a twelve month period from April 1990 through March 1991. Over the period, the northeast air shuttle services to Boston-Logan and Washington-National accounted for 16.7 % of the total aircraft operations at La Guardia Airport, achieving a total annual traffic level of 1.810 million revenue passengers.

The location of La Guardia airport relative to Manhattan results in a large percentage (70%) of business travellers on the air shuttles from New York City to both Boston and Washington DC. The number of leisure travellers on the air shuttles accounted for approximately thirty percent of the boarded passengers. Table 3-2 shows percentages based on trip purpose on both air shuttles.

Table 3-2 Breakdown of LGA Air Shuttle Passengers Based on Trip Purpose
Source: Air Passenger Survey 1990-1991

<u>Trip Purpose</u>	<u>Shuttle Passengers</u>
Business	69.8%
Leisure	30.2%

The New York city metropolitan area is serviced by three major international airports (La Guardia, John F Kennedy, Newark) as well as two regional airports (White Plains, and Islip). The majority (80%) of the New York City based air shuttle

passengers at La Guardia airport originate in Manhattan, as represented in Figure 3-3b. This accounts for only sixty-four (64%) of all shuttle passengers, since only eighty (80%) of all passengers originate in New York City as shown in Figure 3-3a.

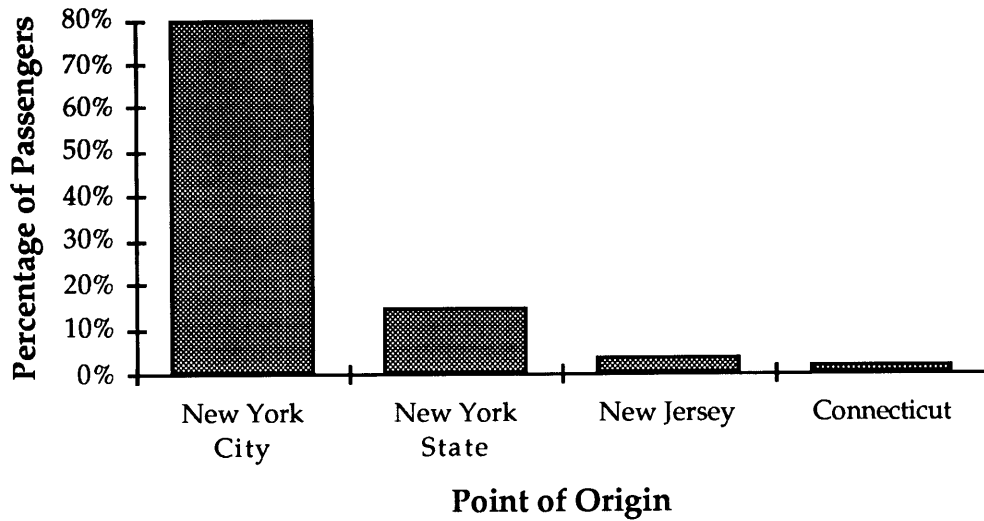


Figure 3-3a Distribution of LGA Air Shuttle Passengers Based on Point of Origin

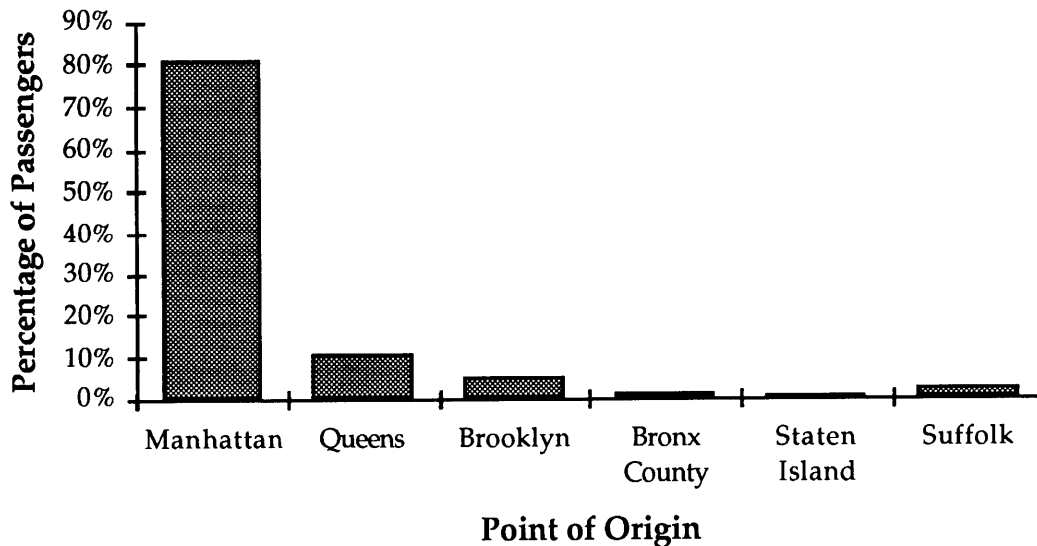


Figure 3-3b Distribution of La Guardia Air Shuttle Passengers Based on Point of Origin Within New York City

Source: *Air Passenger Survey 1990-1991*

The majority of the passengers using the air shuttle carriers at La Guardia airport are frequent flyers (with over seventy-five percent of the surveyed passengers defining themselves as such). The actual break-down of passengers based on frequency of travel is given in Figure 3-4. From the data, it can be estimated that close to 60% of the air shuttle passengers take more than ten flights annually.

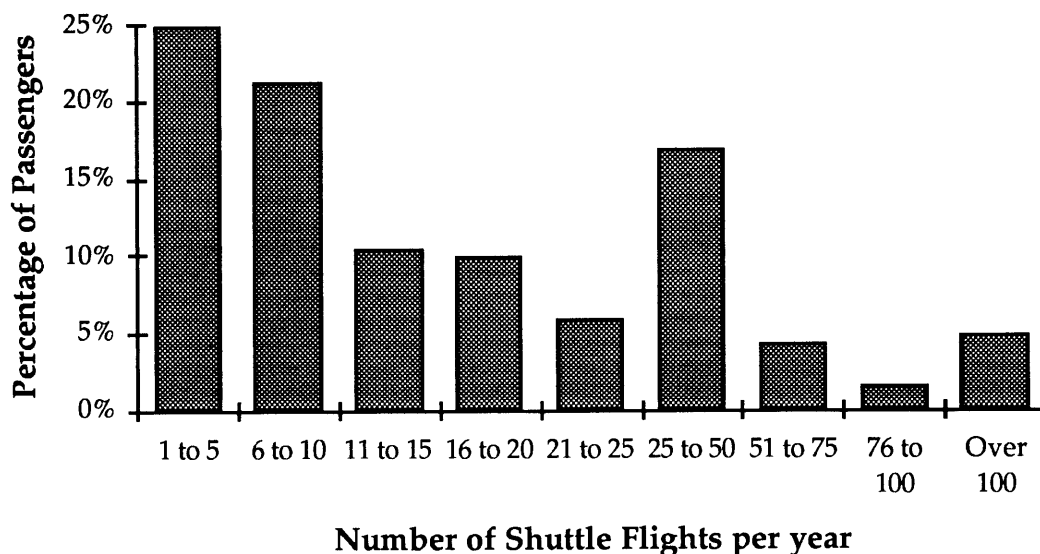


Figure 3-4 Breakdown of LGA Air Shuttle Passengers Based on Trip Frequency
 Source: *Air Passenger Survey 1990-1991*

The prevalence of business passengers on the air shuttles is also reflected by the distribution based on the duration of the trip. The majority of the air shuttle travellers in the survey had a stay equal to or less than three days. Approximately twenty-one percent of the air shuttle passengers were travelling on one-day trips. The overall distribution among surveyed passengers is presented in Figure 3-5. Based on the data, the average stay for an air shuttle passenger is approximately three days. Most of the air shuttle passengers were travelling alone, with closely to eighty percent declaring themselves to be solo travellers.

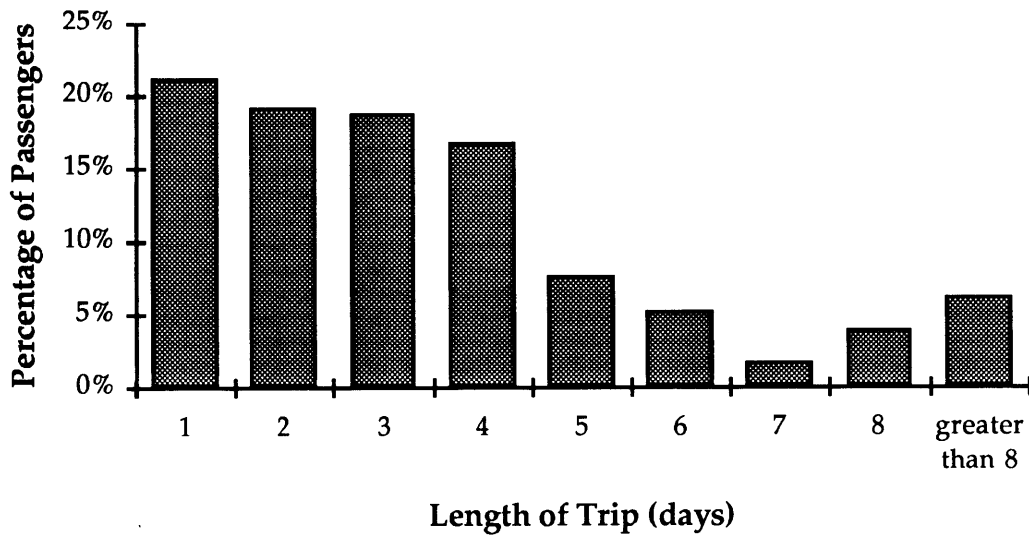


Figure 3-5 Breakdown of LGA Air Shuttle Passengers Based on Length of Trip
 Source: *Air Passenger Survey 1990-1991*

Passenger demographics were also reported in the final report on the Air passenger survey. The most frequently reported age group for the air shuttle passengers was 35 to 44 years old. The overall market distribution by age group is shown in Table 3-3.

Table 3-3 Age distribution of La Guardia Air Shuttle Passengers
 Source: *Air Passenger Survey 1990-1991*

<u>Age Group</u>	<u>Shuttle Passengers</u>	
12 to 19	41	(2.3%)
20 to 24	224	(12.7%)
25 to 34	439	(24.9%)
35 to 44	497	(28.2%)
45 to 54	319	(18.1%)
55 to 64	154	(8.75%)
Over 65	87	(4.9%)

The household income distribution of La Guardia air shuttle passengers is shown in Table 3-4, in which the most frequently reported income bracket was \$60,000 to \$80,000.

Table 3-4 Income distribution of La Guardia Air Shuttle Passengers
Source: Air Passenger Survey 1990-1991

Household Income	Shuttle Passengers
Under \$20,000	4.0%
\$20,000 to \$39,999	11.3%
\$40,000 to \$59,999	13.6%
\$60,000 to \$79,999	16.1%
\$80,000 to \$99,999	15.1%
\$100,000 to \$119,999	14.4%
\$120,000 to \$139,999	5.1%
\$140,000 to \$159,999	4.9%
\$160,000 and over	15.6%

3.3 Massport Logan Airport Survey 1990

In 1990, the Massachusetts Port Authority commissioned studies of ground access travel patterns of airline passengers departing from Logan International Airport. The data collected in this study was used to ascertain an updated view of ground access behaviour, and in the Authority's ongoing ground access planning program. The material discussed below is taken from data generated from the database developed from the 1990 Ground Access Survey. The main interest of our research project centers around the point of origin distribution of air shuttle passengers departing from Logan. From the collected data, it was possible to obtain a detailed breakdown of air shuttle passenger demand based on origin (Appendix B).

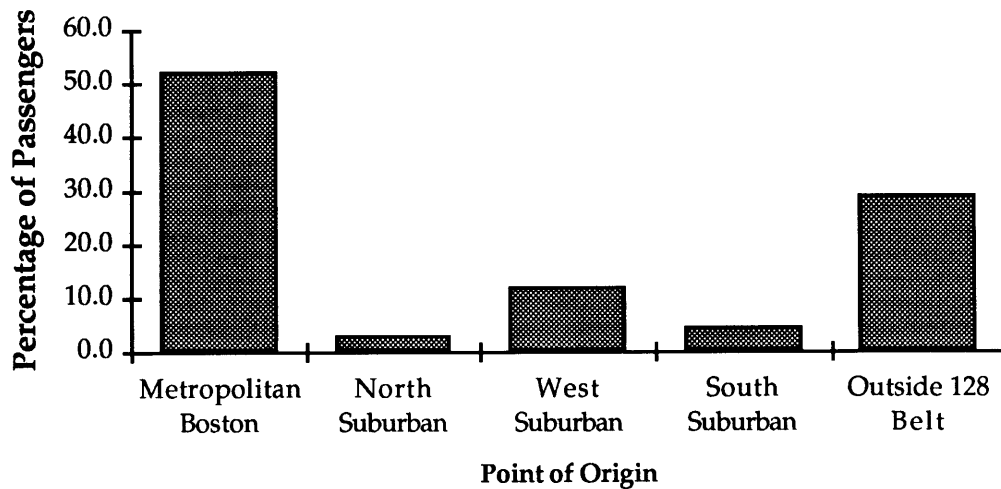


Figure 3-6 Distribution of Logan Air Shuttle Passengers Based on Origin
 Source: *Logan Ground Access Survey 1990*

In considering the viability of high speed rail in the Metropolitan Boston to New York City market, it is important to consider the distribution of origin point at both terminals, as this will play an essential role in determining the attractiveness of such a rail system. From the data, it was established that the majority (70%) of the shuttle passengers departing from Logan originate from within the 128/495 belt around the city, with the largest percentage (50%) of passengers starting their trip from the Boston center area (Boston, Cambridge, Somerville and Brookline). The second largest percentage (30%) of passengers originate from outside the 128/495 area as identified in Figure 3-6. The grouping of cities and municipal areas into the five major categories is based of the NYNEX directory system (listed in Appendix B).

From the Logan Ground Access Survey 1990, it was established that seventy percent of the departing Logan shuttle passengers were destined for the New York City metropolitan area (but not necessarily Manhattan where a high speed rail station might be located), with most of the remaining passengers terminating their travel within the tri-state area. Note that if only fifty percent (50%) of the air shuttle

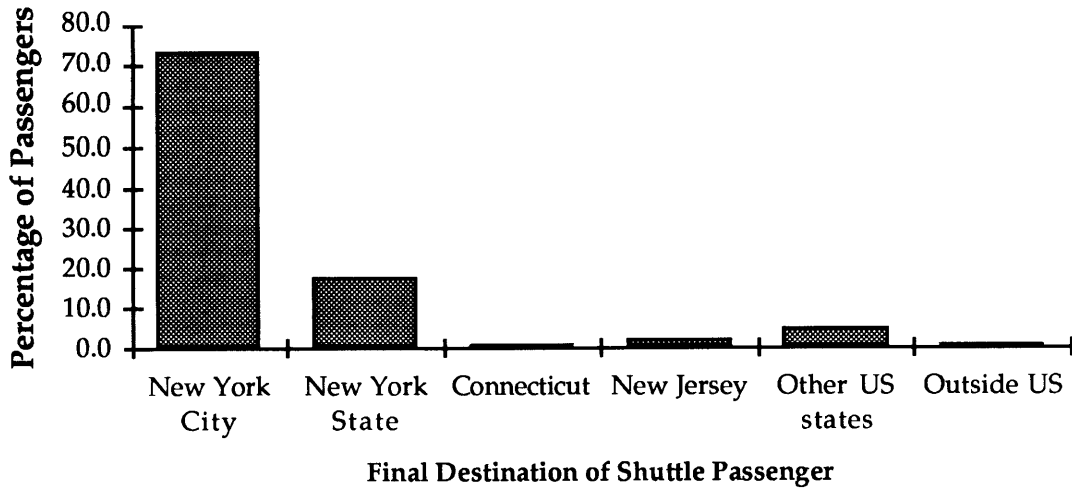


Figure 3-7 Distribution of Logan Air Shuttle Passengers based on Destination
 Source: *Logan Ground Access Survey 1990*

passengers start their trip within the Boston center area, and only seventy (70%) are destined for New York City, then approximately 35% of air shuttle passengers are city-center to city-center passengers, who might use a competing rail service from South Station to Penn Station. A very small percentage of the shuttle passengers were identified as connecting travellers, with itineraries leading to other domestic cities. The overall distribution of passengers based on final destination is presented in Figure 3-7.

Table 3-5 Breakdown of Logan Air Shuttle Passengers based on Trip Purpose
 Source: *Logan Ground Access Survey 1990*

Trip Purpose	Resident*	Non-Resident	Shuttle Passengers
Business	30.2%	48.9%	79.1%
Leisure	7.5%	9.5%	17.0%
No response	0%	3.9%	3.90%

*Where a resident is defined as a legal resident of MA, NH, and RI

The percentage of business travellers in the Logan air shuttle market is very similar to the distribution observed in the La Guardia market. The majority of the departing Logan air shuttle passengers are business travellers, with close to eighty percent being classified as such. The high percentage of business travellers in the Boston-New York origin-destination market results from the close economic interactions which exists between the two financial centers. The overall distribution of passengers based on trip purpose is presented in Table 3-5.

From the Logan survey, it was also possible to establish that a greater percentage of passengers (62.3%) using shuttle services at Logan are not residents of the region. The difference between resident and non-resident travellers is more pronounced in the business segment (48.9% non-resident versus 30.2% resident), perhaps because many New York based companies, have opened secondary offices in the metropolitan Boston area. The prevalence of non-residents in the survey data is reinforced by the percentage of passengers originating in the metropolitan Boston area (approximately 50%), as most visitors to the city, seek accommodations in the

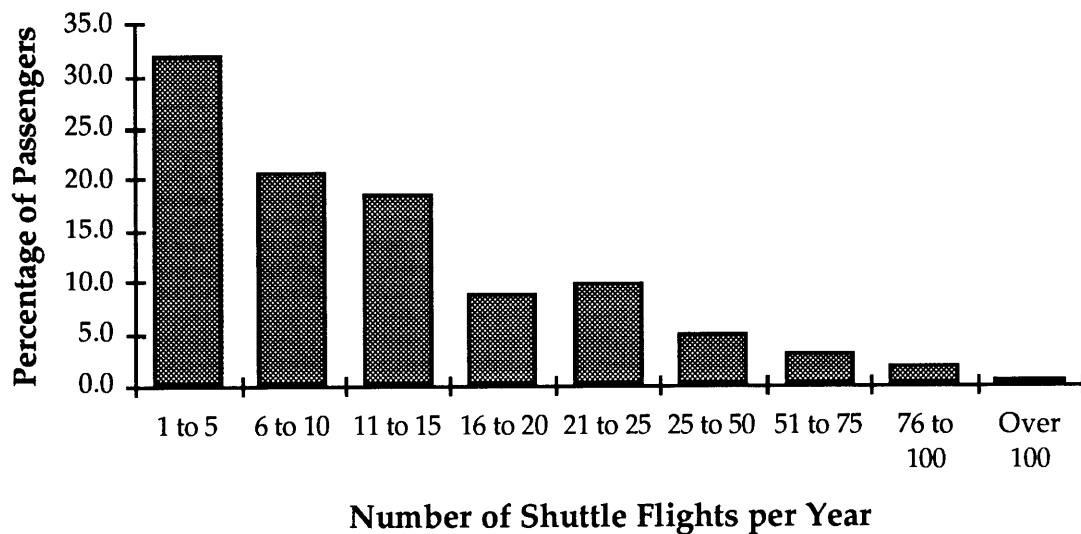


Figure 3-8 Breakdown of Logan Shuttle Passengers based on Trip Frequency
 Source: *Logan Ground Access Survey 1990*

metropolitan area, because of factors such as accessibility and location relative to the city center. The high percentage of business travellers in the Logan market is also reflected by the number of frequent flyers observed. Approximately fifty percent of the surveyed travellers had taken more than ten air shuttle flights in a preceding twelve month period, and nearly 70% had taken five or more in the same time period. The distribution of passengers based on frequency of travel is given in Figure 3-8.

In the Logan survey 1990, passenger demographics were collected in conjunction with the primary data on ground accessibility. Generally, the demographics of interest to forecasters are age and household income, as these parameters will play a significant role in the estimating future demand for a transportation mode. It was established that the 31 to 40 age group had the highest percentage in the market, based on the response of the surveyed passengers. The overall distribution of shuttle passengers by age group is shown in Table 3-6.

Table 3-6 Age distribution of Logan Air Shuttle Passengers
 Source: *Logan Ground Access Survey 1990*

Age Group	Shuttle Passengers
Under 21	2.0%
21 to 30	23.2%
31 to 40	29.1%
41 to 50	27.0%
51 to 60	12.4%
Over 60	6.4%

The household income distribution for the Logan air shuttle passengers is shown in Table 3-7. From the data, it was determined that the most frequently reported

income bracket was \$120,000 and above, with the \$60,000 to \$80,000 bracket having the next highest percentage.

Table 3-7 Income distribution of Logan Air Shuttle Passengers
 Source: *Logan Ground Access Survey 1990*

<u>Household Income</u>	<u>Shuttle Passengers</u>
Under \$20,000	3.5%
\$20,000 to \$39,999	7.8%
\$40,000 to \$59,999	12.4%
\$60,000 to \$79,999	15.0%
\$80,000 to \$99,999	14.3%
\$100,000 to \$119,999	8.9%
\$120,000 and over	38.1%

3.4 Summary of Market Demographics

The development of existing transportation modes in the Northeast Corridor has been influenced by the high level of competition which exists in the market. Currently, automobile, conventional rail, and air travel are the primary modes of transportation modes in the corridor, with the automobile being the most dominant transport mode. Within the corridor, air shuttle services account for the majority of the origin-destination common carrier passengers within the region. In chapter two, existing rail and air services were reviewed and the competitive environment which exists was considered.

Over the last decade, there has been a gradual reduction in the number of passengers using each public transport mode, in part, due to the economic condition which has existed in the US domestic market. It is assumed that the market share of the individual modes has not changed significantly over the period, as they all have

been affected by the recession. The modal choice of a passenger is influenced primarily by the total travel time and the price of travel. It is also influenced by service characteristics such as the reliability of the scheduled travel time, the convenience of departure times, comfort, on-board and in-terminal amenities, and the perceived safety of the travel mode.

The distribution of originating air shuttle passengers at Boston-Logan airport was determined using data from the ground access survey conducted by Massport in 1990. From the survey data, it was established that the largest percentage of air shuttle passengers originated in the metropolitan Boston area, with the second largest percentage originating from outside the Route 128/495 perimeter surrounding Boston. In addition, it was found that the majority (70%) of the air shuttle passengers were destined for New York City (but not necessarily Manhattan). This leads to an estimate that less than one-third of air passengers can be classified as city-center to city-center passengers in the Boston-New York market.

The La Guardia Air Shuttle Passenger survey data showed that approximately eighty percent of the air shuttle passengers started their trips in New York City, and of this number, over eighty percent originated in Manhattan, i.e. sixty-four percent of air shuttle passengers originated in Manhattan. It is not known where their final destinations were in Boston or Washington. Since there is not much difference in access/egress times between rail and air in Boston and Washington, there is a small fraction of air passengers for whom the access to Manhattan is improved by rail service.

The majority of air shuttle passengers are business travellers who are time-sensitive, and rely on the air mode because of its travel time and frequency advantage over rail services. In the Air Passenger Survey 1990 conducted at La

Guardia airport, it was found that close to seventy percent of the surveyed passengers were on business trips. The percentage of business travellers in the Logan-La Guardia air shuttle market was similar to the distribution observed in the La Guardia air shuttle markets. It was determined that close to eighty percent of the surveyed passengers were non-discretionary travellers. In addition, it was observed that the majority of the business travellers were non-residents of the designated region (Massachusetts, Rhode Island and New Hampshire).

The percentage of business travellers on existing rail service does not follow the same pattern as that of the air shuttles. In the Amtrak survey 1986, it was observed that for business trips, rail service accounts only for three percent in the Boston-New York market and fourteen percent in the Washington-New York market. In the discretionary market segment, rail services account for twenty-seven percent in the Boston-New York market and forty-eight percent in the Washington-New York market. These "improved" rail market shares in the Washington-New York market can be attributed to the presence of the premium Metroliner rail service offered in conjunction with the regular conventional rail service. However rail service still has not attracted many business passengers, since only 14% of all passengers on all Amtrak services (Metroliner, Express, and Regular) between Washington and New York City are on business trips.

Chapter 4

Existing Air Market Conditions-Passenger Traffic

4.1 Traffic Modal Split

The Northeast Corridor is by far the most heavily travelled region in the US domestic market. The region is serviced by regularly scheduled airline flights (including two air shuttle carriers), rail service, bus service, and offers an elaborate network of highways and freeways for automobile travel. The competition amongst the different modes of transportation is high, but as stated in Chapter One, air travel has evolved to be one of the dominant modes in the region. The number of air shuttle passengers travelling in the corridor between New York and Boston, and New York and Washington has declined from 3.6 million in 1989, to 2.8 million in 1992 [13]. The total number of air passengers (including regional traffic) in 1992 was 5.02 million, compared to 6.35 million passengers in 1989 [based on the CAB sample]. The decline in air shuttle passenger traffic in the region can be attributed in part to the increase in the number of flights offered by other regularly scheduled air carriers. Moreover, air travel, particularly business air travel, depends on the state of the economy as will be seen in this Chapter.

Although the air shuttles experienced significant reductions in passenger traffic over the four year period, Amtrak's passenger traffic in the Northeast Corridor has declined only slightly over the period (2.2 million passengers to 2.1 million passengers). In 1992, Amtrak's rail services between Boston-South Station and New York-Penn Station accounted for 20.9 percent (rail plus air shuttle) of passengers

travelling in the market. This figure (20.9%) reflects an increase in market share from 17.3 percent in 1990 [13]. As mentioned in Chapter Three, this increase in Amrtak's market share when compared only to the air shuttle, may be a result of the increased competitiveness of regional air carriers in the travel market. It is important to remember that the rail mode is not one of the dominant modes in the northeast region. As discussed in chapter three, automobile and air travel are the two most dominant modes in the region.

The market success of a high speed electric rail system in the Northeast Corridor will be influenced by the travel characteristics and demographics of existing passengers travelling in the region. These issues were discussed in Chapter Three. The potential for the diversion of air passengers to high speed rail will depend on the existing air travel market. It is thus important to consider the current market conditions, and to analyze recent trends in airline passenger levels within the Northeast region in light of the various external factors which have affected the US domestic airline industry since 1980.

4.2 Existing Air Market Trends

In the aftermath of the US domestic Airline Deregulation Act (1978), most major and national carriers have restructured their route system with an emphasis on the hub and spoke network concept, and a reliance on smaller commuter carriers to feed secondary markets. This transition in airline operations has had a significant impact on the number of passengers travelling in many origin-destination markets. There has been a continued growth of traffic on regional airlines in the Northeast region over the period 1980 through the beginning of 1990. By the second quarter of 1990, poor economic conditions had started to affect the level of passenger traffic in

the Northeast region with a gradual downward trend. In addition, the cost of airfares escalated as a result of the Gulf War; adding to the decline in the level of passenger traffic in the region. Many companies reduced the number of business trips for their employees by investing in video-conferencing and more cost-effective communication options.

4.2.1 Boston-New York O/D Market

The level of air passenger traffic in the Boston-New York origin-destination market has fluctuated over the last decade (1980s) with its highest level occurring in the second quarter of 1988. The number of passengers, by quarter, travelling between Boston-Logan and New York City is shown in Figure 4-1, based on ten percent sample data collected by the Department of Transportation. This data was obtained using the OD-Plus database system [D5] which contains a historical listing of CAB data since 1979. In the Boston-Newark sub-market, the number of air passengers has increased significantly as a result of Peoplexpress and Continental Airlines (which absorbed Peoplexpress operations in 1987) establishing hub operations at Newark International. With the increased frequency of service, the route has become more attractive to local O/D passengers whose itineraries are better suited by the location of Newark Airport. The presence of a dominant air carrier in the Boston-Newark market has inhibited service by regional carriers which account for less than twenty-five percent of the total air passenger traffic.

The presence of air shuttle service between Boston Logan airport and New York La Guardia airport accounts for the majority of jet passenger traffic between the two metropolitan areas. The observed trends in the Boston to La Guardia market are direct reflections of the economic condition of the US economy and trade industry, as business passengers (or “commuters”) make up most of the traffic. The air shuttle

Quarterly Passenger Traffic for Major Airlines

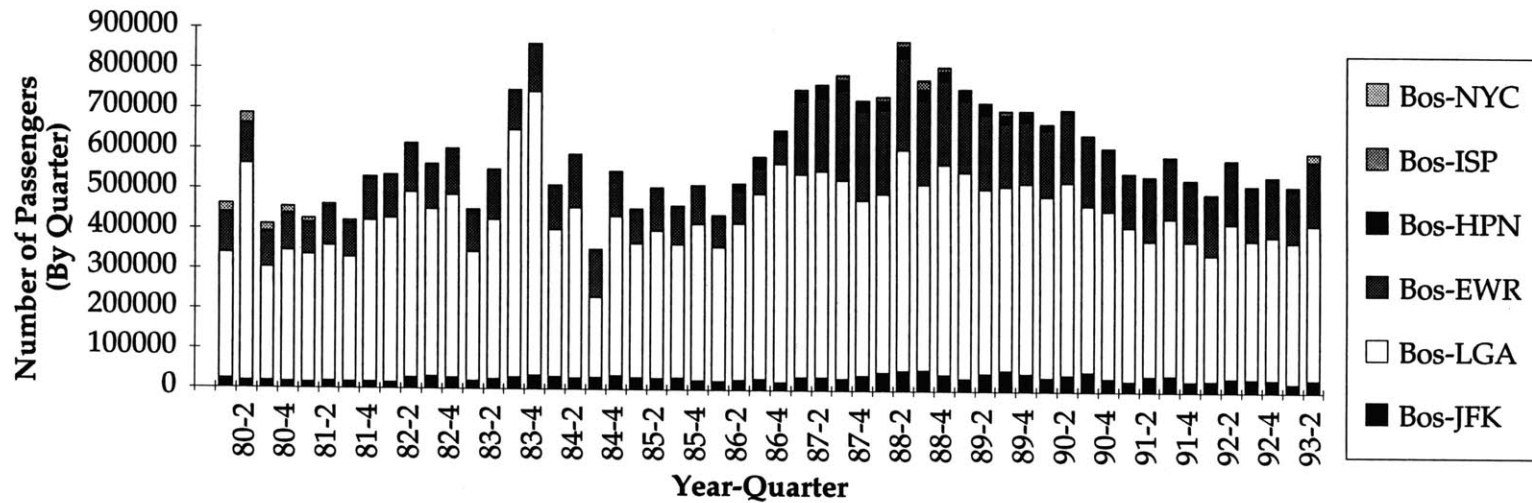


Figure 4-1 Total Revenue Passenger Traffic for Major Airlines Between Boston-Logan and New York City Area Airports by Quarter

Source: *OD-Plus Database*

Quarterly Passenger Traffic for Regional Airlines

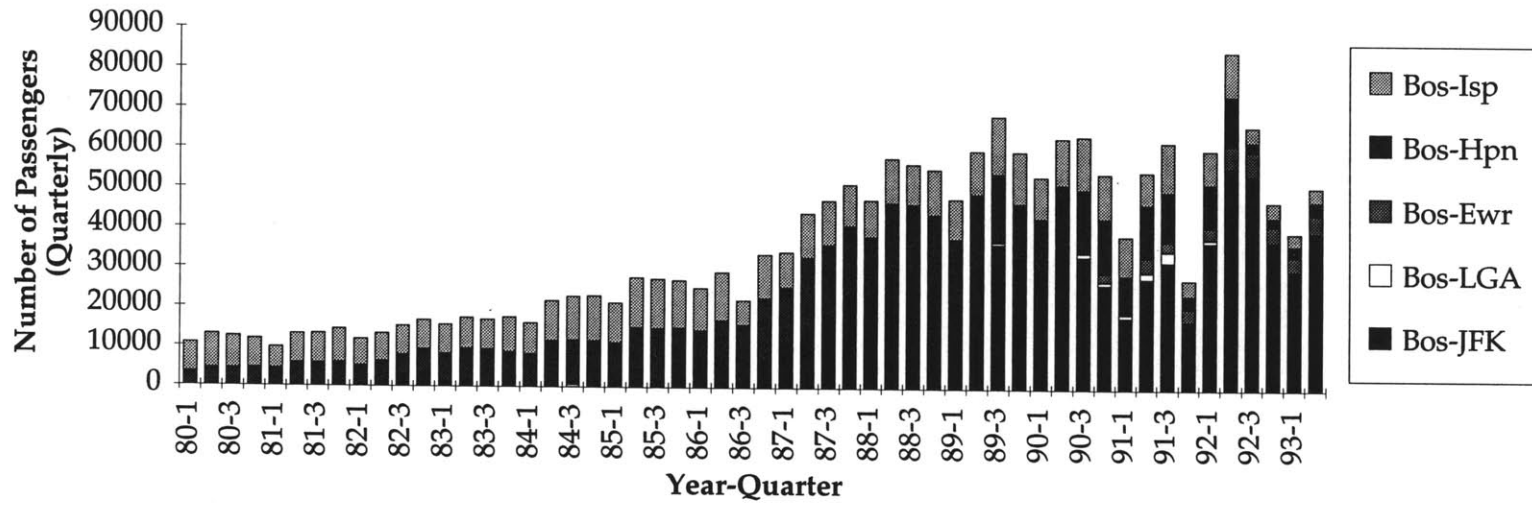


Figure 4-2 Total Revenue Passenger Traffic for Regional Airlines Between Boston-Logan and New York City Area Airports by Quarter

Source: *OD-Plus Database*

services are augmented by airline jet service to John F. Kennedy and Newark International airports.

The level of traffic between Boston-Logan and JFK airport has increased moderately throughout the period 1980 through 1992. Traffic in this O/D market is influenced more by seasonality factors which result in slightly higher traffic levels in the third and fourth quarter of each year. The lack of adequate airline jet service between Boston and JFK created an ideal environment for the growth of regional service which has experienced a significant increase since the first quarter of 1987. By the beginning 1990's, the regional airline services between Logan airport and JFK airport accounted for most of the connecting passenger traffic between Boston and New York.

The regional airports in the New York metropolitan region (Islip and White Plains), are served by regional carriers from Logan airport. The overall trends in the level of regional traffic has been consistent over the period, where the traffic levels has increased gradually since 1980. By the second quarter of 1992, the level of passenger traffic had surpassed 25,000 passengers per quarter. The overall regional traffic trends in the Boston-New York origin-destination markets are presented in Figure 4-2.

4.2.2 Washington - New York O/D Market

The Washington area is serviced by three major airports; National DCA, Dulles IAD, and Baltimore-Washington BWI. The level of air passenger traffic between each airport and the New York area has varied over the last twelve years, as more scheduled air carriers established service in the O/D markets. The overall major airline passenger traffic for the Washington to New York area airports is

Quarterly Passenger Traffic for Major Airlines

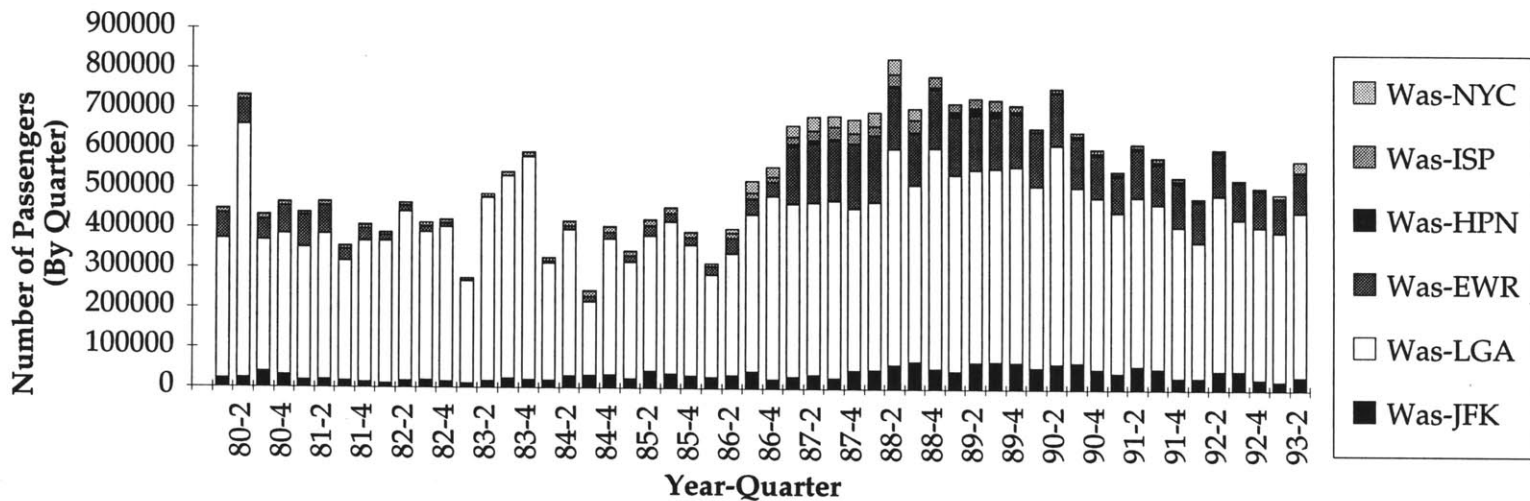


Figure 4-3 Total Revenue Passenger Traffic for Major Airlines Between Washington DC and New York City Area Airports by Quarter

Source: *OD-Plus Database*

Quarterly Distribution of Major Airline Passengers By Airport Origin

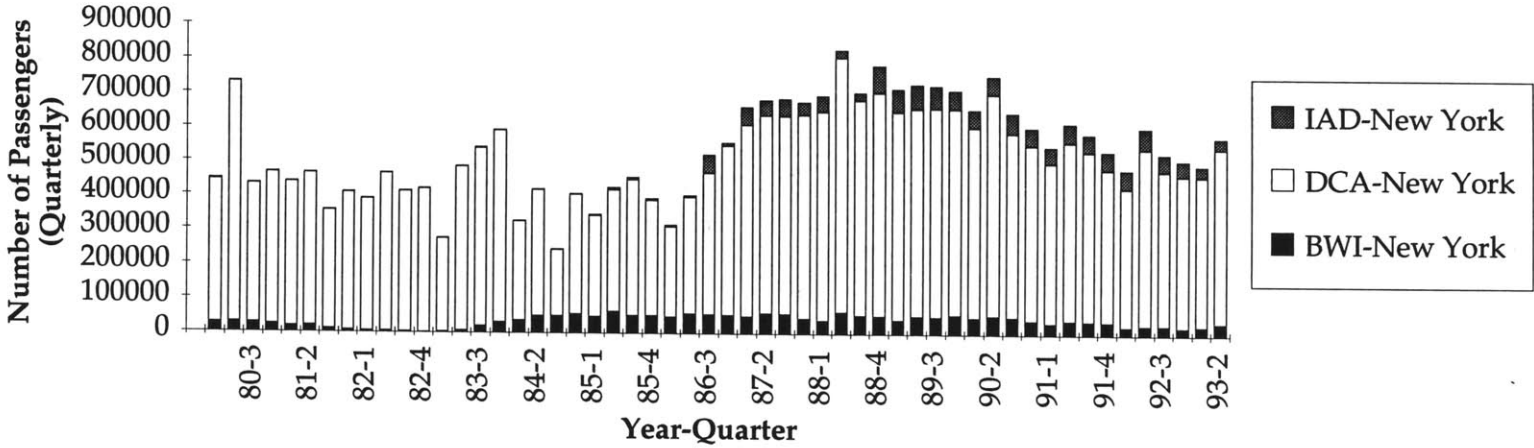


Figure 4-4 Distribution of Major Airline Passenger Traffic in the Washington DC Area
 Based on Point of Origin/Airport
 Source: *OD-Plus Database*

presented in Figure 4-3. These data are based on ten percent sample data as reported in the OD-Plus database [D5]. Similar to the Boston-New York market, the total number of air passengers in this O/D market has been influenced by the recession in the domestic economy. The possible diversion of business passengers to rail in the Washington-New York market was noted in Chapter Three, in the discussion of the Amtrak survey data. It is not observable in the air travel data for the 1980's.

The majority of the air passengers travelling between Washington and the New York area fly into La Guardia airport, which serves as the New York terminal airport for air shuttle operations. By the second quarter of 1992, the overall passenger levels were consistently above 500,000 passengers. The distribution of flights based on the airport of origin in the DC area has changed since 1980, as the level of traffic at the Dulles Airport increased from zero in 1980 to nearly 10% of the total traffic between the two metropolitan areas. In addition, the passenger traffic out of the Baltimore-Washington International Airport has fluctuated over the period. The distribution of major airline passenger traffic at the three Washington airports is shown in Figure 4-4 .

Most of the traffic originating at Dulles airport and Baltimore-Washington International airport were destined for La Guardia airport, as many travellers found it more convenient to use these airports, instead of using existing air shuttle services out of Washington National airport. In addition, the final destination of some of these Dulles and BWI originating passengers shifted to Newark, as more passengers found it convenient to fly to Newark instead of flying into La Guardia airport. As reflected in Figure 4-4, the total number of passengers using these two airports is roughly 15% of the traffic using Washington National airport. However, the significant increase in the number of passengers underscores the importance of diverse airport locations to suit the needs of the travelling public.

Quarterly Passenger Traffic for Regional Airlines

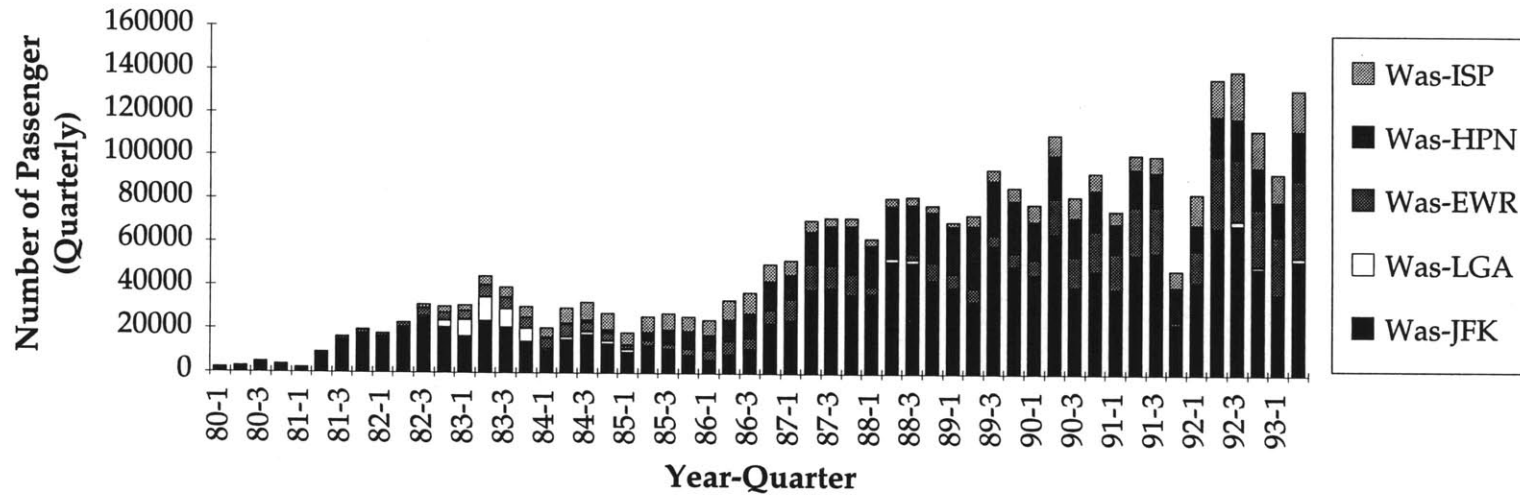


Figure 4-5 Total Revenue Passenger Traffic for Regional Airline Between Washington DC and New York City Area Airports by Quarter

Source: *OD-Plus Database*

Quarterly Distribution of Regional Airline Traffic By Airport Origin

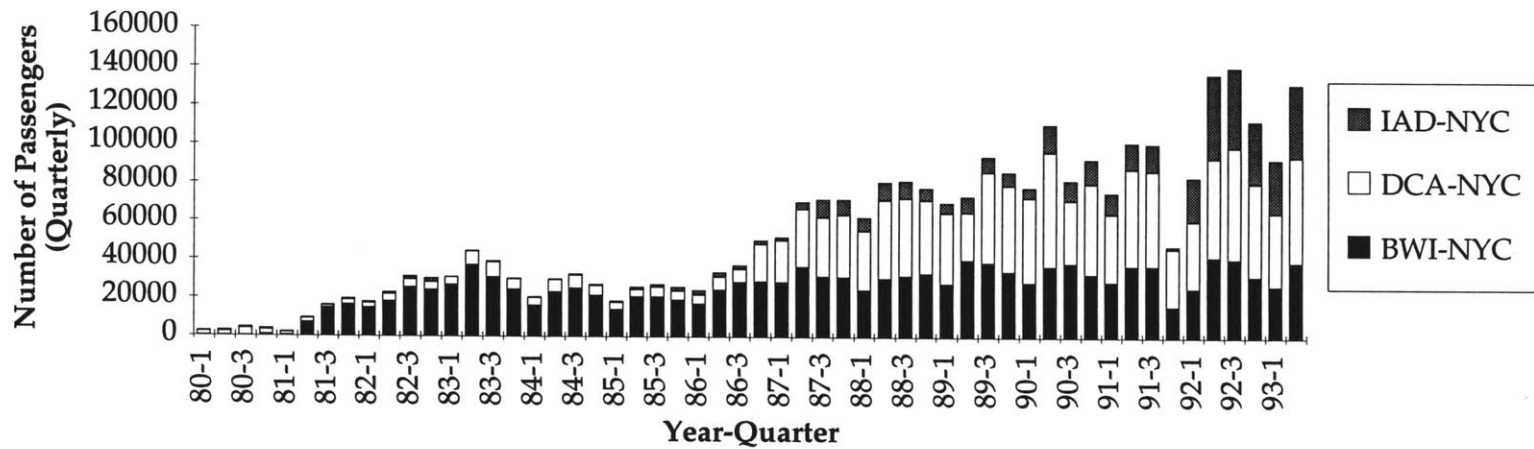


Figure 4-6 Distribution of Regional Airline Passenger Traffic in the Washington DC Area
Based on Point of Origin/Airport

Source: *OD-Plus Data*

The presence of a multi-airport system in the Washington metropolitan area has fostered the development of traffic by regional airlines as they started serving the origin-destination markets between New York City and the metropolitan DC area. The level of regional traffic in the Washington to New York City O/D market has changed significantly over the twelve year period. In 1980, there was very little traffic carried by regional carriers in the market; however regional carrier passenger levels have increased considerably since then to surpass 100,000 passengers in the second quarter of 1992. The overall market trends in regional traffic between Washington and the New York City area are shown in Figure 4-5.

The distribution of regional traffic based on airport destination has varied over the period, as the number of passengers using Newark International airport increased substantially. The breakdown of traffic between Dulles and the New York area airports, and BWI and the New York airports are similar, with the majority of the passengers terminating at Newark and JFK airports. In addition, a small percentage of the originating passengers are destined for the White Plains and Islip regional airports.

Throughout most of the twelve year period, the majority of regional traffic originating out of Washington was based at BWI, with service to all New York City airports except La Guardia. However, by the end of the 1980's, the dominance of BWI in the regional market was reduced as the three DC area airports evolved into to a more equal distribution of flights to the New York City area. The distribution of traffic from the Washington DC area is shown in Figure 4-6, reflecting the changes which have occurred in the market since 1980.

4.3 Summary of Existing Market Conditions

In considering the feasibility of high speed rail in the Northeast Corridor, it has been speculated that the largest percentage of passengers diverted to high speed rail would be airline passengers, as they are time-sensitive travellers who value time more than any other modal choice factors. The reduced rail travel time, in conjunction with lower fares compared to air travel, might allow the high speed rail service to compete more effectively with air travel. The potential for the diversion of air passengers to high speed rail will depend on the existing air travel market. The overall level of passenger traffic in both segments of the Northeast Corridor have been considered in the previous sections, and it was possible to establish distinct market trends.

The overall airline passenger traffic levels in the Boston-New York market has varied substantially over the last decade. From the analysis, it was determined that the air shuttle services between Logan airport and La Guardia airport account for the majority of the passengers travelling in the O/D market. In addition, the level of passenger traffic between Logan and Newark has increased significantly over the period, as the role of Newark as a hub airport grew throughout the mid to late eighties. In addition, there has been a dramatic increase in the level of regional traffic since the third quarter of 1985. By the second quarter of 1992, the number of regional passengers in the Boston-New York market had surpassed 25,000 per quarter.

Similar market trends were observed in the Washington-New York market, with the majority of the major airline passengers travelling between Washington-National and New York-La Guardia airport. The metropolitan Washington DC area is serviced by three major airports: National DCA, Dulles IAD, and Baltimore-

Washington BWI. The distribution of New York bound passengers based on the departure airport has varied over the last decade, as the role of Dulles and BWI as gateways to the Washington DC region expanded with demand.

The presence of a multi-airport system in the Washington DC area has fostered the development of regional air traffic in the region. In 1980, a small percentage of the passenger traffic was carried by regional carriers. However, the number regional passenger in the Washington-New York market has increased considerably since then to surpass 100,000 passengers in the second quarter of 1992. The distribution of Washington out-bound regional traffic based on airport origin has changed over the last decade. The dominance of BWI in the regional travel market has shifted to a more equal breakdown of regional traffic amongst the three airports.

Chapter 5

Forecasting HSR Ridership for the NE Corridor

The Northeast Corridor of the US domestic travel market generates over half of Amtrak's operating revenue. The overall trend in rail ridership in the region has fluctuated since the mid to late sixties, when airlines established air shuttles to serve the Boston-New York-Washington markets. In addition, the private automobile has always existed as a competitive mode. The ability to accurately forecast rail ridership in the Northeast Corridor depends on several variables. These variables include the total population of urban centers, level of employment, average income and the level of ridership on competitive travel modes. There are numerous types of forecasting techniques used in industry, each having its own advantages, as well as limitations, depending on the problem being considered.

5.1 Problems in Forecasting

The ability to develop accurate forecasts for a high speed ground transport such as a high speed rail (HSR) service in the region is restricted by a number of factors. The HSR service might be an extensive improvement of existing conventional rail service. The new rail service would offer passengers new travel times and fare choices. In addition, the enhanced rail service might offer improved levels of reliability, comfort and convenience. All these factors would have an effect on the passenger's choice of travel mode and would have to be incorporated into the ridership forecasts.

Passenger forecasting methods concentrate on various modal factors (such as comparative trip time, cost and frequency) and also relevant passenger demographic factors (such as the total population and income trends of the urban city centers) which comprise the specific travel market. The demographic data are also forecasts, based on current market intercept (in person) surveys. They are themselves subject to forecast error, which will continue over into the demand forecasts for the high speed rail service. On the other hand, modal split forecasts ignore passenger demographic information.

In addition, there is generally a lack of data on the local point of origin and final point of destination of business and non-business passengers within the given origin-destination market. These data would enable demand forecasters to develop more accurate estimates of access and egress times, as well as travel expenses for the total trip. As discussed in Chapter Four, a passenger's modal choice is often driven by the total travel time and cost of a given transport mode. As a result, information on access and egress times is important as it will affect the overall estimates of the demand for high speed rail based on specific modal characteristics such as total trip time and cost.

5.2 Important Issues in Passenger Ridership Forecasts

Demand forecasting and analysis of new intercity rail passenger ridership are influenced by a number of critical issues. A passenger's choice of a particular travel mode is governed by the perceived level of service which has to be factored into the forecast model. The identification of the relevant passenger service variables which influence mode choice, as well as the total travel volume, is important for accurate forecasting. In addition, the manner in which these variables are incorporated in the

demand model is critical to the accuracy of the forecast [11]. The passenger's modal choice is generally affected by the purpose of the trip. Business travellers are insensitive to pricing issues and are more concerned about travel time and the reliability of scheduled service times. On the other hand, leisure passengers are more concerned about the total trip price and are willing to accept longer travel times for the cost savings. The classification of the different groups of travellers (segments) which vary in their decision making behaviour is important to the overall forecasting process [11].

The introduction of high speed electric rail service in the entire Northeast Corridor will create an improved rail mode which should effectively compete with other existing travel modes for passengers. For the business traveller, this would mean competitive travel times, and for non-business travellers, lower fare offerings. The potential diversion of passengers from existing modes is critical to the accuracy of the HSR demand forecast. The report, "In Pursuit of Speed: New Options for Intercity Passenger Transport," anticipates that majority of high speed rail passengers will be diverted from current modes of transportation (including automobile), with only a small potential for induced travel. The ability to identify the structure of competition that will develop among intercity modes is essential to the forecasting process [11]. The absence of a Metroliner high speed rail service between Boston and New York limits the effectiveness of existing modeling techniques which are based on the observation of existing traveller behaviour (revealed preferences) under a variety of service conditions.

In general, econometric and travel demand forecasting methods are based on the estimation of model parameters using past data about actual choices in situations which are similar to the situation in which travel demand is to be predicted in the future. The lack of these revealed (actual) preference data limits the applicability of

such models to the prediction of travel demand for new travel modes such as high speed rail. In an effort to resolve the problem of the lack of adequate data on actual travel patterns, many forecasting projects have resorted to “stated preference” opinion survey data, and model estimation to supplement the conventional use of revealed preference (observed choice) data collection and model estimation [11].

5.3 Types of forecasting techniques

According to “Forecasting High Speed Rail Ridership”, three forecasting methods have recently been used to estimate ridership for high speed rail systems. In two of these forecasting methods, a forecast is made of the total origin-destination travel for the forecast years for all the competing modes of transportation. The first of these forecasting techniques involves the use of a multinomial mode choice model to determine the share and the number of passenger trips for each of the competing travel modes. The second approach utilizes a nested logit procedure which separates auto trips from common carrier trips. A subsequent choice model is used to separate common carrier trips into those made by air versus high speed rail [2].

The third method of forecasting high speed rail ridership involves the individual estimation of the number of passenger trips for each existing travel mode and then determining, with separate mode choice models, the share of passenger trips by each mode that would be diverted to the high speed rail mode as a function of relative service characteristics and other relevant factors. This forecasting approach incorporates the fact that passengers travelling on various existing modes exhibit different decision making behaviour when confronted with the choice to use high speed rail [2].

5.4 Summary of HSR Forecasts for the NE Corridor

The improvement of rail services in the Northeast Corridor should have a significant impact on the level of rail passenger traffic in the region, as rail services should then compete more effectively with other transport modes such as air travel. Forecasts of Boston-New York rail ridership have been developed for improved travel times and conditions anticipated to result from each stage of the Northeast Corridor Improvement Project. These forecasts were produced by using ridership models developed as part of high speed ridership studies performed in Florida and Texas [3]. It is anticipated that high speed electric rail service between Boston and New York after the completion of the improvement project will be similar to existing Metroliner rail service between Washington and New York, as described in Chapter Two.

In forecasting year 2010 ridership for the baseline travel time established by Program One of the improvement project, conventional and Metroliner type service between Boston and New York are each assumed to operate at hourly intervals over a fifteen hour period each weekday. Slightly more frequent high speed service is assumed to be offered during peak periods by scheduling one additional Boston-New York express departure in each direction [3]. This is an operating schedule based on one now used by Amtrak in the New York-Washington service and represents a significant improvement on the level of service currently offered in the Boston-New York market (as described in chapter two).

In developing the forecasts of rail ridership for the Boston-New York O/D market, the future costs (adjusted for inflation), travel times and the level of service offered by competing travel modes (primarily air travel and automobile) were assumed to remain at current figures. It is anticipated that congestion levels on

Table 5-1 Forecast of Annual Rail Ridership in the Boston-New York Corridor
Source: *Commuter-Intercity Rail Improvement Study May 1993*

Market Segment	1988 Actual	2010 Forecast	Percentage	2010 Forecast
	Traffic	Program 1	Growth	Program 4
Boston-New York	714	1,392	95%	2,150 - 2,250
Boston-New Haven	115	172	49%	180
Providence-New York	189	313	66%	400 - 410
Providence-New Haven	23	35	52%	40
Subtotal	1,041	1,912	84%	2,760 - 2,870
Others North of New York	821	1,342	64%	1,730 - 1,800
Trips Through New York	475	560	18%	720 - 750
Total	2,337	3,814	63%	5,220 - 5,430

Notes

1. All figures all in thousands (000s)
2. "Others north of New York" include trips with both origin and destination north of New York City. Also includes travel between Springfield-Hartford and points within corridor.
3. "Trips through NYC" define trips with either origin or destination north of New York but other end south of New York.
4. Program 1/Baseline forecasts are based on rail system rehabilitation only
5. Program 4/Complete forecast considers all system improvements and electrification under the Northeast Corridor Improvement Project

highways and at major airports in the Northeast Corridor should increase with continuing growth in the volume of intercity travel, thereby cancelling any gain in mode travel time. The assumption of constant door-to-door travel time for all competing travel modes may contribute to conservative forecasts of travel on an improved rail system [3]. Certainly, the air travel costs will decrease to match competitive services.

Fares for the proposed high speed rail service are assumed to be based on ticket prices now charged by Amtrak in the New York-Washington segment of the corridor. This would indicate that based on existing rail fares, undiscounted fares for the 231 mile trip between Boston's South Station and New York's Penn Station would be approximately \$86 for high speed rail travel, and \$65 for conventional service. These fares are less than the current air shuttle fares of \$135 discussed in chapter two. The improved rail travel time would be approximately two and one-half hours, compared to one hour for the air shuttle.

The base year 1988 rail ridership in the Boston-New York corridor, together with ridership projected to occur during 2010 are presented in Table 5-1. With the completion of Program Four of the NECIP project, ridership growth in the four major markets within the Boston-New York corridor is projected to increase by 84% from its actual level during 1988, with the largest increase (95%) projected to occur in travel between Boston and New York City. The projected year 2010 ridership level is expected to consist of 25-30% trips for business related purposes, with the remaining 70-75% representing leisure travel [3]. The difference between 1988 and future rail ridership result from improvements in travel times due to the NECIP project, increased frequency of service, and demographic and income growth within the region between 1988 and the year 2010. These business percentages reflect a tremendous increase over current percentages observed in the Northeast Corridor. (3% for Boston-New York)

As indicated in Table 5-1, the projected effect of improvements in NECIP on total corridor rail travel is quite pronounced with a significant increase in the rail passenger levels. Total rail ridership in the Boston-New York corridor is projected to range from 5.22 to 5.43 million trips annually after the completion of the Northeast Corridor Improvement Project by the year 2010. These potential ridership increases

represent substantial growth from the 3.8 million trip baseline forecast for the Boston-New York market [3]. The “complete” forecasted rail ridership in the Boston-New York O/D market is 2.15 to 2.25 million passengers, a significant increase over the baseline forecast of 1.392 million. It is important to remember that these increases would be a result of dramatic reductions in rail travel times (currently at four hours, down to under three hours) and an increase in the frequency of rail service between Boston and New York City. But neither the projected travel time nor frequency is competitive with current air service.

However, this improvement in rail travel time is expected to increase the attractiveness of rail service to business travellers, resulting in a gradual increase in the share of rail trips for business travel. With the completion of the full NECIP project described in Chapter Two concluding with Program Five, it is estimated that 38-40% of total rail ridership will comprise of business travellers, a thirteen percent increase over the forecast for Program One for 2010 [3]. The coexistence of conventional and high speed rail in the Boston-New York corridor will allow the rail mode to compete more effectively with other existing travel modes. The split of traffic expected to use high speed rail and conventional rail services is estimated to be equal after the completion of program one in the NECIP project. After the completion of all phases of the improvement project it is forecasted that high speed electric rail service should have a slightly higher share over conventional rail.

The distribution of passengers diverted to high speed rail from other existing travel modes (automobile and commercial air service) was also forecasted. It is estimated that close to eighty percent of the diverted passengers to rail services are current airline travellers, with the remainder taken from automobile travel [3]. The percentage of diversion from air travel to high speed rail was estimated using a functional relationship for each competing transport mode and market segment (by

trip purpose). It incorporated several explanatory parameters such as total travel time, total trip cost, and frequency of service. In addition, the model utilized stated preference methodology, and considered the effects of the unobserved characteristics of high speed rail (HSR) relative to the competing travel mode [2].

It is believed that most of the growth in passenger rail travel will be in response to improvements in travel times and frequency of service. The high proportion of high speed rail passengers diverted from airline travel reinforces the hypothesis that improved rail service should appeal more to time-sensitive business travellers who now predominantly choose air travel. Nevertheless, the anticipated diversion of discretionary (non-business) air passengers whose mode travel choice reveals comparatively high values of travel time also represents an important source of new rail ridership [3].

The forecasted demand for high speed rail service and improved conventional rail service in the Boston-New York corridor implies significant increases in passenger ticket revenues for Amtrak. It is estimated that Amtrak's revenue could surpass \$350 million (in 1990 dollars) for the region, depending on the reduction in travel time, improvements in frequency of service and the corresponding increase in passenger ridership. However, the improved rail service will come with substantial increases in operating expenses. Based on current unit operating costs, it is forecasted that future annual operating expenses may surpass \$200 million. As a result, Amtrak could realize a net operating profit of over \$150 million for the improved Boston-New York rail service [3]. This forecasted gain in operating revenue in the Boston-New York corridor should be considered in light of the significantly large capital investments required for the improvement project.

Chapter 6

Summary: Observations and Conclusions

6.1 Existing Market

The high level of intercity passenger travel in the Northeast Corridor is supported by densely populated metropolitan city-centers, the suitable distance between the urban areas, and the extent to which economic and social activities in these urban areas complement each other. Within the region, automobile and air travel account for the majority of the passenger traffic. Current Amtrak passenger rail service in the Northeast plays a minor role in comparison to other competing transport modes. In Chapter Two, existing rail services for the region were described, and a summary of these services is presented in Table 6-1. An important point to observe is that Amtrak's service between Washington DC and New York City is superior to that offered in the Boston and New York City market.

Air Shuttle services account for the majority of the air travel offered between Boston-New York, and New York-Washington. These Air Shuttles offer hourly jet departures (150 seats) from each terminal airport of the major cities. However, since deregulation, there has been consistent traffic growth on regional air carriers, as well as on other regular jet service in the region. The growth of these regional air carriers has been facilitated by the introduction of larger regional turboprop aircraft, which have higher cruising speeds and requires lower operating costs. A summary of existing air service is given in Table 6-2, based on information obtained from the Official Airline Guide (North American Edition, August 1993).

Table 6-1 Summary of Rail Services in the Northeast Corridor

Market	Boston - New York	Washington - New York
Conventional		
Travel Time (hrs:min)	5:10	4:10
Frequency (daily)	10	15
Fare (one-way)	\$52.00	\$68.00
Express		
Travel Time (hrs:min)	4:00	2:35 ¹
Frequency (daily)	2	2
Fare (one-way)	\$57.00	\$96.00
Metroliner		
Travel Time (hrs:min)	not available	3:00
Frequency (daily)		17
Fare (one-way)	<i>see Note 2</i>	\$96.00

Notes

1. This service is described as an express Metroliner service in Amtrak’s Northeast Timetable.
2. After the completion of the NECIP project, Amtrak plans to introduce Metroliner type rail service between Boston and New York City with similar levels of service (frequency, fare, travel time) to the Washington to New York segment.

Table 6-2 Summary of Air Services in the Northeast Corridor

Market	Boston - New York	Washington - New York ¹
Air Shuttle		
Travel Time (hrs:min)	1:05	1:00
Frequency (daily)	34	31
Fare (one-way)	\$135.00	\$135.00
Scheduled Jet		
Travel Time (hrs:min)	1:15	1:10
Frequency (daily)	36	38
Fare (one-way) ²	\$52.00 - \$158.00	\$64.00 - \$160.00
Regional		
Travel Time (hrs:min)	1:15	1:20
Frequency (daily)	44	84
Fare (one-way)	\$52.00 - \$158.00	\$64.00 - \$160.00

Notes

1. These values are based on the total origin-destination data between the three DC major airports (IAD, DCA, BWI) and NYC five major airports.
2. Fare range for air service depends on restrictions on the ticket purchase

6.1.1 Level of Competition

The development of transportation modes in the Northeast has been governed by the high level of competition which exists in the travel market. A passenger's modal choice is influenced by the purpose of the trip, as business travellers place a greater premium on travel time savings and have less schedule flexibility than non-business travellers. The majority of air shuttle passengers are business travellers, who are price insensitive and rely more on air travel because of its convenience and travel time. Current market demographics were established from available survey data and a summary of these data is given in Table 6-3. It is observed that air travel has a much larger market share than rail service in both segments of the Northeast Corridor.

Table 6-3 Summary of Demographic Information Based on Survey Data

Market	Boston - New York		Washington - New York	
Modal Split				
Rail Services (%)		5		15
Air Services (%)		30		35
Automobile (%)		65		50
Modal Preference-Public Service				
Business	Air 97%	Rail 3%	Air 86%	Rail 14%
Non-business	Air 73%	Rail 27%	Air 52%	Rail 48%
Overall (Estimated)	Air 92%	Rail 8%	Air 76%	Rail 24%
Trip Purpose				
Business		79%		70%
Non-business		21%		30%

In reviewing the survey data, it was observed that sixty-four percent (64%) of the Air Shuttle passenger at La Guardia Airport originate in Manhattan (80% originating from New York City). In addition, it was established that the majority of these passengers are frequent flyers whose average trip duration was three days. The

data from the Logan Ground Access Survey revealed that fifty percent (50%) of the Air Shuttle passengers at Logan Airport originate in metropolitan Boston, and that seventy percent of Air Shuttle passengers were destined to the New York City metropolitan area. It can be estimated that only thirty-five percent (35%) of the Air Shuttle passengers travelling between Boston-Logan and New York-La Guardia are city-center to city-center passengers.

Table 6-4 Summary of Passenger Traffic in the Northeast Corridor

Year	1980	1988	1992
<i>Air Services</i> ¹			
Boston-New York			
Air Shuttle	1,481,110	2,003,520	1,422,170
Regular Jet	540,840	1,201,380	723,030
Regional	<u>48,644</u>	<u>110,270</u>	<u>259,291</u>
Total	2,070,594	3,315,170	2,404,491
Washington-New York			
Air Shuttle	1,628,040	1,843,670	1,411,350
Regular Jet	455,140	1,178,900	715,410
Regional	<u>13,711</u>	<u>303,060</u>	<u>474,786</u>
Total	2,096,891	3,325,630	2,601,546
<i>Rail Services</i> ²			
Boston-New York	203,300	714,000 ³	600,000 ⁵
Washington-New York	2,830,400	1,486,000 ⁴	1,600,000 ⁵
Metroliner	1,970,500	n/a	n/a
Conventional	859,900	n/a	n/a

Notes

1. Traffic levels based on ten percent sample data collected by the CAB
2. Rail service traffic levels for 1980 were assumed to be similar to 1977 levels (only accessible data for pre-airline deregulation)
3. Based on O/D traffic levels given in report "Commuter-Intercity Rail Improvement Study (Boston-New York)", published by the Department of Transportation
4. Estimated using total rail traffic in the Northeast Corridor in 1989.
5. Traffic does not include New York-Baltimore passengers

6.1.2 Passenger Traffic

The importance of air travel in the Northeast Corridor is reflected by its market share, having the largest share for common carriers serving the region. The majority of the air passengers travelling between Washington DC and New York, and Boston and New York, use the existing Air Shuttle services, which offer hourly service between each city-pairs. In addition to the Air Shuttles, other regularly scheduled carriers (including regional carriers) offer services in these markets as described in Chapter Two. Over the last decade, there has been a significant growth in regional air traffic within the Northeast Corridor, especially between New York City and the Washington DC area. The overall market trends for the last fourteen years have been described in Chapter Four and Table 6-4 presents a summary of air and rail passenger traffic levels in the Northeast Corridor.

The growth of regional carriers in the Northeast Corridor has affected the level of passenger traffic on the air shuttles, as well as traffic levels on the rail service. According to Amtrak, rail passenger traffic levels have remained more or less constant in the Boston-New York O/D market and have experienced a gradual growth in the Washington-New York market. However, based on the available passenger traffic data, it is observed that there has been a decline in the Boston-New York market, and there has been a slight improvement in rail passenger traffic between Washington DC and New York City since 1988. The observed market trends in rail passenger traffic levels has generally been attributed to the depression of the domestic economy. However, it is necessary for the observer to consider the influence of regional air carrier growth on the rail traffic, as current regional airfare offerings promotes competition between the two modes of transportation.

6.2 Future Markets

The ability of ground transportation modes to compete effectively with air travel has been inhibited by the lack of high speed rail (HSR) service. It is claimed that the introduction of such services in the region could create an environment, in which rail services would effectively compete with existing air services. The completion of the Northeast Corridor rail Improvement Project (NECIP) is intended to allow Amtrak's rail services to compete more effectively with other existing modes of transportation on the route between Boston and New York. The primary benefit of NECIP will be a significant reduction in rail travel time between Boston-South Station and New York-Penn Station, yet still well above the air travel time.

As described in Chapter Two, the system improvements are expected to yield Boston-New York rail travel times ranging from two and half to three hours, depending on the level of investment in the project and the type of trainset (rolling stock) used on the corridor. The rail travel times forecasted are optimistic, requiring the validity of all assumptions and railroad operations which meet the highest standards in terms of precision and reliability. Improved travel times should make rail service more attractive in the entire Northeast Corridor, especially in the Boston-New York segment of the route. But these travel times are at least twice the existing air travel times, and will not be competitive for the business traveller.

6.2.1 Forecasted HSR Ridership

Compared to the current traffic levels of 600,000 rail passengers per year, it is forecasted for the NECIP project that by 2010, annual ridership for Amtrak between Boston and New York City origin-destination market will grow to as much as 2.3 million passengers for a two-and-half hour trip time. In addition, it is forecasted that approximately eighty percent of the new rail passengers will be diverted from air

travel, with the remaining passengers being diverted from automobile travel. The NECIP forecasts are based on the premise that more business travellers will choose the rail mode over air travel, as the issue of differences in total travel time would become less pronounced between the two modes of transportation. i.e. Instead of a travel time difference of three hours, it will be reduced to an extra one hour for rail travel from Boston to New York.

It is important to point out that these NECIP forecasts are based on several questionable assumptions concerning competing modes of transportation. For example, the assumption that future costs (adjusted for inflation), travel times and the level of service offered by competing travel modes (primary air and automobile) will remain at current figure is problematic. The airline industry continuously pursues cost reductions efforts which lead to reduced overall airline operating costs. In addition, the introduction of newer and larger aircraft, which incorporate advanced technologies, offer improved travel times and reduced direct operating costs.

It has been anticipated that congestion levels on highways and at major airports in the Northeast Corridor should increase with continuing growth in the volume of intercity travel, thereby cancelling any gain in mode travel time. The increased volume of air traffic can be accommodated by an increase in the frequency of service (leading to increased congestion) or by the use of larger aircraft on the Air Shuttle routes. Currently, both segments of the Northeast Corridor (Boston-New York, Washington-New York) are serviced by 150 seat aircraft, but these aircraft could easily be replaced by larger aircraft, offering the same level of service that is now available. In the 1980's, much larger 300 seat aircraft were used at peak times on shuttle routes, offering better economics, and a return to such practices could serve as a solution to future passenger traffic growth and anticipated congestion problems.

6.2.2 Assessment of the Potential for Diversion

The forecasted ridership for high speed rail in the Boston-New York segment of the Northeast Corridor ranges from 5.22 to 5.43 million passenger trip annually after the completion of the NECIP improvement project by 2010. Of this number, 2.15 to 2.25 million rail passengers were estimated to travel in the Boston-New York origin-destination market. In 1992, there were 2.41 million air passengers (including regional service) travelling in the Boston-New York origin-destination market, a decrease from 3.315 million passengers in 1988. In that same year, there were 600,000 passenger rail trips in the Boston-New York O/D market. Based on these figures, the forecasted rail ridership calls for a substantial diversion of air passengers, since the NECIP forecast anticipates that there will be very little induced new travel in the region. As a comparison, there were 2,601,546 air passenger trips and 1,600,000 rail passenger trips in the Washington-New York origin-destination market during 1992.

It can be estimated that 1.32 million of the new rail passengers will be diverted from air travel to high speed rail based on the forecasted HSR ridership and the percentage of diversion stated in the NECIP report. The level of air passenger travel between Boston and New York can be estimated using demand forecasts for Boston-Logan Airport published in the "Strategic Assessment Report: Volume II". The report states that total air passenger demand for Logan in 2010 will range from 26.51 to 37.92 million passengers assuming existing operational conditions without any ATC improvement or the upgrading of the Northeast Corridor to high speed service [18]. From these figures, it was estimated that there will be approximately 4.6 million air passengers travelling from Boston-Logan to the New York city market (based on the current market share for Bos-NYC of 15%). From these figures, one

can conclude that NECIP forecasts calls for a twenty-nine percent (29%) diversion of air passengers to high speed rail in the Boston-New York origin-destination market.

The justification for this forecast of a large diversion of air passengers is not apparent, since the existing air shuttle travel times of one hour are superior to any projected rail travel times (even if one considers total door-to-door total trip time). It is important to note that only thirty-five percent (35%) of Air Shuttle passengers are city-center to city-center passengers. As stated earlier, the majority of current air shuttle passenger are business travellers who are price insensitive, and are more concerned about travel time and schedule reliability. It is difficult to believe that this diversion will occur unless air congestion is assumed to become severe. The ability of future high speed rail systems in the Northeast Corridor to divert air passengers will depend on several issues, which currently do not play a major role in modal choice. These issues may include enhanced on-board and in-terminal amenities which may facilitate the business person in transit, such as computer clusters, facsimile machines, and even mini-conference rooms.

The success of France's Train a Grande Vitesse (TGV) on the Paris-Lyon route has often been cited as proof that high speed rail can have a significant impact on air services. Within the first five years of operations of the Paris-Lyon TGV line, airline passenger traffic experienced a substantial loss of forty percent (40%). However, two important points about the population of these cities and the location of airports are warranted. A large percentage of the potential travel market actual lives, originates or is destined for the center of Paris (a densely populated city-center). The major domestic airport (Orly) serving the metropolitan Paris area is located sixteen kilometres (10 miles) away from the city-center and the Lyon-Satolas Airport is twenty-four kilometres (18 miles) from the city-center. The location of these airports therefore require substantial egress and access travel times for an air passenger

travelling between Paris and Lyon. The new TGV rail service was able to outperform existing air service in terms of the city-center to city-center travel time.

The general layout of an American metropolitan area includes several suburban areas which may be as much as thirty kilometres from the city-center. As observed in the Logan Ground Access Study, only fifty percent (50%) of the air shuttle passengers at Logan originate in the metropolitan Boston area (excluding suburbs). Similarly, sixty-four percent (64%) of La Guardia air shuttle passengers originate in Manhattan (the site of Penn Station, New York's primary rail station). It is estimated that only one-third of Boston-New York passengers actually originate and end in the city centers. The close proximity of Logan Airport to the Boston metropolitan area (3 miles) and La Guardia Airport to Manhattan (8 miles) is important when considering the potential for diverting air passengers travelling within the city-pair. There may be an advantage for rail at New York, but it is small, and only affects a minority of passengers.

6.2.3 Emerging Competition

The accuracy of the forecasts for high speed rail ridership is therefore questionable for several reasons. As discussed in Chapter Five, the accuracy of the forecasts is limited by the lack of historical data on high speed rail service in the US domestic market, the estimation techniques used for the forecasting and dependence on secondary forecasts of passenger demographics, based on current market intercept surveys. The level of potential diversion of passengers from existing transport modes is essential to the accuracy of the high speed rail (HSR) demand forecast. The ability to identify the structure of competition that will develop amongst the transport modes is therefore critical to the diversion forecast. This competition has been ignored.

The emergence of new telecommunication technologies such as video-conferencing could have a substantial impact on the future transport market. The high percentage of non-discretionary passengers within the Northeast Corridor O/D markets may create the ideal environment for a significant diversion of air travel to video-conferencing. It was forecasted in the Strategic Assessment Report that a reduction of fourteen percent (14%) in domestic business trips could result because of advancements in telecommunications [18]. The overall impact of telecommunications on competition amongst the varying modes of transportation would also be a factor to consider in determining the viability on a new transport mode such as high speed rail. The potential for the diversion of air passengers to high speed rail will depend on the development of telecommunication technologies, and the impact this development will have on the transport market.

It was also reported in Strategic Assessment report [18], that the planned rail improvements to the Northeast Corridor, would result in some modest diversion of air travellers, and would not provide a viable alternative travel mode to the existing air travel services in the region. This principal finding was based on the premise that telecommunication technology would tend to reduce the net demand for air travel. However, this finding is in direct contrast to the forecasts put forth by the Department of Transportation DOT in May 1993. Significant diversion of air passengers to high speed rail is anticipated by forecast studies commissioned by the US Department of Transportation. The level of diversion reported in the DOT documents is questionable.

Throughout this thesis, several issues associated with the diversion question have been considered, and it is the opinion of the author that the anticipated levels of diversion reported by the Department of Transportation are overestimated. It is obvious that there will be some form of diversion of air passengers to a new high

speed rail service. The ability to accurately predict the level of diversion of air passengers is not currently possible. The overall travel behaviour of existing passengers in the Northeast Corridor have not been fully considered.

As a recommendation for future HSR ridership forecasting studies, the author suggests that existing air passengers be surveyed about the proposed high speed rail service, as well as existing transport services. This should enable the forecaster to develop more accurate predictions of rail ridership in the Northeast Corridor, based on revealed and stated preferences of existing passengers. An example of such a survey has been prepared by the author and is presented in Appendix A. Only then, can accurate forecasts about high speed rail ridership be possible, given the majority of the HSR passengers are anticipated to be diverted from air travel.

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Appendices

Appendix A

Airport Survey 1993

Survey Methodology

The survey was designed to provide current user characteristics for air shuttle passengers departing from Boston Logan. The emphasis of the airport survey is to collect objective data on the round-trip of the respondent via the air shuttle. These data would be used to determine the main characteristics of air shuttle passengers including; point of origin, final destination, and total travel time and expenditure. The format of the air shuttle survey is based on the 1987 Washington-Baltimore regional air passenger survey conducted by the Maryland Department of Transportation in conjunction with other transportation authorities in the area.

The essential data for the survey were:

- The origin and destination of the trip;
- Access and egress time;
- The main purpose of the air shuttle trip;
- Total travel expenses;
- Round trip information;
- Frequency of travel on air shuttle/Frequent flyer program;
- Passenger demographics;
- Socio-economic characteristics of the respondent (age, sex, occupation) &
- Socio-economic characteristics of the respondent's household (income).

In addition, the survey contains questions about existing rail services in the Northeast corridor and a proposed high speed rail service between Boston-South Station and New York-Penn Station. Some of the issues considered included frequency of service, cost of service, and preferred on-board amenities for the high speed rail service.

Air Shuttle Passenger Survey
 Viper™ (High Speed Rail) Version 3.0
 © June 1993

1. Is your final destination in the NY/NJ/Conn metropolitan area?
 - No STOP (We only want pax. in Boston-NY market)
 - Yes (continue)

2. Are you a resident of the tri-state metropolitan area?
 - Yes (skip to NY resident section)
 - No (Boston resident)

Boston Residents

Introduce yourself, explain the primary purpose of the survey. In addition, note the shuttle departure time and the cost of a ticket for the flight.

1. Local Access Trip
 - a. At what time did start your trip to Logan and arrive in this passenger terminal?
 - i. _____
 - ii. _____
 - b. From where did you start your trip to Boston Logan today?
 Zip Code/address _____

2. Are you travelling on business?
 - No
 Are you paying for this trip yourself, and how much? _____
 - Yes
 Is your business paying, and what is the cost? _____

3. What type of business or industry do you work in? _____
 - Professional/Technical
 - Services
 - Manufacturing
 - Sales/Trade
 - Finance
 - Managerial
 - Other

- 4a. What is your final destination, when you arrive in the NYC area?
 Zip Code/address _____

4b. If NYC, which borough is your destination ?

- Manhattan
- Bronx
- Brooklyn
- Queens
- Staten Island

4c. Do you have an appointment in the NYC area?

- No (Skip to question 5)
- Yes What time? -----

5. Planned Egress Trip in NYC area

How much time do you expect to spend travelling between LaGuardia airport and your final destination? -----

6. When do you plan on returning to Boston? -----
(Number of days.....0, 1, 2, 3, 4, 5, . . .)

7. Will you return by air shuttle/air transportation?

- Yes (continue)
- No (skip to Rail trip option)
- Undecided (skip to Rail trip option)

This section gathers informations about the return trip to Boston if the outbound passenger intends to return to Boston via the air shuttle

8. On your return to LaGuardia airport?

- a. What will be your point of origin (zip code) -----
- b. How much time do you expect to spend travelling between your origin and LaGuardia airport? -----

9. When you arrive in Boston (Local Egress Trip)

- a. Where will you final destination be?
Zip code/Address -----
- b. How much time do you expect to spend travelling between Logan airport and the final destination? -----

New York Resident

Introduce yourself, explain the primary purpose of the survey. In addition, note the shuttle departure time and the cost of a ticket for the flight.

1. Local Access Trip

a. At what time did start your trip to Logan and arrive in this passenger terminal?

i. _____ ii. _____

b. From where did you start your trip to Boston Logan today?

Zip Code/address _____

2. Are you travelling on business?

• No

Are you paying for this trip yourself, and how much? _____

• Yes

Is your business paying, and what is the cost? _____

3. What type of business or industry do you work in? _____

- Professional/Technical
- Services
- Manufacturing
- Sales/Trade
- Finance
- Managerial
- Other

4a. What is your final destination, when you arrive in the NYC area?

Zip Code/address _____

4c. If NYC, which borough is your destination ?

- Manhattan
- Bronx
- Brooklyn
- Queens
- Staten Island

4d. Do you have an appointment in the NYC area?

- No (Skip to question 5)
- Yes What time? _____

5. Planned Egress in NY city area

How much time do you expect to spend travelling between LaGuardia airport and final destination? _____

6. How long was your trip to the Boston area? -----
 (Number of days.....0, 1, 2, 3, 4, 5, . . .)
7. Did you come to Boston by air shuttle/air transportation?
- Yes (continue)
 - No (skip to Rail trip option)
8. First leg of trip to NYC airport?
- a. What was your point of origin?
 Zip Code/address -----
- b. How much time did you spend travelling between your point of origin
 and LaGuardia airport? -----
9. When you arrived in Boston
- a. What was your final destination ?
 Zip Code/address -----
- b. How much time did you spend travelling between Logan airport and
 final destination? -----

Passenger Demographics

1. How many air shuttle trips have you taken in the past 12 months?

- 0 to 5 round trips
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- above 50

2. *Business/Frequent Traveller*

How much does this trip usually cost including all ground transportation from origin to final destination? \$ _____

3. Are you a member of the Air shuttle frequent flyer program?

- Yes
- No

4. Observe gender

- M
- F

5. What range corresponds to your age and annual household income?

Age Group

- 12 - 19
- 20 - 24
- 25 - 34
- 35 - 44
- 45 - 54
- 55 - 64
- 65 and over

Household Income

- Under \$20,000
- \$20,000 - \$39,999
- \$40,000 - \$59,999
- \$60,000 - \$79,999
- \$80,000 - \$99,999
- \$100,000 - \$119,999
- \$120,000 - \$139,999
- \$140,000 - \$159,999
- \$160,000 and over

Important Issues

Revealed preferences

Stated preferences

Diversion

In general, research projects on passenger modes of transportation tend to focus only on one of two types of information. In some cases, the project would observe actual travel choices (revealed preferences); while in other situations, the study would elicit travel choices under hypothetical situations (stated preferences). The primary objective of conducting this survey would be to determine the potential diversion of air shuttle passengers to high speed rail in the northeast corridor. These face-to-face surveys would be conducted at Boston-Logan Airport on passengers traveling in the New York-Boston origin-destination market.

The primary objective of the study necessitates that the survey collect all types of information from the air shuttle passenger which would be used to determine the potential market for the proposed rail service. It would provide a detailed understanding of the existing air shuttle market without the alternative high speed rail service, as well as a means of establishing the changes in each sub-market, that may result from the introduction of the new rail service. In particular, the survey could provide an estimate of the diversion of air shuttle passengers and look at the sensitivity of these diverted passengers to the characteristics of the new high speed rail system (including in-terminal and on-board amenities).

The diversion of the air shuttle passengers to high speed rail based on the difference in frequency of service, offered fare, time of travel, and on-board amenities could be determined and studied from the collected data. The analysis portion of the project would be based on the data collected from face-to-face surveys

conducted at Logan airport on a Macintosh Powerbook™. The survey can be conducted directly on the computer, using the program Airport Survey™ which was written on the Hypercard™ development kit software package.

The face-to-face survey questionnaire was designed to include a stated choice experiment in which the respondent is asked to consider the high speed rail service with systematic changes in the travel time and cost of the rail mode. In addition, the survey includes questions to obtain a socio-economic and demographic profile of the respondent and their household. The survey also asks the respondent to provide the total time and cost of the trip including all access egress portions of the trip.

The analysis of the observed travel patterns in the northeast corridor would be used to determine the major factors affecting the modal choice, and indicate subgroups of passengers who react differently to these factors. In addition, the analysis of the stated preferences related the high speed rail could be used to identify factors affecting the diversion of air shuttle passengers, and to indicate the perceived value of on-board amenities, and special ground access facilities.

Appendix B

Data from Logan International Airport Ground Access Survey 1990

Courtesy of Massport Authority

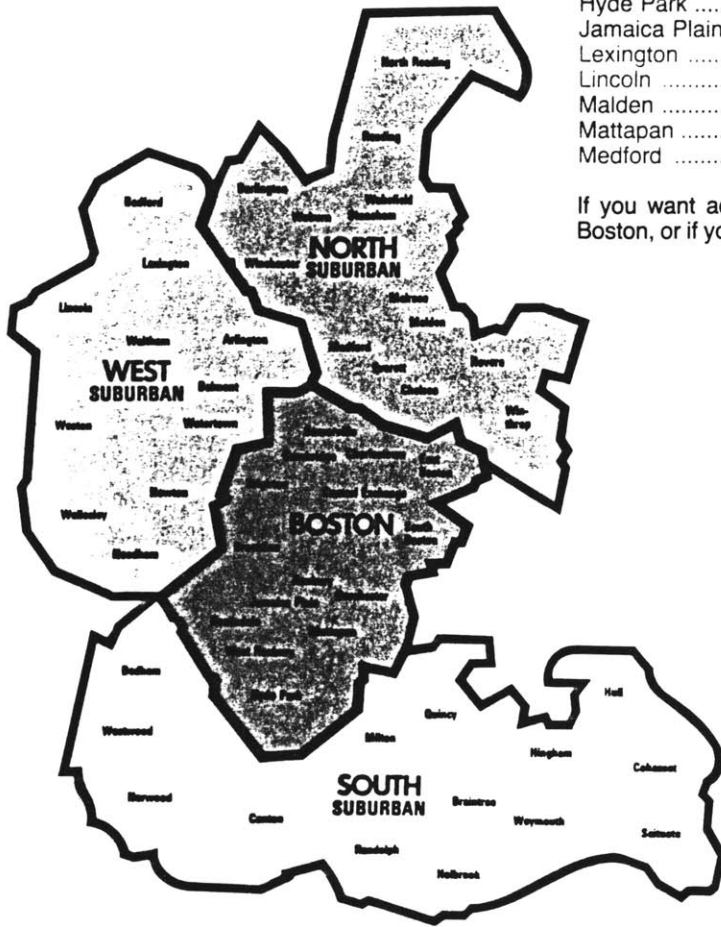
<u>Category</u>	<u>Total Percent</u>	<u>Category</u>	<u>Total Percent</u>
Trip purpose		Age	
Business	79.1	Under 21	2.0
Leisure	17.0	21 to 30	23.2
No-response	3.9	31 to 40	29.1
	Resident	41 to 50	27.0
Business	30.2	51 to 60	12.4
Leisure	7.5	Over 60	6.4
No-response	0.0		
	Non-Resident	Travel Party	
Business	48.9	Solo	73.8
Leisure	9.5	Group	26.2
No-response	3.9		
Trip Frequency		Gender	
Frequent	88.6	Male	63.9
Infrequent	11.4	Female	36.1
Number of Trips /year		Household Income	
1 to 5	31.9	Under \$20,000	3.5
6 to 10	20.7	\$20,000 to \$39,999	7.8
11 to 15	18.5	\$40,000 to \$59,999	12.4
16 to 20	8.8	\$60,000 to \$79,000	15.0
21 to 25	9.8	\$80,000 to \$99,999	14.3
25 to 50	4.9	\$100,000 to \$119,999	8.9
51 to 75	3.1	\$120,000 and over	38.1
76 to 100	1.7		
Over 100	0.6		

Category	Total Percent
Point of Origin	
Auburndale	0.2
Arlington	0.5
Bedford	0.5
Belmont	1.4
Downtown Boston	36.1
Braintree	0.8
Brighton	0.8
Brookline	2.4
Cambridge	10.6
Canton	0.5
Charlestown	0.2
Chelsea	0.0
Chestnut Hill	0.5
Cochituate	0.2
Cohasset	0.0
Dedham	0.5
Dorchester	0.0
East Boston	0.3
Everett	0.2
Hingdam	1.0
Holbrook	0.0
Hull	0.0
Hyde Park	0.2
Jamaica Plain	0.0
Lexington	1.1
Lincoln	0.5
Malden	0.0
Mattapan	0.0
Medford	0.3
Melrose	0.2
Milton	0.2
Needham	0.3

Category	Total Percent
Point of Origin	
Newton	3.1
North Reading	0.2
Norwood	0.2
Quincy	0.3
Randolph	0.2
Reading	0.2
Revere	0.0
Roslindale	0.2
Roxbury	0.0
Scituate	0.0
Somerville	1.0
South Boston	0.2
Stoneham	0.3
Waban	0.2
Wakefield	0.2
Waltham	1.9
Watertown	0.0
Wellesley	1.1
Weston	0.3
Westwood	0.5
West Roxbury	0.0
Weymouth	0.3
Winchester	1.0
Winthrop	0.0
Woburn	0.2
Point of Origin	
Metropolitan Boston	52.0
North Suburban	2.8
West Suburban	11.8
South Suburban	4.5
Outside 128 Belt	28.9
Within 128 Belt	71.1

Localities served by the white pages of each directory.

Arlington	West	Melrose	North
Bedford	West	Milton	South
Belmont	West	Needham	West
Braintree	South	Newton	West
Brighton	Boston	North Reading	North
Brookline	Boston	Norwood	South
Burlington	North	Quincy	South
Cambridge	Boston	Randolph	South
Canton	South	Reading	North
Central Exchange	Boston	Revere	North
Charlestown	Boston	Roslindale	Boston
Chelsea	North	Roxbury	Boston
Chassett	South	Scituate	South
Dedham	South	Somerville	Boston
Dorchester	Boston	South Boston	Boston
East Boston	Boston	Stoneham	North
Everett	North	Wakefield	North
Hingham	South	Waltham	West
Holbrook	South	Watertown	West
Hull	South	Wellesley	West
Hyde Park	Boston	Weston	West
Jamaica Plain	Boston	Westwood	South
Lexington	West	West Roxbury	Boston
Lincoln	West	Weymouth	South
Malden	North	Winchester	North
Mattapan	Boston	Winthrop	North
Medford	North	Woburn	North



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Destination

California	0.5
Connecticut	0.7
District of Colombia	0.8
Florida	1.0
Illinois	0.2
Maine	0.2
Massachusetts	0.7
Missouri	0.2
New Hampshire	0.2
New Jersey	2.1
New York	90.9
Texas	0.5
Virginia	0.3
Virgin Island	0.3
Washington	0.2
Outside US	1.3
New York City	73.4
New York State	17.5
Connecticut	0.7
New Jersey	2.1
Other US states	5.0
Outside US	1.3