ECONOMIC IMPACTS OF THE TRENTON-MERCER AIRPORT

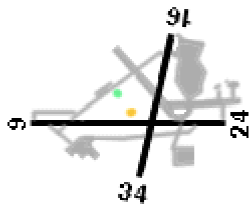

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Table of Contents

1 SUMMARY OF FINDINGS

As part of efforts to examine the economic role of the Trenton-Mercer Airport, the Division of Economic Development of the County of Mercer commissioned the Center for Urban Policy Research (CUPR) at the Edward J. Bloustein School of Planning and Public Policy, Rutgers University, in New Brunswick, New Jersey to undertake an assessment of its economic impact. The objective of the study is to determine the contributions to economic activity created by Trenton-Mercer Airport by evaluating the economic contributions of airport businesses, economic activity created by visitors to the airport.

Trenton-Mercer Airport is well established as a corporate air center. A diverse group of establishments currently call the grounds of Trenton-Mercer Airport's their home. In addition to services that support airport activity, four corporate flight departments are located there (Pfizer, Bristol-Myers Squibb, Unisys, and Merck) as well as several military and federal government agencies.

The airport is geographically well positioned to take on a larger role within the New York-Philadelphia air passenger market. Although in 2005 the airport catered to no more than 13,100 boarding passengers, in the not-so-distant past it has handled as many as 90,400 enplanements. Due to the very positive socio-demographics of its market area (Burlington, Hunterdon, Mercer, Middlesex, Ocean, and Somerset counties in New Jersey and Bucks County in Pennsylvania), much potential readily-accessed commercial passenger demand remains untapped.

During the course of the study a survey of tenants and air operations was undertaken. Publicly available Mercer County fiscal information was also researched. Including spending by visitors that enplane and deplane, activity based at Trenton-Mercer Airport injects about $114.3 million into the Mercer County economy annually. This level of economic activity supports about 750 jobs and $50.7 in labor income within the county (jobs that pay an annual average of about $67,600). It also generates $2.3 million in local government revenues with Mercer County and nearly $3.9 million in state tax revenues statewide. It also helps to generate another $0.6 million in local tax revenues across the state.

During the investigation, three alternative commercial passenger enplanement scenarios were detailed. All were compared to a Base Case of year 2005 when only 13,100 enplanements were counted. The other three scenarios were (1) commercial ridership that was equivalent to the peak level of in 1998—90,400 enplanements; (2) 201,200 enplanements—the equivalent to the Federal Aviation Administration's (FAA) 2010 forecast for the airport; and (3) the enplanement breakeven point for a benefit/cost analysis of a new $25 million terminal at the airport. The direct fiscal benefits over the Base Case for the first two of these alternatives are calculated to be $509,000 and $1,238,000, respectively. Economic impact analyses reveal that multiplier effects could add as much as $360,000 over the Base Case to tax coffers in Mercer County in the case of Alternative 1, and as much as $1,208,000 in the case of Alternative 2. Thus net total fiscal benefits of Alternatives 1 and 2 are estimated to be $869,000 and $2,446,000, respectively.

Because Mercer County's share of costs for a new terminal would be no more than 5 percent of its total costs, if approved by the FAA, the annual costs of a new terminal are expected to be relatively small. Its share of a $25 million dollar investment supported by the FAA would be $1.25 million. Even if paid back quickly—within ten years—the cost would be about $145,000 annually. Thus the fiscal benefit/cost ratio for Mercer County in the case of Alternative 2 is on the order of 17:1. (Alternative 1 does not require a new terminal.)

Based on estimates of direct fiscal revenues of $6.58 per passenger and of total fiscal revenues of $11.24 per passenger, the breakeven enplanement level is identified to be only marginally above 1998's enplanement level of 90.400. In fact because of the low cost to Mercer County of the terminal, the range of enplanements is also fairly tight—between 103,300 enplanements and 112,300 enplanements. Given recent flight additions at the airport and the improvements in the noise levels and fuel use by regional jets, this level of enplanements could be readily met by 2010 if a new terminal is put in place.

2 STUDY OBJECTIVES AND BACKGROUND

2.1 Study Background

In 1996, the New Jersey Division of Aeronautics, a unit of the New Jersey Department if Transportation, released the technical report *Economic Impact of General Aviation in New Jersey* to public officials, businesses, and community groups. The report, prepared by The Airport Technology and Planning Group, Inc., under contract to the Delaware Valley Regional Planning Commission, included an economic analysis of New Jersey's public-use general aviation airports. Trenton-Mercer Airport was one of the airports included in the study.

A critical component of the Mercer County's economic growth strategy to date has been maintaining a viable and environmentally friendly airport that meets the travel needs of its residents and businesses. The Trenton-Mercer Airport's easy access, free parking, light traffic densities, and relatively low rents combine to make it an attractive alternative for area businesses and potential passengers alike. These attributes are making the airport increasingly attractive as a venue for commercial airlines as gate fees, landing fees, security clearance wait times, parking fees escalate at the greater region's major airports—Philadelphia International and Newark Liberty—escalate. Commercial airline passengers within Trenton-Mercer Airport's effective market area are most vulnerable to the rising costs of access to commercial air transportation. This is because they are located more or less midway between these two airports and, therefore, suffer also greater congestion and commuting costs to the airports.

Moreover, the Trenton-Mercer Airport market area is among the fastest growing regions in New Jersey and eastern Pennsylvania. The New York/Northern New Jersey/Long Island Consolidated Metropolitan Statistical Area (CMSA), of which Mercer County is a part, grew 8.4 percent from 1990 to 2000 compared to only 5 percent for the Philadelphia CMSA.[1] Mercer County itself grew at a 7.7 percent rate from 1990 to 2000 compared to only 2 percent in Essex County.[2] Hence, even if the waiting costs of enhanced security in the wake of the 9-11 tragedy abate, traffic costs will undoubtedly

[1] Source: Census 2000 PHC-T-3. Ranking Tables for Metropolitan Areas: 1990 and 2000
[2] Source Census 2000 PHC-T-4. Ranking Tables for Counties: 1990 and 2000

continue to rise, especially so if recent escalations in the costs of diesel fuel and gasoline persist.

Since the first study of Trenton-Mercer Airport's economic effects in 1996, the airport has undergone significant changes. Commercial passenger enplanements rose to a peak of 90,397 in 1998 and have since fallen to minimal levels—close to 13,000 in 2005. Thus, the cursory analysis performed in 1996 is no longer valid. Moreover, since it was part of a larger analysis of the state's general aviation airports, the earlier report does not handle the array of operational possibilities that Mercer County officials are currently pondering.

Like most public use airports, Trenton-Mercer Airport is owned and operated by a local government—in this case Mercer County. Thus like other programs, the County needs to weigh the relative benefits of the Airport to the effort and funds it invests into it. While the act of measuring pecuniary costs of the Airport to Mercer County is straightforward, measuring the benefits of the Airport is not. This is because the Airport does not only benefit the County residents through the jobs it provides them and the purchases of supplies and services it makes from local firms. County-based Airport users also obtain lower net travel costs as a result of accessing the facilities. Moreover, some firms, for example Merrill Lynch, have repeatedly stated that they would not opt to locate in the region if they could not have had easy access to a facility like the Trenton-Mercer Airport. Thus, jobs and income that are not readily connected to the airport's operations can also be attributed to the presence of the airport. Finally, as a "community airport," Trenton-Mercer Airport serves a region larger than just Mercer County itself, both inducing job growth and increasing social welfare via reduced total net transportation costs of firms and households in its broader market area.

In seeking to evaluate the economic contribution of Trenton-Mercer Airport to the region, the Division of Economic Development of the County of Mercer, New Jersey, commissioned this study in 2003 as a follow up to the 1996 study noted above. The Center for Urban Policy Research (CUPR) of Rutgers University, New Brunswick, New Jersey, conducted the study with the assistance of the firm of ASWinc of Westfield, New Jersey. The study team was asked to examine the role of Trenton-Mercer Airport in the economy of Mercer County. This task involves answering several important questions.

How many Mercer County jobs are affiliated with the Airport and affiliated businesses? How does this translate into other local economic activity? By how much does the Airport reduce net transportation costs of commercial air transport passengers?

2.2 Trenton-Mercer Airport's Location and Layout

Trenton-Mercer Airport is located five miles northwest of the City of Trenton, New Jersey, in Ewing Township. The airport is located midway between New York and Philadelphia in the center of New Jersey. Approximately a tenth of the U.S. population is located within 75 miles of the airport. The airport is easily accessed by Interstate Highway 95, the primary north-south roadway of the Boston-Washington corridor.

Trenton Mercer Airport is a premiere publicly owned, public-use facility operated by Mercer County. The airport is part of the County's Foreign Trade Center (FTZ) strategically located, which comprises over 1,000 acres surrounding the airport. Seventy six acres of Trenton-Mercer County Airport are part of this FTZ. The FTZ enables establishments to defer, reduce or even eliminate U.S. Customs duties on products admitted to the zone. Hence, the FTZ supports research and development, manufacturing, warehousing, light industry, and offices. Among the establishments in the FTZ is Marriott's Courtyard Ewing Hopewell, a hotel located adjacent to the airport. The hotel's rate ranges from $189 and $234 per room night. The hotel has 125 rooms and two meeting rooms

Trenton-Mercer Airport is home to general aviation operators and both transient business and pleasure flyers. It also is a designated as a commercial service airport, competing with Atlantic City International, Newark Liberty International, and Philadelphia International airports for enplanements.

The airfield is a base for 175 aircraft and experiences 146,000 annual operations (takeoffs and landings).[3] The airport supports a large contingent of helicopters, and over 18 military aircraft are based at the airport. The primary runway, Runway 6/24, is 6,006 feet long and is equipped with a precision approach (ILS RWY 6) and two non-precision approaches (NDB RWY 6 and VOR RWY 24). The runway is equipped with high

[3] Source: "Economic Impact of General Aviation in New Jersey", The Airport Technology and Planning Group, Inc., May 1996

intensity runway lighting (HIRL), visual approach slope indicators (VASIs), and an approach lighting system (MALSR). Runway 16/34 is 4,800 feet long and is equipped with two non-precision approaches (VOR/DME RWY 6 and VOR/DME RWY 34). In addition to airside capabilities for handling the majority of the corporate and potential air carrier fleet, the facility provides FAA Air Traffic Control services between 6:00 A.M. and 10:00 P.M., and 24 hour, security and fire protection. The airport layout is depicted in Figure 1.

The airport's infrastructure supports year-round operations in a range of weather conditions by a variety of aircraft types, ranging from small private aircraft and large corporate aircraft such as the Gulfstream 550 to commercial aircraft used by regional airlines. Commercial airline service began at Trenton-Mercer Airport during the summer of 1995, and is now provided by Pan Am Clipper Connection, which provides regularly scheduled service between Trenton and Bedford, Massachusetts, and Portsmouth, New Hampshire. Pan Am Clipper Connection employs the Boeing 727-200 and the British Aerospace Jetstream 3101. The Boeing 727-200 (pictured below left) is capable of carrying 145 passengers on flights up to 2,400 miles. The Jetstream 3101 (pictured below right) is a 19 passenger, twin engine turboprop capable of flying 850 miles. Pam Am currently employs the Jetstream 3101 for service to and from Trenton.

Boeing 727-0200

BAE Jetstream 3101

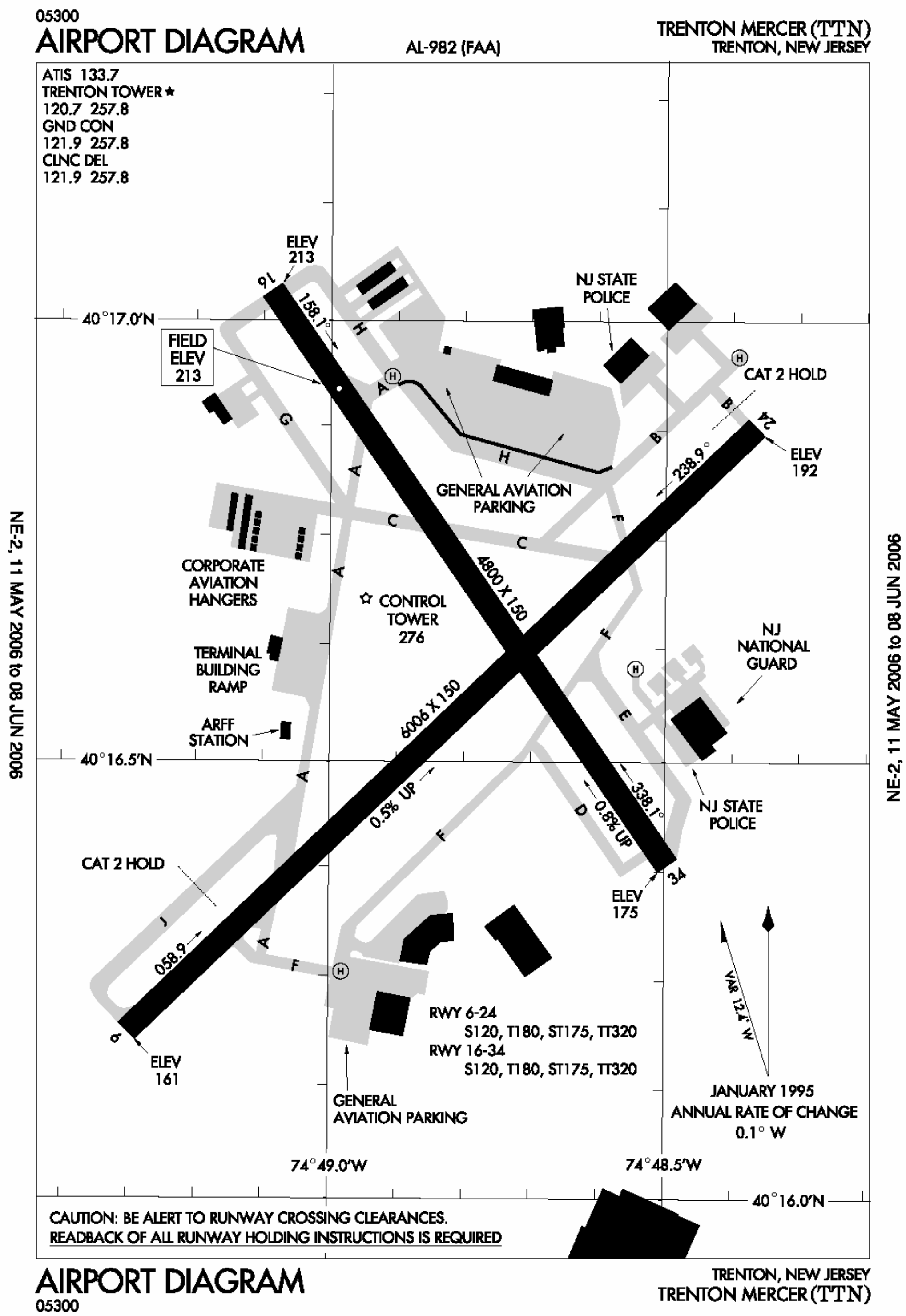
The airport is readily accessed by other modes of transportation. In particular, it is accessible by the ever-important auto since it is a mile east of either Exit 2 (Bear Tavern Road) or Exit 3 (Scotch Road) in New Jersey on Interstate 95. Taxi service between Trenton Mercer County Airport and the Trenton train station is available. Taxi cabs generally stage outside the front of the terminal. New Jersey Transit connects New York

City with Trenton. The fare from New York's Penn Station to Trenton station on New Jersey Transit's Northeast Corridor Line is approximately $15.00. By rail, Southeastern Pennsylvania Transportation Authority (SEPTA) R-2 Line connects Philadelphia's 30th Street Station with Trenton Station and the R-3 Line with the West Trenton Station. The fare from Center City Philadelphia to either rail station is about $8.00.

Since Newark Liberty International Airports is on New Jersey Transit's Northeast Corridor Line and one can transfer at Philadelphia's 30th Street Station to the R-1 Line which runs to Philadelphia International Airport, flow among the three airports is conceivably easy. Similarly Trenton Mercer has fairly ready access to rail stations beyond New York and Philadelphia via AMTRAK, which makes regular stops at Trenton Station.

Trenton-Mercer Airport's geographic and socio-demographic settings have some profound implications for the future. Aviation technology is making it increasingly possible for businesses to exist farther from the nation's major airports while locating closer to larger ones. The implications of air jet technology now on the horizon should also reduce both airport noise levels while also making fuel consumption by smaller craft more efficient. More details on the implications of future technology on business location decisions are provided in Appendix D.

Figure 1: Plan of Trenton Mercer Airport



3 ECONOMIC IMPACT ANALYSIS: CURRENT OPERATIONS

This portion of the study examines the numerous economic effects of Trenton-Mercer Airport on Mercer County and the State of New Jersey. Economic impacts are the direct and multiplier effects of site-based construction and operations of airport facilities and tenant businesses on levels of employment and associated income on the rest of the county and the state. For example, from the value of construction dollars, such analyses show how many jobs were created directly at the site; jobs created indirectly through suppliers of materials used in the development; and jobs created through the disposable spending of those workers from the first two categories. An analysis of economic impacts also provides a summary of the impacts this job creation would have on levels of personal income. It also estimates the amount of indirect business and household tax revenues generated on the multiplier effects. These are taxes not covered in the fiscal impact analysis. The multiple economic impacts listed above are quantified by a sophisticated input-output model—the R/ECON™ I-O model.

The results of R/ECON™ I-O model used include many fields of data. The fields most relevant to this study are the total impacts of the following:

- **Jobs:** *Employment, both part- and full-time, by place of work, estimated using the typical job characteristics of each industry*. (Manufacturing jobs, for example, tend to be full-time; in retail trade and real estate, part-time jobs predominate.) All jobs generated at businesses in the region are included, even though the associated labor income of in-commuters may be spent outside of the region. In this study, all results are for activities occurring within the time frame of one year. Thus, the job figures should be read as job-years; i.e., several individuals might fill one job-year on any given project.
- **Income:** *"Earned" or "labor" income—specifically, wages, salaries, and proprietors' income*. Income does not include nonwage compensation (i.e., benefits, pensions, or insurance), transfer payments; or dividends; interest, or rents.
- **Wealth**: *Value added—the equivalent at the subnational level of gross domestic product (GDP). At the state level, this is called gross state product (GSP).* Value added is widely accepted by economists as the best measure of economic well-being.

It is estimated from state-level data by industry. For a firm, value added is the difference between the value of goods and services produced and the value of goods and nonlabor services purchased. For an individual industry it is composed of labor income (net of taxes); taxes; nonwage labor compensation; profit (other than proprietors' income); capital consumption allowances; and net interest, dividends, and rents received.

- **In-State Wealth:** *Gross State Product (GSP) less federal tax revenues generated.*
- **Taxes**: *Tax revenues generated by the activity.* The tax revenues are detailed for the federal, state, and local levels of government. Totals are calculated by industry.

  Federal tax revenues include corporate and personal income, social security, and excise taxes, estimated from the calculations of value added and income generated.

  State tax revenues include income, excise, sales, and other state taxes, estimated from the calculations of value added and income generated (e.g., purchases by visitors).

  Local tax revenues include payments to substate governments, mainly through property taxes on new worker households and businesses. Local tax revenues can also include sales and other taxes.

3.1 Direct Economic Effects

The economic impacts of a project, event, or program are typically bifurcated into direct effects and the combination of indirect and induced effects. Direct effects are defined by focus of study and their magnitude is the size of that portion of the study activity injected into the local economy. The local economy is defined by the context of the study. In the case of the current study, the economy represents both Mercer County and the State of New Jersey. Mercer County was selected since that is the level of geography at which cost-benefit first becomes a concern, since the county is accountable for the costs of operating the airport. New Jersey was selected since that is the next best level of geography for addressing policy issues regarding the market area beyond Mercer County's borders.

In the context of the present study, the direct effects are measured as the jobs, earnings, and dollar amount of an investment or business activity (sales) located at the airport. For example, in the case of a construction project, the direct labor is defined as the labor at the construction site (at labor's workplace). Meanwhile, the materials used on a construction job are often purchased from a local retailer or wholesaler. But goods purchased from these market intermediates are typically produced outside of the local economy. As a result, such purchases of goods from outside of the area must be discounted from the investment amount when defining the direct effects on a specific geography, while the expenditures associated with the retail and wholesale margins of the purchases are allocated to the local economy. In the case of Mercer County and New Jersey, therefore, the direct economic effects of the Trenton-Mercer Airport are somewhat different. This is because construction activity in Mercer County could require material and equipment purchases from wholesalers or producers within New Jersey but beyond Mercer County's boundaries.

The documentation of the direct effects is determined by surveys of the affected groups and/or businesses and through the examination of existing data on these specific data categories. Thus, information on employment and payroll were a primary target of the study, and the general nature of air-related business and consumer spending were a secondary target.

3.1.1 Current Operating Parameters for Trenton-Mercer Airport

Trenton-Mercer Airport's existing two-gate terminal is used by the current provider of scheduled air service, Boston-Maine Airlines, which operates under the name Pan Am Clipper Connection. Pan Am provides service between Trenton-Mercer Airport and Lawrence G. Hanscom Airforce Base in Bedford, Massachusetts. Service on this flight from Trenton continues to Pease International Tradeport in Portsmouth, New Hampshire. Both destinations are within the Boston metropolitan area. Portsmouth is about an hour north northeast of Logan International Airport: Bedford is about 30 minutes northwest of Logan, near the interchange of State Route 128 and U.S. Route 3. During the summer of 2006, Pan Am announced that it plans to add flights to Baltimore-Washington Airport and to Elmira/Corning, New York.

The current terminal has typical throughput combined with ground loading of aircraft and operates 365 per year. Daily, traffic consists of three turns per gate via ground loading. Pan Am uses British Aerospace Jetstream 3101 aircraft, which have a passenger capacity of 19. Given the current level of enplanements (the total count of in- and out-bound passengers), which in 2004 were estimated to be 13,295 (Federal Aviation Administration, 2004), the aircraft load factor averages 64 percent.

Comair, a subsidiary of Delta Air Lines, has announced that it will launch service from Trenton-Mercer Airport to two new destinations, pending approval from the Federal Aviation Administration (FAA). It is slating three daily round-trips each to two of Delta's major hubs Hartsfield-Jackson International in Atlanta and Logan International Airport in Boston. Comair currently is targeting the routes to be handled by 50-seat Bombardier regional jets. Revenue from this expansion alone is, according to Mercer County sources, expected to reach $300,000 annually in fees and lease payments.

3.1.2 Business Operations

3.1.2.1 County Operating Expenses Incurred at Trenton-Mercer Airport

A main purpose of this study is to estimate the total economic impact of the airport upon Mercer County. Hence, a primary focus is the actual set of expenses that the county incurs in operating the airport. At the Trenton Mercer Airport, Mercer County expenses not related to capital items totaled $3.14 million during the fiscal year ending December 31, 2005 (see Table 1). As in the case of the typical businesses, slightly more than 30 percent of all airport operating-related expenses compensate labor. The slightly more than $1 million in payroll supported the 15 Mercer County employees in the Airport Manager's Office. An equivalent share of expenses is allocated from Mercer County to the Airport and is labeled in Table 1 as "Indirect Total Cost Allocation." These are expenses allocated to the airport by the county for services rendered by other county agencies. The bulk of remaining costs are for services (19.2 percent or about $604,000)—nearly 90 percent of which (or $583,400) was dedicated to a aircraft rescue and fire fighting contract—and for communications and utilities (11.8 percent or about $370,000).

Estimated county allocations of its 2005 indirect costs to the airport by general spending categories are shown in Table 2. The largest share (38.4 percent) was for the provision of public safety services. In addition to this charge by the County Sheriff's Office, allocations for utilities, mail service, landscaping and gardening, and county vehicles were based on the airport's usage of these services. Most of these costs undoubtedly paid for payroll and supporting equipment in the respective agencies. Assuming, as in the case of the airport, that about 50 percent of all allocable costs in these agencies are payroll related, the airport supports about another 8 workers employed by Mercer County. Thus in net about 23 Mercer County government jobs are supported directly by airport-related activities.

Table 1: Operating and Indirect Expenses at Trenton-Mercer Airport, 2005

Expense Item	**Amount ($)**	**Share of Total**
Personnel Compensation & Benefits	$1,003,893	31.9%
Communications and Utilities	369,825	11.8%
Supplies, Materials, Repairs, Maintenance	125,062	4.0%
Services	604,192	19.2%
Insurance and Claims	28,674	0.9%
Payments to Other Governments	944	0.0%
Other	11,952	0.4%
Total Operating Expenses	$2,144,542	68.2%
Total Indirect Cost Allocation	997,973	31.8%
Total Mercer County Expenses	$3,142,515	100%

Source: Airport Manager's Office, Division of Finance, Mercer County, Operating and Financial Summary, FAA Form 5100-125.

Table 2: Some Estimated Detail of County Indirect Costs Allocated to Trenton-Mercer Airport: Year 2003 Shares Applied to the Year 2005 Total

Expense Item	**Amount ($)**	**Share of Total**
Sheriff	$382,977	38.4%
Utilities & Mail Service	169,924	17.0%
Outside Services (landscaping & gardening)	139,394	14.0%
Motor Pool & Vehicle Use	62,468	12.0%
County Administration	119,870	7.0%
Allocated Building & Equipment Fund	53,261	6.3%
Personnel, Insurance, & Fringe Benefits	70,080	5.3%
Total	$997,973	100.0%

Source: Year 2003 shares generated by the Center for Urban Policy Research from more-detailed data developed for Mercer County by the Pino Consulting Group Inc.

3.1.2.2 Airport-based Operations and Business

Investigations revealed that a diverse group of establishments occupy the airport grounds. They include businesses directly associated with the aviation industry and others not so associated. Two large multi-service firms provided aircraft sales, aircraft cleaning and maintenance, fuel sales, accounting and sales services, and aircraft scheduling services. Ronson Aviation, a subsidiary of the Ronson Corporation, has provided aviation services since 1963. Ronson Aviation's services include new and pre-owned aircraft sales, charter, airframe & power-plant repair and modification (FAA approved repair station EHHR538D), avionics repair and installation, on-site U.S. Customs and Immigration Service, and full FBO Services including cargo handling. Corporate Aviation Hangars of TTN, LLC, provides a number of corporate-sized hangars for small business and private use. Both Budget and Hertz car rental agencies are located at the airport.

Four corporate flight departments were located at the airport, providing high-value corporate travel services to companies such as Pfizer, Bristol-Myers Squibb, Unisys, and Merck. Pfizer recently completed a new 90,000 square foot terminal. Merck also increased the size of its terminal, adding another 30,000 square feet. Light air traffic density allows corporate operations to be conducted with virtually no delays compared to Newark Liberty International, Philadelphia International, and even Teterboro airports. Located outside of FAA-designated Class B airspace, flights in and out of the airport are subject to far fewer delays than those to Newark, Philadelphia, and Teterboro. Combined with easy ground access and the absence of ground traffic congestion, these factors make Trenton-Mercer Airport an ideal location for these corporate aircraft.

Military tenants included the U.S. Marines Reserve Center and the New Jersey National Guard Aviation Division. Other government tenants included a contract control tower group, Federal Aviation Administration, the General Services Administration, U.S. Customs, and the Transportation Security Administration. The Mercer County Community College flight school was located at Trenton-Mercer Airport, as is a Mercer County Medical Examiner and the Mercer County Sheriff.

A variety of aviation service firms also are located at the airport. These firms provided fire and rescue services as well as hangar services to privately owned aircraft. Airport management staff is located in the terminal building. At the time of the study, scheduled commercial air service was provided by U.S. Airways. Non-aviation-related businesses included the restaurant and vending machine operator in the terminal building, a newspaper publishing company, and two manufacturing firms.

In total, there were 36 total tenants on the airport in 2001 that supported over 835.5 full-time-equivalent employees. The annual payroll for these tenants was $21.7 million An additional $7.7 million was spent upon materials, equipment, and services, making total operating expenses about $29.4 million in 2001. These estimates of tenant employment, payroll, and business revenue from data were provided by the airport administration.

More recent data (for 2003) were obtained during the course of the present study via a survey of tenants to ascertain the nature of the tenant firms spending patterns. It became clear almost immediately that fuel sales dominate the airport tenants' expenses. Hence, to get a better sense of the operating expenses, the sample was bifurcated between into aviation- and non-aviation-related tenants.

Table 3 illustrates the spending pattern for aviation-related organizations located at the airport. For this group, spending on fuels even before its meteoric rise in late 2005 was more than that for all other categories combined. Total operating expenditures by aviation-related organizations (non-Mercer County government facilities were included) surveyed was $57.7 million. Since 16 organizations replied to this 2003 survey, it was tantamount to a census of this category of organizations at the airport. It should be mentioned, however, that several organizations only reported their payroll figures.

Table 4 shows the somewhat more balanced spending pattern by non-aviation tenants, with food & beverage services, office & general supplies, marketing & advertising services, and insurance accounting for about half of this group's non-payroll expenditures. The total operating expenditures for non-aviation-related firms surveyed was $4.5 million.

Some tenants are in a foreign trade zone (FTZ) that embraces part of the airport. Foreign Trade Zone #200 was created in Mercer County by order 683 of the U.S.

Department of Commerce on March 11, 1994. FTZs are legally considered beyond the boundaries of the U.S. Customs territory. Hence, foreign and domestic merchandise admitted into these zones for operations such as storage, exhibition, assembly and manufacture and processing are not subject to formal customs entry procedures, the payment of duties, or the payment of federal excise taxes.

Table 3: Non-Payroll Expenditure Shares for a Sample of Aviation-related Firms at Trenton-Mercer Airport

Expense Item	Share
Fuel	16.7%
Aircraft Parts/Supplies	5.3%
Insurance Services	3.4%
Hanger Rent	1.7%
Repair/Maintenance Equipment	1.7%
Food and Beverage Supplies	1.3%
Communication Services	0.5%
Electricity	0.4%
Mercer County Rent	0.4%
Security Services	0.3%
Property Tax	0.3%
Cleaning Supplies	0.2%
Cleaning Services	0.2%
Rent (not Mercer County)	0.1%
Office/General Supplies	0.1%
Data Processing Services	0.1%
Office Equipment	0.1%
Legal Services	0.1%
Marketing/Advertising Services	0.1%
Other	0.1%
TOTAL	33.1%

Source: Survey of firms performed by ASWinc and CUPR calculations

Table 4: Non-Payroll Expenditure Shares for a Sample of Non-Aviation-related Firms at Trenton-Mercer Airport

Expense Item	Share
Food and Beverage Supplies	6.5%
Marketing/Advertising Services	6.3%
Office/General Supplies	6.1%
Insurance Services	4.2%
Communication Services	3.4%
Property Tax	3.3%
Electricity	3.1%
Legal Services	2.9%
Rent (not Mercer County)	2.2%
Hanger Rent	1.9%
Repair/Maintenance Equipment	1.4%
Cleaning Services	0.6%
Data Processing Services	0.4%
Banking/Finance Services	0.3%
Office Equipment	0.2%
Security Services	0.1%
Fuel (Heat)	0.1%
TOTAL	43.0%

Source: Survey of firms performed by ASWinc and CUPR calculations

Clearly, firms located within an FTZ can gain significant financial advantages. This is because they may defer payment of duty on imported goods until they are actually sold to customers in the United States...if the goods are sold within the U.S. at all. Manufacturers who import component parts clearly can gain additional advantages. This is because when the duty on the finished product is less than the sum of the duties on the component parts, the manufacturer can elect to pay the lesser single duty. Firms who import goods frequently gain another advantage: instead of paying entry fees (which are required in addition to customs duties) for every incoming shipment, a firm in an FTZ pays only one entry fee per week. The airport has a United Stated Customs office located on site to facilitate the importing of goods.

While not related to the airport, a free Trade Zone in East Windsor, New Jersey, exemplifies the potential of the airport’s Foreign Trade Zone. This zone, subzone 200A, was created in East Windsor in 1997 and subsequently occupied by Conair Corporation. Conair’s facility currently includes warehousing/distribution, testing, repackaging, and service/repair of a variety of consumer products. Its operations sometimes include reassembly and a change in Customs classification of incoming foreign components. Finished products include: electric personal care appliances (e.g., hair dryers/trimmers, massagers, heating pads, toothbrushes); beauty care products; small kitchen appliances/cookware (e.g., food processors/mixers/grinders, pasta makers, toasters, blenders, coffee/espresso makers); and consumer telephones and answering machines. Foreign components that would be used in reassembly/service activity include: plastic handles and knobs, fasteners, knives, fans, electric motors, generators, transformers, telephone components, microphones, loudspeakers, earphones, resistors, printed circuits, switches, diodes, integrated circuits, conductors, insulators, and timing devices. In fiscal year 2004, $289 million of merchandise was received by Conair, and $279 million of merchandise was shipped (Foreign-Trade Zones Board, 2005).

3.1.2.3 Commercial Air Passenger Operations

At the time the survey work was undertaken, only one commercial air company was operating out of Trenton-Mercer Airport—US Airways. Moreover, it opted not to respond to the survey effort. Even if it had responded, however, we would not have reported US Airways' response without violating the anonymity traditional promised in lieu of respondents' efforts. Because of this, the project team was forced to resort to a more generic treatment of this particular aspect of airport operations. Fortunately, their not only is a specific sector in R/Econ I-O models that addresses commercial air passenger service. Moreover, the project team had performed work on airports that vindicates use of this sector of the model for similar purposes.

The first data column in Table 5 summarizes the spending of commercial passenger airlines nationwide as of 1997. Since airplanes and hangars are major fixed capital costs that are allocated over numerous years, they are not shown here. Instead, their depreciation costs are not reported in this table. Neither are profits and taxes. Since 1997 the relative cost of jet fuel has risen rather substantially, and for obvious reasons security has experienced an increase in its share of spending. The cost shares of these two items were consequently increased as shown in the second column of data in Table 5. The cost share rises assume that actual costs have been born by airlines and passengers equally. Moreover, they suggest that the real cost of jet fuel to airlines has risen nearly 63 percent and that of security has more than doubled. The jump in security costs seems reasonable. Plus since they make up a very small share of airline costs even larger rises would not affect economic impact estimates significantly. The rise in fuel costs is downwardly adjusted from the national average nominal rise of jet fuel between May 2004 and May 2006 (a rise of 78 percent) as reported by the U.S. Department of Energy's Energy Information Administration. The rise was downwardly adjusted partly to account for inflation but also because fuel prices have dropped rather precipitously since May 2006. A more accurate adjustment to October 2006 prices was not available at the time of this report was being written.

Table 5: Expenditure Shares for U.S. Air Transportation Service Firms, Prior to and After Adjustment for Increased Real Fuel and Security

Expense Item	Expenditure Share	Adjusted Expenditure Share
Fuel	10.21%	16.70%
Aircraft Parts/Supplies	3.51%	3.27%
Insurance Services	2.08%	1.94%
Electricity	0.52%	0.48%
Communication Services	0.34%	0.31%
Data Processing Services	0.30%	0.28%
Security Services	0.26%	0.50%
Wholesale Trade	0.22%	0.21%
Hanger Rent	0.21%	0.19%
Repair/Maintenance Equipment	0.18%	0.17%
Cleaning Services	0.14%	0.13%
Office/General Supplies	0.06%	0.05%
Legal Services	0.05%	0.04%
Marketing/Advertising Services	0.04%	0.04%
Food and Beverage Supplies	0.03%	0.03%
Other Materials/Equipment/Services	2.28%	2.13%
Labor	40.15%	37.45%
TOTAL	60.57%	63.95%

Source: U.S. Bureau of Economic Analysis, Benchmark National Input-Output Accounts for 1997 adjusted by R/Econ to account for differences between national Gross Domestic Product and New Jersey's Gross State Product for 2001 also as reported by the U.S. Bureau of Economic Analysis. The adjusted security and fuel costs come from findings reported in Table 3.

Table 6: Commercial Passenger Air Fares
from Trenton-Mercer Airport to Various Destinations

Destination Airport	Lowest Fare	Highest Fare
Baltimore-Washington International	$170.92	$170.92
Bedford, Massachusetts	$159.10	$202.10
Portsmouth, New Hampshire	$175.22	$175.22
Elmira/Corning, New York	$159.10	$159.10

As of October 2006, one-way fares out of Trenton Mercer Airport offered by Pan Am Clipper Connection average somewhere around $170 dollars (see Table 6). The fares are assumed to be net of passenger and landing fees. At this average fare and 2004 enplanement levels of nearly 13,300, total revenues were about $2.26 million in 2004. This revenue level was entered into the model for Mercer County that contained the adjusted expenditures.

3.1.3 Spending by Air Travelers

The primary off-airport effects are the result of spending by visitors in various trave1-related industry sectors. These include spending such as those for food, lodging, entertainment, shopping, local transportation and other related services. Measuring these effects that occur off-site begins with the estimation of nonlocal visitors. The focus on nonlocal visitors is undertaken since it is presumed that, in the absence of the airport, locals would have spent their money in the area anyway. Thus, to count only nonlocal visitor spending is reasonable and customary in order to provide the most accurate and conservative estimate of economic impacts.

Attempts were made to get passengers to fill out a postcard survey of their spending behavior while visiting the region. Unfortunately for the survey team, boarding passengers were unwilling to complete the survey largely because they were in a hurry and had no waiting time available during which they could fill out the brief form. Deplaning passengers were unwilling to fill out the form because they were either running to their parked cars or to their reserved rental car, which was awaiting them in the parking lot. Thus, in the end, the survey lacked reportable results. This outcome speaks volumes about the perceived and apparent efficiency of movement in the current terminal at Trenton Mercer Airport.

In any case, the lack of reliable survey results required reliance on outside sources for data on spending by visitors that use air transportation. Thus the present study relies on studies performed by the Massachusetts Aeronautics Commission and the Virginia Department of Transportation (Virginia DOT). These studies reveal that such visitor spending averages about $145 per trip. Other airport studies set visitor spending at up to $600 per trip, but these larger spending amounts tend to pertain to airports with very much larger enplanement figures—those catering to destinations like Seattle-Tacoma, Orlando, and Chicago. Hence, for the sake of conservativism, the lower value is used for the present analysis.

Over time, CUPR staff has performed numerous studies of tourism and household spending in New Jersey. Those expenses undertaken by business travelers are no exception. Table 7 show the general set of spending share that apply this group of travelers.

Approximately 11,150 visitors used the Trenton Mercer Airport in 2003. These Massachusetts and Virginia studies show that about 86 percent of air visitors used the airport for business travel, while 14 percent use them for recreational use. Assuming that the spending identified by the Virginia and Washington Departments of Transportation hold for nonlocal Trenton-Mercer visitors, annual direct spending by general aviation visitors passing through Trenton-Mercer Airport is estimated to currently be about $1.62 million.

Table 7: Business Traveler Spending Shares

Expense Item	Expenditure Share
Lodging	57.35%
Dining	13.68%
Car Rentals	13.49%
Retail: Food, Tobacco, & Beverages	8.09%
Entertainment	4.27%
Retail: Gifts	3.12%
TOTAL	100.0%

3.1.4 Capital Spending

3.1.4.1 County Capital Spending at Trenton-Mercer Airport

Trenton-Mercer Airport not only affects the local economy by operating as other businesses in employing workers and purchasing local supplies and services, but also makes local capital expenditures for maintenance and/or expansion of the local facilities. This spending is in addition to regular operating expenditures for the Airport. These improvements are largely funded by federal monies that would not otherwise be received in the local area. In order to measure these local expenditures for construction and maintenance projects, Airport management provided researchers with the five-year plan for capital spending, from which we will use an average capital expenditure to estimate the economic impact.

The need for the five-year capital plan is that, unlike business operations, such spending tends to be quite uneven across time. For example, most years such spending may cover just building maintenance and basic equipment needs. Meanwhile once every five or ten years, capital spending can spike to cover extraordinary items like new runways, hangars, gates, or snow and ice removal equipment. Hence, while greater expanses of time are best for evaluating an organization's "typical" annual capital spending, a five-year span is reasonable, given the difficulties associated with maintaining pertinent records as well as the propensity of such expenses to rise with airport size.

The economic repercussions of capital spending are ephemeral: that is, they are a one-time expense. That is the set of jobs and income associated with this spending appears in the economy as the funds are spent. For example, the capital outlays for a new hangar include the salaries of workers on the construction job and payrolls of manufacturing workers that produce the materials needed during the course of putting the structure in place. Thus the expenses take place over a fixed time frame and can vary widely from one year to the next, depending upon the particular project undertaken. Thus, except for the case of maintenance construction, such spending is not considered a regularly recurring expense such as an operating expense.

3.1.4.2 Capital Spending by Tenants of Trenton-Mercer Airport

However, given the regular nature of these expenses at Trenton-Mercer Airport as well as projected similar expenses through 2008, we will count this type of capital spending as an annual expense for the near future, using an average in our estimates in order to even out annual differences. In 2001, the total amount of capital spending by airport tenants was $1,392,280. In 2000, capital spending by airport tenants was $2,611,353.

Capital improvements made by airports benefit from the federally administered Airport Improvement Program (AIP), which provides grants for terminal expansions and modifications, runway and taxiway improvements, and other enhancements to the airport's infrastructure. The Federal Aviation Administration and the State of New Jersey currently provide up to 95 percent of funds needed for such construction, with the sponsoring organization only responsible for five percent. For Fiscal Year 2002, Mercer County's share of capital investments was $124,141, for example.

In the end, in this study we assume that about $2.5 million in capital investments (year 2005 dollars) are made annually at the Trenton-Mercer Airport.

3.2 The Total Annual Economic Contribution of Trenton-Mercer Airport

The direct effects discussed in the prior section are those that are most easily and accurately measured. But other organizations cater to business at the Trenton-Mercer Airport to maintain their livelihoods. If the airport did not exist, it is likely that at least some other jobs in Mercer County and in the State of New Jersey would cease to exist. In other cases, the lack of a Trenton-Mercer Airport would cause come firms' costs to rise. This latter is perhaps the case of Pfizer Corporation which maintains a fleet of small aircraft in a hangar at the airport. If Trenton-Mercer Airport ceased operations, Pfizer would be forced to seek another, more-expensive option to house its planes.

This study is focuses strictly on the extent of the potential loss of interindustry/interfirm linkages—so called county and state economic "multiplier effects" of the airport. Thus, price effects on area firms of the proposed absence of the airport are not estimated here. Nor are does the report address the effect on business formation or retention within Mercer County or the state due to the lack of a second-tier airport in central New Jersey. These two potential types economic repercussion minimally require the development of various economic scenarios based on extensive interviews with a broad range of corporate executives. These scenarios then would likely be followed up with an analysis using a time-series econometric or computable general equilibrium model of the focal economies. Such interviews and modeling were included within the scope of the present study. Thus, this study of the economic contributions of the Trenton-Mercer Airport is limited to activities at the airport and the set of more readily measured multiplier effects of these activities.

3.2.1 Description and Measurement of Multiplier Effects

Total economic impacts encompass both direct and multiplier effects. The latter incorporate indirect and induced impacts. The character of the direct impacts is derived as discussed in the previous section, where it is presented in some detail. The direct effects generate multiplier effects throughout the Mercer County and State of New Jersey economies. These effects result from spending being circulated throughout the economy through local purchases of goods and services as well as household spending of employees in the directly affected industries.

For example, the Airport may spend $100 locally for the purchase of some type of supplies, or a visitor may spend $100 on hotels/motels, restaurants, gas purchases, entertainment venues, and/or retail purchases. From the original $100, some portion would immediately leave the area since some goods may not be produced locally (for example, a business owner may have to pay a supplier that is in another state). The remainder of the money then circulates through spending and re-spending by local businesses and their employees, with all eventually being exhausted from the local area. The original $100 would be the direct effect, while the sum of all the related spending would be the multiplier effects. For example, if the multiplier effects totaled $40, the total economic impact would be $140, with a multiplier of 1.4 (total effects ($100 + $40)/direct effects ($100)).

This implies that for every $100 of spending by the Airport (or related business or visitor) there will be an additional $40 of spending throughout the local area (this is an example only, not a universal multiplier figure for such spending). The multiplier can be analyzed from a variety of perspectives, including jobs, income, or economic activity generated by the Airport and related businesses in order to assess the magnitude of the local economic interactions between businesses and consumers.

As might be expected, effects can vary for different sectors of the economy, depending on how much is spent locally for supplies or equipment, and how large an economic area is being examined. These effects result from the re-circulation of spending by the suppliers to the aviation and related industries, industries frequented by visitors, and by workers in those industries.

The indirect impact component consists of spending on goods and services by industries that produce the items purchased by the general contractors. Among his many business relationships, for example, a contractor might purchase windows from “Jerry’s Home Improvement Inc.” (JHI), which makes custom windows. In order to produce windows, JHI must hire craftsmen as well as contract with firms that supply glass, adhesives, paints and coatings, glazing, and wood products. JHI also hopes to make a profit for its owners/shareholders. In order to meet JHI’s needs, its suppliers must also hire workers and obtain materials and specialized services. The same process is repeated for their suppliers, and so on. Thus, an extensive network of relationships is established based upon round after round after round of business transactions that emanate from a single preservation project. It is this network of transactions that describes the set of indirect impacts. Of course, a firm’s net indirect contribution to the construction activity largely depends on (1) the total value of its transactions in the network; and (2) the proximity of its business relationship(s) to the construction contractor within the project’s business network. Similar to direct impacts, local indirect impacts are composed only of indirect business transactions that occur in the local economy.

Finally, induced impacts are a measure of household spending. They are a tally of the expenditures made by the households of the construction workers on a development, such as the construction of a new gate at Trenton-Mercer Airport, as well as the households of employees of the supplying industries.

One means of estimating indirect and induced impacts would be to conduct a survey of the business transactions of the primary contractor. The business questionnaire for this survey would ask for the names and addresses of the contractor’s suppliers; what and how much they supply; the names and addresses of the contractor’s employees; and the annual payroll. A related questionnaire would cover the household spending of the employees of the surveyed firms. It would request a characterization of each employee's household budget by detailed line items, including names and addresses of the firms or organizations from which each line item is purchased.

Both questionnaires (which are expensive to effect) subsequently could be used to measure indirect and induced impacts of the primary contractor's activity. The business questionnaire would be sent to the business addresses identified by the primary contractor; the household questionnaire, in turn, would be sent to the homes of the employees of those businesses that responded to the survey. This "snowball-type" sampling would continue until time or money was exhausted. In order to keep each organization's or household's contribution to the project in proper perspective, its total spending would be weighted by the size of its transaction with its customers who were included in the survey activity. The sum of the weighted transaction values obtained through the surveys would be the total economic impact of the project.

This survey-based approach to estimating indirect and induced impacts consumes a great deal of money and time, however. In addition, response rates by firms and households on surveys regarding financial matters are notoriously low. Hence, in the rare cases where survey work has been conducted to measure economic impacts, the results have tended to be not statistically representative of the targeted network of organizations and households. Consequently, relatively less expensive economic models based on Census data are typically used to measure economic impacts.

The economic model that has proven to estimate the indirect and induced economic effects of events most accurately, and the one used in the current study, is the input-output model. Its advantage stems from its level of industry detail and its depiction of interindustry relations. As shown in Appendix A to this chapter, a single calculation—known as the Leontief inverse—simulates the many rounds of business and household surveys. Input-output tables are constructed from nationwide Census surveys of businesses and households. The most difficult part of regional impact analysis is modifying a national input-output model so that it can be used to estimate impacts at a subnational level. Regionalization of the model typically is undertaken by the model producer and requires a large volume of data on the economy being modeled. This study employs a multiregional input-output model composed of Mercer County and the rest of New Jersey to estimate the extent of the indirect and induced economic effects from Trenton-Mercer Airport: operations, capital investment, and visitor spending. Trade between the regions is estimated using a gravity model formulation, which is based on rough estimates of average travel times for freight between the regions.

R/ECON® I-O, the model of choice for this study, expresses the resulting jobs, income, and wealth impacts in various levels of industry detail. The most convenient application breaks the industry-level results at the one-digit standard industrial code (SIC) or division level. This level has 11 industry divisions:

1. Agriculture
2. Agricultural, Fishing, and Forestry Services
3. Mining
4. Construction
5. Manufacturing
6. Transportation, Communications, and Public Utilities (TCPU)
7. Wholesale Trade
8. Retail Trade
9. Finance, Insurance, and Real Estate (FIRE)
10. Services
11. Government

R/ECON® I-O provides results in two other industry breakdowns that detail subcategories under each of these eleven groups. These breakdowns use an 86-industry specification and the full industry specification of the input-output model (517 industries).

The model results, however, are only as good as the data that go into them. Thus, when the direct requirements are estimated—as earlier done in this report with respect to Trenton-Mercer Airport—and the industry-level purchases are estimated (as is the case in this study), care should be taken in interpreting model results, especially when they contain extreme categorical detail. Hence, the main body of this chapter focuses on rather aggregated sectoral results. Tables with more detailed results and job impacts by occupation are made available as exhibits. The purpose of providing such detail is to enable a better idea of the quality of jobs that are likely to be created and of the types of industries that are most likely to be affected by the various activities.

3.2.2 The Economic Contribution of Trenton-Mercer Airport to Mercer County

Table 8 displays the output from the R/ECON I-O model for Mercer County after the direct effects from Section 3.1 were entered into it. It first of all reveals (on Line II.1) that the activity, including tourism and capital investment, at Trenton-Mercer Airport directly maintains a total of about 650 jobs in Mercer County, which support over $46.2 million in labor income. Hence, these jobs pay an average of about $70,833 annually ($46.2 million divided by 653 jobs). Thus, airport activity largely directly engages the kinds of jobs most regions seek—those requiring higher skills and at the upper-end of the pay scale.

The multiplier effects are comparatively small within Mercer County. This is because Mercer County businesses depend rather heavily on outside firms for their supplies as well as for their markets. That is, Mercer County's economy is not insular and, instead, depends rather heavily on trade that travels across its borders. As a result, multiplier effects of the airport's activities generate about 94 more jobs. Moreover, the jobs are associated with $4.4 million in labor income. That is, each of these indirect/induced jobs pays on average about $47,200 annually—about two thirds of the average for the direct jobs.

Most of the jobs associated with the airport activity is concentrated, not surprisingly, in the transportation and utilities sector, the services sector, and in retail trade. Note that, for the purposes of this exercise, Mercer County officials directly associated with airport activities were allocated to the transportation sector, rather than to the government sector.

The model estimates that all economic activity associated with the airport generates on the order of $2.3 million in local taxes annually. This sum does not include just over $86,000 in passenger and landing fees Mercer County receives from commercial flights in 2004. It also does not include any rents the County collects from tenants.

In addition to the local tax revenues, which are large due to enhanced property values, the state is estimated to collect over $1.4 million in taxes due to airport activity. In both cases, state and local taxes, households contribute little. This is because most workers on the airport's grounds are assumed to commute from outside of the County.

Table 8: Economic and Tax Impacts of Annual Operations and Investment at the Trenton-Mercer Airport on the Economy of Mercer County, NJ

	Economic Component			
	Output (000 $)	Employment (jobs)	Income (000$)	Gross State Product (000$)
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	12.1	0	1.3	3.3
2. Agri. Serv., Forestry, & Fish	25.2	0	12.4	19.4
3. Mining	37.9	0	6.7	21.1
4. Construction	1,583.7	16	868.7	1,171.8
5. Manufacturing	965.3	6	270.8	295.3
6. Transport. & Public Utilities	104,177.3	537	41,555.8	55,909.4
7. Wholesale	778.4	5	316.5	334.3
8. Retail Trade	2,015.1	46	607.7	1,063.7
9. Finance, Ins., & Real Estate	3,840.0	18	1,286.9	2,874.4
10. Services	12,974.5	114	5,535.5	6,388.4
11. Government	701.1	4	236.1	454.9
Total Effects (Private and Public)	127,110.7	747	50,698.3	68,536.1
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	114,302.3	653	46,254.1	61,453.6
2. Indirect and Induced Effects	12,808.4	94	4,444.3	7,082.5
3. Total Effects	127,110.7	747	50,698.3	68,536.1
4. Multipliers (3/1)	1.112	1.144	1.096	1.115
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				43,716.2
2. Taxes				7,777.2
a. Local				2,107.5
b. State				1,430.7
c. Federal				4,239.0
General				3,443.9
Social Security				795.1
3. Profits, dividends, rents, and other				17,042.7
4. Total Gross State Product (1+2+3)				68,536.1
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		43,716.2	7,415.8	---------
2. Taxes		7,777.2	2,647.6	10,424.8
a. Local		2,107.5	192.8	2,300.3
b. State		1,430.7	168.9	1,599.5
c. Federal		4,239.0	1,143.0	5,382.0
General		3,443.9	1,143.0	4,586.9
Social Security		795.1	0.0	795.1
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				6.4
Income				437,119.4
State Taxes				13,791.0
Local Taxes				19,833.2
Gross State Product				590,915.9
INITIAL EXPENDITURE IN DOLLARS				$115,982,810

3.2.3 The Economic Contribution of Trenton-Mercer Airport to New Jersey

Not surprisingly, the total economic effects of Trenton-Mercer Airport on New Jersey are somewhat larger than those on Mercer County alone (see Table 9). The direct effects are practically identical, although very modestly larger. Abut 10 more direct jobs are attributed to the rest of the state than to Mercer County (c.f. line II.1 in Tables 8 and 9). These jobs as well as their associated labor income and business revenues (output) undoubtedly are associated with manufacturers that provide supplies to contractors and airport vendors.

New Jerseys economy retains much more in the way of multiplier effects, however. Thus, much of the airport activity in Mercer County spills over into the state in the form of indirect and induced effects. The added jobs are fairly well distributed across eight of the eleven sectors displayed in the table. Thus the nearly 290 jobs additional jobs created statewide and beyond Mercer County's boundaries are associated with $15.2 million in labor income. Thus at nearly $52,600, the average pay of these jobs is very close to the state average.

Because workers residences are captured in a statewide version of the model, the state and local tax revenue estimates are substantially higher. At the state level, state tax revenues associated with the Airport's activity are expected to be about $3.9 million and for local government statewide are expected to receive tax revenues on the order of $4.5 million. Both of these are nearly double the revenues expected to be received via Mercer County alone.

Table 9: Economic and Tax Impacts of Annual Operations and Investment at the Trenton-Mercer Airport on the Economy of New Jersey

	Economic Component			
	Output (000 $)	**Employment (jobs)**	**Income (000$)**	**Gross State Product (000$)**
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	202.6	1	19.7	36.2
2. Agri. Serv., Forestry, & Fish	59.2	1	27.9	46.6
3. Mining	89.6	0	16.0	49.9
4. Construction	2,795.1	18	1,029.3	1,577.6
5. Manufacturing	21,765.2	49	3,884.0	4,189.2
6. Transport. & Public Utilities	110,360.8	555	42,923.3	58,319.8
7. Wholesale	3,132.5	16	1,273.8	1,345.4
8. Retail Trade	9,584.3	148	3,433.9	5,465.0
9. Finance, Ins., & Real Estate	11,798.9	55	4,218.2	8,109.9
10. Services	20,784.3	186	8,781.2	10,387.5
11. Government	967.3	5	317.6	585.5
Total Effects (Private and Public)	181,539.8	1,036	65,924.9	90,112.5
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	115,946.1	663	46,774.1	62,262.9
2. Indirect and Induced Effects	65,593.8	373	19,150.8	27,849.6
3. Total Effects	181,539.8	1,036	65,924.9	90,112.5
4. Multipliers (3/1)	1.566	1.564	1.409	1.447
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				56,704.6
2. Taxes				15,920.9
a. Local				2,877.8
b. State				2,293.4
c. Federal				10,749.7
General				4,049.1
Social Security				6,700.6
3. Profits, dividends, rents, and other				17,487.1
4. Total Gross State Product (1+2+3)				90,112.5
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		56,704.6	46,415.8	---------
2. Taxes		15,920.9	12,850.7	28,771.6
a. Local		2,877.8	1,627.0	4,504.8
b. State		2,293.4	1,591.2	3,884.6
c. Federal		10,749.7	9,632.5	20,382.2
General		4,049.1	9,632.5	13,681.6
Social Security		6,700.6	0.0	6,700.6
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				8.9
Income				568,402.1
State Taxes				33,492.9
Local Taxes				38,840.2
Gross State Product				776,947.4
INITIAL EXPENDITURE IN DOLLARS				$115,982,810

4 PASSENGER GATE ALTERNATIVES

4.1 Description of Alternatives

In addition to the total contribution of the Trenton-Mercer Airport, Mercer County administration specified that it was interested in assessing possible alternative courses of action (or inaction) with regard to expansion of airport activities. It was further specified that the alternatives would focus upon alternative levels of commercial passenger air travel activity emanating from Trenton-Mercer Airport. Thus all activity on airport property not pertaining to commercial air activity was eliminated from consideration. Hence, future expansion opportunities through corporate air travel and tenant activity were to be ignored within the confines of the alternatives that were to be evaluated. Moreover, the assessment was requested to have both fiscal and economic orientations.

Various alternatives were considered. In the end, during an early project meeting (August 14, 2003) the study team with full approval from Mercer County management put forward four passenger gate alternatives that should be elaborated. The alternatives selected were:

- The current level of enplanements and on-site activity for the most recent year;
- Full use of the capacity of the current terminal plus all currently planned and existing on-site activity;
- A new two-gate terminal plus all currently planned and existing on-site activity; and
- An alternative that represents the break-even enplanement level for a new two-gate terminal.

Following are detailed descriptions of the first three alternatives and a summary table of them. The break-even alternative is necessarily derived after a thorough assessment of these three alternatives.

4.1.1 Base Case: Typical Use of Current Two-Gate Terminal

The existing terminal and the passenger traffic that it currently supports (based on 2004 data, the latest available from the Federal Aviation Administration), serves as the base case. The existing two-gate terminal is used by the current provider of scheduled air service, Pan Am Clipper Connection. Pan Am provides service between Trenton and

Bedford, Massachusetts. Service then continues to Portsmouth, New Hampshire. Both of these destinations are within reasonable traveling distance to Boston, Massachusetts.

The base case assumes typical passenger throughput using the existing passenger terminal. For the year 2004, the Federal Aviation Administration reports 13,295 enplanements took place at the airport. The airport operates 365 days per year. Based on the schedule data available from Pan Am Clipper, three to five departures are scheduled daily using British Aerospace Jetstream 3100 aircraft with a passenger capacity of 19. A typical load factor (percentage of aircraft seats will passengers) is 64 percent.

To estimate passenger air transport revenues, half of an average round-trip fare out of Trenton-Mercer Airport ($175) was applied to 13,300, five more annual enplanements than existed in 2004. Air passenger revenues for 2004 were thereby estimated to be about $2.26 million.

4.1.2 Alternative 1: Full Capacity of Current Two-Gate Terminal

Historical data provides the basis for the first alternative scenario. Numerous airline service providers have operated from Trenton-Mercer Airport, providing transportation to a variety of destinations. Eastwind Airlines provided service between Trenton and Jacksonville, West Palm Beach, Florida, Boston, Massachusetts, and Atlanta, Georgia, from 1995 to 1999 using Boeing 737 aircraft. From 1999 to 2004, Shuttle America employed DeHavilland Dash-8/200 turboprop and other aircraft to provide up to ten round-trip flights daily between Trenton and Bedford, Massachusetts.

Alternative 1 is based on the historical enplanements as reported by the Federal Aviation Administration. In 1998, there were a total of 90,397 passenger enplanements at Trenton-Mercer Airport. Most of these resulted from Eastwind Airlines which employed the Boeing 737 aircraft. For purposes of this analysis, it is assumed that Pan Am Clipper would continue to provide service using the British Aerospace (BAE) Jetstream 3100 aircraft (passenger capacity of 19), and that additional service would be provided by either Pan Am Clipper Connection or another airline using a DeHavilland Dash 8/200-class aircraft with a passenger capacity of 37 as previously employed at Trenton-Mercer by Shuttle America.

To estimate revenues, we applied the same approach discussed very briefly in the prior subsection. In this case, we assumed there would be about 90,400 enplanements.

This level of enplanements is likely to be maintained by low-cost airlines similar to those like Pan Am Clipper Connection. Hence fares should remain low at about $170 per enplanement. Total commercial air passenger revenues in this case would be about $15.4 million.

4.1.3 Alternative 2: New Two-Gate Terminal Operating at Typical Capacity

Alternative 2 is based on the enplanement forecast taken from the Trenton Mercer Airport Environmental Assessment.[4] This forecast, developed by the Federal Aviation Administration, indicates that by 2010, as many as 201,200 passengers could depart from Trenton-Mercer Airport annually. The forecast assumes that with a state-of-the-art terminal, at least one air carrier will provide scheduled air service at Trenton-Mercer at levels consistent with those seen in previous years when Trenton's regional passenger demand was being met by a Trenton-based air carrier. Increased regional passenger demand is expected to stimulate an associated increase in Trenton-Mercer Airport enplanements resulting in the total enplanement forecast.

With a state-of-the-art passenger terminal, it is expected that, consistent with the FAA's forecast, additional passenger traffic will be supported by multiple air carriers. The mix of scheduled operations can be expected to be 12 departures and arrivals daily consisting of British Aerospace Jetstream 3101 aircraft with passenger capacity of 19; six departures daily consisting of a Dehavilland Dash 8/200 with a passenger capacity of 37; and three departures daily consisting of a Boeing 727/200 with a passenger capacity of 145.

This alternative also takes into account the fact that a new terminal is needed to support the security infrastructure mandated by the Transportation Security Administration. With a new terminal, and the ability to provide federally-mandated security procedures, the likelihood of additional air service providers being willing to offer service to and from Trenton increases. As noted in the latest Trenton-Mercer Airport Environmental Assessment, the current terminal, constructed in 1976, was designed to accommodate only small commuter aircraft. A variety of conditions mentioned in the report resulted in the conclusion that the current terminal did not

[4] Trenton Mercer Airport Environmental Assessment Report, Section 2, "Air Carrier Activity Forecasts", 6/3/01.

provide adequate space for multiple airlines to operate, creating a condition that precluded competition between airlines.[5] This last scenario also allows for the increased likelihood of more than one airline operating out of the new terminal, and assumes that being able to travel from a more convenient location will result in additional passengers being drawn from not only Mercer County, but the surrounding New Jersey counties (Hunterdon, Middlesex, Burlington, Somerset, Monmouth and Ocean) as well as some from southeastern Pennsylvania counties (Bucks and Montgomery).

Total annual revenues in this case would approach $50.3 million. This estimate assumes enplanements of 210,200 and a roundtrip air fare $500, half of which is assigned to the Trenton-Mercer Airport and the other half to passengers' destinations/origins. It is important to understand that this level of enplanements could not be sustained without a new terminal. Appendix C discusses the relationship between enplanements and the number of gates in somewhat more detail. Nonetheless, in the ensuing analysis, we assume that 90,400—the airport's peak level of enplanements attained in 1998—is very close to the maximum enplanement count that could be achieved at Trenton-Mercer Airport with the current set of facilities.

4.1.4 Summary of Alternatives

Table 10 summarizes the Terminal Alternatives provided in Section 3.1.1 through 3.1.3. Note that it includes estimates of both commercial airline revenues and visitor spending after arrival through Trenton-Mercer Airport.

4.2 Total Economic Impacts of the Three Main Alternatives

Economically, the three main alternatives vary on two key dimensions—via airline revenues and via visitor spending. As discussed above, these fundamental differences are laid out in Table 10. In as much as the base case is included within the analysis disclosed in Section 3, differences between that case and Alternatives 1 and 2 show how much more an expansion of commercial air transportation activity at Trenton-Mercer Airport would benefit both Mercer County and the State of New Jersey from economic and fiscal perspectives.

[5] Trenton Mercer Airport Environmental Assessment, Appendix I, 2006

TABLE 10: The Three Main Enplanement Alternatives

	Base Case	Alternative 1	Alternative 2
BAE Jetstream 3101			
Daily departures	3	9	12
capacity	19	19	19
load factor	0.64	0.64	0.64
Enplanements	13,295	39,945	53,180
Dehavilland Dash-8/200			
departures		6	6
capacity		37	37
load factor		0.62	0.62
Enplanements		50,452	50,239
Boeing 727/200			
departures			3
capacity			145
load factor			0.62
Enplanements			97,781
Total Annual Enplanements	13,300	90,400	201,200
Total Attributable Revenues	$2,260,000	$15,400,000	$50,000,000
Total Visitor Spending	$1,620,000	$11,140,000	$24,800,000

4.2.1 Total Economic Impact of the Base Case

Due to the small amount at activity laid out in the base case —13,300 enplanements — it should not be surprising that both net commercial air revenues and associated tourism spending are small as along with the relevant total economic impacts (see Tables 11 and 12). For Mercer County and New Jersey, respectively, just 28 and 40 jobs were identified as being related to the $3.9 million in direct spending associated with this travel. These figures are generous, since it is likely that some of these jobs should, instead, be allocated destinations of flights out of Trenton-Mercer Airport. The same can be said of the, respectively, $1.2 and $2.0 million in related labor income and $1.7 and $3.0 million in total accumulated wealth (gross state product), as well as the various estimated tax impacts. But as was mentioned earlier, this case is not important to this study in isolation. Rather is the base from which all other alternatives will be compared. That is, the magnitude of the total economic impacts of this base case is important only inasmuch as it detracts from the size of the total economic impacts of the other alternatives. In this regard, we will report the economic impacts of the other alternatives as differences from this base case.

4.2.2 Net Economic Impact of the Alternative 1

The net direct difference in spending between Alternative 1 for passenger enplanements at Trenton-Mercer Airport and that for the Base Case is estimated to be $22.66 million (see Tables 13 and 14). (The 90,400 annual enplanements of Alternative 1 are expected to yield $15.4 million in commercial air passenger revenues plus $11.14 million in tourism spending. The $3.88 million in spending from the Base Case is then subtracted from the resulting $26.54 total.) Of this net total in direct spending, about $16.32 million is expected to be spent in Mercer County, and almost all of the remaining $6.34 million in direct spending is expected to occur within the state of New Jersey.

Over half of the spending in Mercer County is expected to be distributed to local workers and business proprietors in the former of labor income. For the rest of the state, the returns on direct spending in the form of labor income is expected to be closer to a third since much of it is spent on inputs from local manufacturers. At between $50,000-$51,000 per job for both the Mercer County and the State, the average pay generated by this added spending is expected to be close to the state average. In net, $6.3 million in direct labor income is expected to be garnered by workers in Mercer County. Another $2.1 million of the spending is expected to be allocated directly to workers elsewhere in the State.

The main item of concern in the next section is that regarding fiscal impacts. Hence, a detailed discussion of the effect of the additional activity on local indirect tax revenue collections is reserved for that analysis. Nonetheless, note that about $655,000 more in local and state tax revenues are generated within Mercer County over the Base Case, $331,000 of which are local tax revenues. Moreover, another $990,000 are generated statewide, of which $543,800 are local tax revenues.

Table 11: Economic and Tax Impacts of the Base Case Alternative on Mercer County

	Economic Component			
	Output (000 $)	Employment (jobs)	Income (000$)	Gross State Product (000$)
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	1.2	0	0.1	0.2
2. Agri. Serv., Forestry, & Fish	1.3	0	0.7	1.0
3. Mining	1.1	0	0.2	0.6
4. Construction	12.1	0	1.7	4.0
5. Manufacturing	30.5	0	8.3	8.5
6. Transport. & Public Utilities	2,341.7	14	932.2	1,255.1
7. Wholesale	74.9	0	30.5	32.2
8. Retail Trade	252.7	8	68.7	128.0
9. Finance, Ins., & Real Estate	98.5	1	31.7	73.3
10. Services	332.5	4	122.7	194.0
11. Government	4.3	0	1.3	2.0
Total Effects (Private and Public)	3,150.8	28	1,197.8	1,699.0
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	2,802.0	25	1,079.2	1,508.9
2. Indirect and Induced Effects	348.9	3	118.7	190.1
3. Total Effects	3,150.8	28	1,197.8	1,699.0
4. Multipliers (3/1)	1.125	1.129	1.110	1.126
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				1,009.0
2. Taxes				209.2
a. Local				56.9
b. State				46.3
c. Federal				106.0
General				85.6
Social Security				20.3
3. Profits, dividends, rents, and other				480.8
4. Total Gross State Product (1+2+3)				1,699.0
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		1,009.0	189.7	---------
2. Taxes		209.2	38.5	247.7
a. Local		56.9	4.9	61.9
b. State		46.3	4.3	50.7
c. Federal		106.0	29.2	135.2
General		85.6	29.2	114.9
Social Security		20.3	0.0	20.3
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				7.3
Income				308,722.8
State Taxes				13,059.0
Local Taxes				15,941.8
Gross State Product				437,886.7
INITIAL EXPENDITURE IN DOLLARS				$3,880,000

Table 12: Economic and Tax Impacts of the Base Case Alternative on New Jersey

	Economic Component			
	Output (000 $)	**Employment (jobs)**	**Income (000$)**	**Gross State Product (000$)**
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	14.4	0	1.0	2.2
2. Agri. Serv., Forestry, & Fish	4.3	0	2.1	3.5
3. Mining	2.9	0	0.4	1.5
4. Construction	63.8	0	8.6	21.3
5. Manufacturing	764.6	2	113.1	133.5
6. Transport. & Public Utilities	2,560.3	15	980.9	1,340.6
7. Wholesale	165.5	1	67.3	71.1
8. Retail Trade	561.2	14	183.4	301.3
9. Finance, Ins., & Real Estate	378.0	2	129.6	259.2
10. Services	1,516.9	14	550.7	873.8
11. Government	15.0	0	4.6	7.3
Total Effects (Private and Public)	6,031.9	40	2,037.2	3,008.1
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	3,862.1	28	1,433.4	2,104.7
2. Indirect and Induced Effects	2,184.8	12	608.4	910.7
3. Total Effects	6,046.9	40	2,041.8	3,015.4
4. Multipliers (3/1)	1.566	1.426	1.424	1.433
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				1,726.6
2. Taxes				519.1
a. Local				100.5
b. State				88.5
c. Federal				330.1
General				126.2
Social Security				203.8
3. Profits, dividends, rents, and other				769.8
4. Total Gross State Product (1+2+3)				3,015.4
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		1,726.6	189.7	---------
2. Taxes		519.1	380.8	899.9
a. Local		100.5	44.5	145.0
b. State		88.5	43.3	131.8
c. Federal		330.1	293.0	623.1
General		126.2	293.0	419.2
Social Security		203.8	0.0	203.8
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				12.4
Income				526,232.5
State Taxes				33,970.7
Local Taxes				37,375.3
Gross State Product				777,169.1
INITIAL EXPENDITURE IN DOLLARS				$3,880,000

Table 13: Net Economic and Tax Impacts of Alternative 1 on Mercer County

	Economic Component			
	Output (000 $)	Employment (jobs)	Income (000$)	Gross State Product (000$)
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	7.0	0	0.4	1.3
2. Agri. Serv., Forestry, & Fish	7.7	0	3.9	6.1
3. Mining	6.7	0	0.9	3.6
4. Construction	71.0	0	9.8	23.7
5. Manufacturing	178.4	1	48.4	49.7
6. Transport. & Public Utilities	13,616.2	70	5,420.3	7,297.9
7. Wholesale	439.8	2	178.8	188.9
8. Retail Trade	1,483.9	41	403.3	751.7
9. Finance, Ins., & Real Estate	574.4	3	184.8	427.8
10. Services	1,951.1	21	719.5	1,138.4
11. Government	25.1	0	7.5	11.5
Total Effects (Private and Public)	18,361.4	139	6,977.7	9,900.6
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	16,324.8	123	6,285.1	8,791.0
2. Indirect and Induced Effects	2,036.5	16	692.6	1,109.6
3. Total Effects	18,361.4	139	6,977.7	9,900.6
4. Multipliers (3/1)	1.125	1.129	1.110	1.126
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				5,876.7
2. Taxes				1,219.6
a. Local				331.8
b. State				270.6
c. Federal				617.2
General				498.5
Social Security				118.6
3. Profits, dividends, rents, and other				2,804.3
4. Total Gross State Product (1+2+3)				9,900.6
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		5,876.7	1,106.5	---------
2. Taxes		1,219.6	224.5	1,444.1
a. Local		331.8	28.8	360.6
b. State		270.6	25.2	295.8
c. Federal		617.2	170.5	787.7
General		498.5	170.5	669.1
Social Security		118.6	0.0	118.6
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				6.1
Income				307,929.4
State Taxes				13,053.0
Local Taxes				15,912.4
Gross State Product				436,920.7
INITIAL EXPENDITURE IN DOLLARS				$22,660,000.0

Table 14: Net Economic and Tax Impacts of Alternative 1 on New Jersey

	Economic Component			
	Output (000 $)	Employment (jobs)	Income (000$)	Gross State Product (000$)
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	84.2	0	6.0	12.6
2. Agri. Serv., Forestry, & Fish	25.0	0	12.2	20.4
3. Mining	16.6	0	2.5	9.0
4. Construction	373.1	1	50.5	124.6
5. Manufacturing	4,458.0	9	659.9	779.1
6. Transport. & Public Utilities	14,893.2	74	5,704.9	7,797.5
7. Wholesale	969.1	5	394.1	416.2
8. Retail Trade	3,288.2	66	1,074.1	1,764.9
9. Finance, Ins., & Real Estate	2,207.5	10	756.6	1,514.3
10. Services	8,903.8	70	3,231.6	5,129.5
11. Government	88.0	0	26.8	42.7
Total Effects (Private and Public)	35,306.6	236	11,919.3	17,610.7
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	22,554.8	165	8,366.7	12,292.2
2. Indirect and Induced Effects	12,751.8	70	3,552.6	5,318.6
3. Total Effects	35,306.6	236	11,919.3	17,610.7
4. Multipliers (3/1)	1.565	1.425	1.425	1.433
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				10,078.6
2. Taxes				3,030.7
a. Local				586.9
b. State				517.4
c. Federal				1,926.5
General				736.4
Social Security				1,190.1
3. Profits, dividends, rents, and other				4,501.4
4. Total Gross State Product (1+2+3)				17,610.7
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		10,078.6	1,106.5	---------
2. Taxes		3,030.7	2,252.3	5,283.0
a. Local		586.9	288.7	875.6
b. State		517.4	252.8	770.1
c. Federal		1,926.5	1,710.8	3,637.3
General		736.4	1,710.8	2,447.2
Social Security		1,190.1	0.0	1,190.1
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				10.4
Income				526,005.3
State Taxes				33,986.0
Local Taxes				38,639.0
Gross State Product				777,173.0
INITIAL EXPENDITURE IN DOLLARS				$22,660,000.0

4.2.3 Net Economic Impact of the Alternative 2

The net direct difference in spending between Alternative 2 for passenger enplanements at Trenton-Mercer Airport and that for the Base Case is estimated to be $70.8 million (see Tables 15 and 16). (The 201,200 annual enplanements of Alternative 2 are expected to yield $50 million in commercial air passenger revenues plus $24.8 million in visitor spending. The $3.88 million in spending from the Base Case is then subtracted from the resulting $74.8 million total.) Of this net total in direct spending, about $55.7 million is expected to be spent in Mercer County, and almost all of the remaining $15.1 million in direct spending is expected to occur within the State of New Jersey.

Over half of the spending in Mercer County is expected to be distributed to local workers and business proprietors in the former of labor income. For the rest of the state, the returns on direct spending in the form of labor income is expected to be closer to a third since much of it is spent on inputs from local manufacturers. At between $50,000-$51,000 per job for both the Mercer County and the State, the average pay generated by this added spending is expected to be close to the state average. In net, $21.7 million in direct labor income is expected to be garnered by workers in Mercer County. Another $4.9 million of the spending is expected to be allocated directly to workers elsewhere in the State.

The main item of concern in the next section is that regarding fiscal impacts. Therefore, a detailed discussion of the effect of the additional activity on local indirect tax revenue collections is reserved for that analysis. Nonetheless, note that about $2.2 million more in local and state tax revenues are generated within Mercer County over the Base Case, $1.2 million of which are local tax revenues. Moreover, another $3.0 million are generated statewide, of which $1.5 million are local tax revenues.

Table 15: Net Economic and Tax Impacts of Alternative 2 on Mercer County

	Economic Component			
	Output (000 $)	**Employment (jobs)**	**Income (000$)**	**Gross State Product (000$)**
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	18.5	0	1.2	3.7
2. Agri. Serv., Forestry, & Fish	21.2	0	10.6	16.6
3. Mining	23.5	0	3.3	12.6
4. Construction	210.1	1	29.0	70.1
5. Manufacturing	502.9	3	135.2	139.8
6. Transport. & Public Utilities	49,314.5	254	19,650.0	26,450.6
7. Wholesale	1,180.6	6	480.1	507.1
8. Retail Trade	3,855.6	106	1,087.9	1,975.4
9. Finance, Ins., & Real Estate	1,878.3	9	621.9	1,394.5
10. Services	5,046.0	55	1,896.9	2,930.3
11. Government	74.9	0	22.5	34.3
Total Effects (Private and Public)	62,126.1	435	23,938.5	33,534.9
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	55,635.1	384	21,706.6	29,978.3
2. Indirect and Induced Effects	6,491.1	51	2,231.8	3,556.6
3. Total Effects	62,126.1	435	23,938.5	33,534.9
4. Multipliers (3/1)	1.117	1.132	1.103	1.119
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				20,221.6
2. Taxes				4,107.8
a. Local				1,113.2
b. State				870.1
c. Federal				2,124.6
General				1,733.6
Social Security				391.0
3. Profits, dividends, rents, and other				9,205.4
4. Total Gross State Product (1+2+3)				33,534.9
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		20,221.6	3,646.6	---------
2. Taxes		4,107.8	739.9	4,847.7
a. Local		1,113.2	94.8	1,208.0
b. State		870.1	83.0	953.1
c. Federal		2,124.6	562.0	2,686.6
General		1,733.6	562.0	2,295.7
Social Security		391.0	0.0	391.0
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				6.1
Income				338,219.3
State Taxes				13,466.3
Local Taxes				17,067.1
Gross State Product				473,804.1
INITIAL EXPENDITURE IN DOLLARS				$70,777,944

Table 16: Net Economic and Tax Impacts of Alternative 2 on New Jersey

	Economic Component			
	Output (000 $)	Employment (jobs)	Income (000$)	Gross State Product (000$)
I. TOTAL EFFECTS (Direct and Indirect/Induced)*				
1. Agriculture	228.6	1	16.9	35.1
2. Agri. Serv., Forestry, & Fish	67.0	1	32.7	54.5
3. Mining	58.3	0	8.7	31.5
4. Construction	1,121.5	2	151.6	374.7
5. Manufacturing	14,833.2	27	2,138.2	2,543.9
6. Transport. & Public Utilities	53,327.9	266	20,526.0	28,011.4
7. Wholesale	2,766.1	13	1,124.8	1,188.1
8. Retail Trade	8,958.7	176	2,966.9	4,844.7
9. Finance, Ins., & Real Estate	6,872.3	31	2,391.0	4,706.6
10. Services	22,831.0	183	8,381.2	13,079.5
11. Government	262.7	1	80.1	127.1
Total Effects (Private and Public)	111,327.4	702	37,818.3	54,997.1
II. DISTRIBUTION OF EFFECTS/MULTIPLIER				
1. Direct Effects	70,521.8	483	26,649.0	38,333.8
2. Indirect and Induced Effects	40,805.6	220	11,169.3	16,663.3
3. Total Effects	111,327.4	839	37,818.3	54,997.1
4. Multipliers (3/1)	1.579	1.455	1.419	1.435
III. COMPOSITION OF GROSS STATE PRODUCT				
1. Wages--Net of Taxes				32,032.9
2. Taxes				9,535.5
a. Local				1,831.8
b. State				1,565.1
c. Federal				6,138.7
General				2,388.5
Social Security				3,750.2
3. Profits, dividends, rents, and other				13,428.7
4. Total Gross State Product (1+2+3)				54,997.1
IV. TAX ACCOUNTS		**Business**	**Household**	**Total**
1. Income --Net of Taxes		32,032.9	3,646.6	---------
2. Taxes		9,535.5	7,097.3	16,632.8
a. Local		1,831.8	909.7	2,741.5
b. State		1,565.1	796.5	2,361.5
c. Federal		6,138.7	5,391.1	11,529.8
General		2,388.5	5,391.1	7,779.6
Social Security		3,750.2	0.0	3,750.2
EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE				
Employment (Jobs)				11.9
Income				534,322.8
State Taxes				33,365.5
Local Taxes				38,733.7
Gross State Product				777,037.4
INITIAL EXPENDITURE IN DOLLARS				$70,777,944

5 THE NET FISCAL EFFECTS OF THE ALTERNATIVES

5.1 General Description of the Approach

The general approach in a fiscal impact of various feasible projects is to essentially two-pronged. During the first step analysts typically tally the added expenditures as well as the added benefits offered via the various alternatives. In the second step, the benefits of each alternative are simply weighed against the expected expenditures associated with the respective alternative. The alternatives are subsequently compared via a benefit/cost ratio.

Naturally, matters are not always so simple. Incoming revenues from a project last over an extended period of time, while payment for a project must be made over a shorter period—typically two to three years for a piece of infrastructure like a new airport terminal or new highway. Moreover, funds for a project typically could be put to an alternative use. In the case of public projects, the jurisdiction's bond rate is typically used for comparison, since that essentially is the (nonpolitical) cost of money to the jurisdiction. Naturally, borrowed funds can, of course, be repaid over different periods of time. Hence, there are many more variables involved than simply the inflow of revenues and the construction cost of an infrastructure project when performing a benefit/cost analysis.

In the following sections, the approach applied in this study is detailed. First the annual government revenues are estimated. Some fees are levied directly upon the amount of activity at the Trenton-Mercer Airport. Hence, we draw attention to this distinct, clear set of revenues first. We subsequently embellish these revenues indirect local tax revenues estimated via the net economic impacts estimated in the previous section—Section 4—to obtain estimated of the expected annual net fiscal benefits of each Alternative. Costs associated with expansions in enplanements for each alternative are elaborated next. These costs are then annualized and embellished to account for the cost of obtaining the requisite funds via municipal bonds. Finally, the net annual expenditure estimates are then compared to the expected net annual revenues.

5.2 Expected Tax Revenues

5.2.1 Annual Direct Mercer County Fiscal Benefits

The primary sources of revenue to Mercer County resulting from commercial passenger traffic are landing fees assessed on the airline and passenger facility charges authorized by the Federal Aviation Administration under 14 CFR Part 158. The Passenger Facility Charge (PFC) Program allows the collection of PFC fees up to $4.50 for every enplaned passenger at commercial airports controlled by public agencies. Airports use these fees to fund FAA-approved projects that enhance safety, security, or capacity; reduce noise; or increase air carrier competition. To determine direct Mercer County's revenues resulting from the two main enplanement-based alternatives, we first estimate the average revenue per passenger from these two sources. We then assumed that landing fees and PFC charges will rise directly with the number of enplanements. Thus, we multiply the current combined average of landing and passenger fees per passenger by the net enplanements added for each of the two main alternatives to derive their corresponding total direct revenues.

The revenue forecast that result from these calculations does not include other revenue-stimulating effects such as increases in gate rental fees or either additional ramp or overnight parking fees. It also does not include any revenue that might be generated after the existing passenger terminal is converted to other uses.

5.2.1.1 Fiscal Revenues from the Base Case

The initial case is based on 2004 enplanement data from the Federal Aviation Administration (the latest year that enplanement data is available) and 2005 revenue information provided by Trenton-Mercer Airport staff. In 2005 passengers' fees accounted for $47,283 in airport revenue and landing fees accounted for $38,925. With total revenue (landing fees and PFCs) of $86,208 and 13,095 enplanements, we arrive at average revenues per passenger of about $6.58.

5.2.1.2 Net Fiscal Revenues from Alternative 1

Using this average per passenger revenue, we can estimate the effect on airport revenue resulting from the two alternatives as well as for the Base case. The revenue estimates of all three scenarios are shown in Table 17. Alternative 1 is based upon the historical maximum number of enplanements, achieved in 1998 when Eastwind Airlines provided scheduled air service. In that year, 90,397 enplanements occurred: hence, Alternative 1 is based on a rough-grained estimate of 1998's commercial air passenger activity, or 90,400 enplanements. Applying the $6.58 charge per passenger derived above, we derive direct passenger-based revenues of about $595,000, an increase of $508,800 over the Base Case.

5.2.1.3 Net Fiscal Revenues from Alternative 2

Alternative 2 results in substantially more passenger-based revenue than the Base Case or Alternative 1. Applying the charge of $6.58 per passenger to the FAA's forecast of 201,200 enplanements for year 2010 used for this scenario yields a revenue forecast of about $1,325,000 for the Trenton-Mercer Airport. Netting from this total $86,208 in revenues from the Base Case yields net direct revenues to the airport of about $1,238,000 via this alternative. Thus, the $86,208 in revenue received in 2005 could increase by about $509,000 in annual fiscal revenues if Trenton-Mercer Airport enplanements rebound to 1998 levels. They could gain a further $719,000 in annual fiscal revenues if it is able to meet FAA enplanement expectations for 2010.

TABLE 17: Trenton-Mercer Airport Revenues under the Three Different Enplanement Scenarios

	Base Case	Alternative 1*	Alternative 2*
Enplanements	13,095	90,400	201,200
Annual Direct Fiscal Revenues	$86,208	$509,000	$1,238,000
Annual Indirect Fiscal Revenues+	$61,900	$360,000	$1,208,000
Annual Total Fiscal Revenues	$148,108	$869,000	$2,446,000

Note: *Fiscal revenues for Alternatives 1 and 2 are net of those from the Base Case.
+ Extracted from line II.2.a of Tables 11, 13, and 15, respectively.

5.2.2 Net Annual Indirect Mercer County Fiscal Benefits

The third data row of Table 17 presents the local tax revenue impacts generated airline revenues allocable to Trenton-Mercer Airport and associated visitor spending. These data items were generated in Section 4 and extracted from line II.2.a of Tables 11, 13, and 15.

Note that the indirect fiscal revenue differences between the alternatives in Table 17 are quite large. While sizeable, they do not exceed direct revenues. This is important because the estimates of indirect revenues are less well defined. That is, while it is clear that the fiscal revenues are associated with local governments within Mercer County, it is not clear whether they should be attached to the county, or to the townships, municipalities, and school districts that it embraces. Moreover, the model does not distinguish between the types of taxes. Instead the indirect fiscal revenues shown in Table 17 are simply approximations of the local property and other tax revenues that would be generated via the economic activity at the airport.

5.2.3 Net Annual Total Mercer County Fiscal Benefits

Total fiscal revenues generated at the county level from added commercial passenger activity at the Trenton Mercer Airport is detailed in the final line of Table 17. The general finding, which follows assumptions made, is that fiscal revenues rise at least as much as enplanements. That is the 690 percent rise in air activity from about 13,100 to 94,400 enplanements yields a parallel rise in revenues from about $148,100 to $1.04 million ($148,108 plus $869,000). Likewise a rise from 13,100 to 201,200 enplanements (a 1,535 percent increase) is expected to invoke a 1750 percent rise in fiscal revenues—from about $148,100 to $2.6 million ($148,108 plus $2,446,000).

5.3 Fiscal Expenditures Associated with the Alternatives

In the Base Case and Alternative 1 no new facilities are or would be required. Moreover, airport officials indicated that beyond a small amount of added security staff that would be largely handled by the airlines, no extra expenditures would likely be incurred by Mercer County. Evidence of these rather broad statements was provided through the experience in 1998 when Eastwind Airlines had commercial passenger business attaining more than 90,000 enplanements.

Indeed, only Alternative 2 requires significant spending on the part of Mercer County. In fact, a report by Fredric R. Harris, Inc.[6] estimated the costs of the two-gate terminal required to sustain enplanements above 100,000 for Trenton-Mercer Airport at nearly $16 million in year 1998 dollars. In present year 2006 dollars, the 16 million in 1998 dollars figures to be roughly $23 million. Thus for the sake of conservatism, we use an estimate of $25 million for the cost of a new terminal outlined in the Harris report.

Table 18 displays Mercer County's approximate annual payment amounts for an investment of $25 million if it were paid off within ten years at the stipulated interest rate. The reason the payments are so low is that the Federal Aviation Administration pays for 95 percent of investments at small commercial airports. Typically states pay a lion's share of the remaining 5 percent of the costs. (For example, Connecticut pays 75 percent of the remaining portion.[7]) The sponsor—in the case of this report Mercer County—must pay for the rest. Of course, in addition to the State, the Port Authority of New York and New Jersey (PA NY/NJ) might also assist. The information in Table 18 is based on debt consisting of 5 percent of the $25 million investment required for a new terminal—a grand total of $1.25 million that would have to be covered jointly by Mercer County, the State and the PA NY/NJ.

Table 18: Estimated Annual Payment across 10 years for a Debt of $1.25 Million

Interest Rate	Annual Payment
6%	$169,835
5%	$161,881
4%	$154,114
3%	$146,538
2%	$139,158
1%	$131,978

[6] Fredric R. Harris, Inc. 1998. *Economic Feasibility Study, Trenton-Mercer Airport, Final Repor*t to the Airport Technology and Planning Group, Inc., June.

[7] *Connecticut Statewide Airport System Plan* , published in June 2006 and available online at http://www.ct.gov/dotinfo/site/default.asp.

One can interpret the interest rates as the so-called “real annual yield rate” on a bond that would have to be floated to cover the costs associated with the County’s investment. A “real annual yield rate” is a bond’s actual average yield rate less the average expected inflation rate for period the bond is held. Thus a bond with a nominal annual yield rate of 7 percent during a period that sustained average annual inflation rate of 2 percent would have a real annual yield rate of 5 percent. Thus, one should for all intents and purposes discount the stipulated interest rate to account for inflation in the context of a fiscal analysis.

5.4 Benefit-Cost Comparisons of the Alternatives

5.4.1 Benefit-Cost Analysis for Alternative 2

The benefit/cost ratios for all but Alternative 2 are trivial. That is, no measurable investment is required, so no ratio can be estimated. The fiscal returns from Alternative 2—should the FAA enplanement forecast pan out—exceed costs to Mercer County and any other nonfederal sponsoring agencies of the airport. Using as high an annual real bond yield as 5 percent gives a ratio of expected benefits of $2,446,000/$161,881 or 15:1. That is for every tax $1 the County itself invests it (and the municipalities it embraces) can expect to receive $15 dollars in tax revenues and airport related fees in return. Perhaps needless to say, this is an extremely generous fiscal return for a public entity.

Even if we restrict the benefits to just those generated via passenger charges and landing fees (those benefits that will definitely result from the enplanement level specified) a benefit/cost ratio on the order of 7.5:1 results. Of course, even with this ratio we are erring on the side of conservatism by applying a 5 percent yield. A more realistic annual nominal bond yield is closer to 4.825 percent,[8] and of course this should be discounted by 2 percentage points to account for inflation. Thus a ratio closer to 8.7:1 is more realistic. In any case, it is clear that the terminal at Trenton-Mercer Airport is a worthwhile investment providing enplanements peak out at least as high as 200,000.

[8] Annual bond yields (or coupons) are available for viewing at MunicipalBonds.com. Nominal coupons for Mercer County bonds traded on November 6, 2006, ranged between 4.25 and 5.8 percent.

5.4.2 Alternative 3: The Breakeven Alternative for a New Terminal

Given that fiscal resources are returned fifteen times assuming enplanements reach or exceed 201,200 begs the following question: “About what level of enplanements would be required to meet cost to Mercer County of a new $25 million terminal?” To be perfectly clear, we will provide several answers to this question. In all cases, we will assume are about $145,000 annually—this is based on a real bond yield rate of about 2.825 percent (an annual nominal bond rate of 4.825 percent discounted by an average annual inflation rate of 2 percent).

First we define the breakeven enplanement level by the number of enplanements required to assure that the annual costs of the investment are covered by both landing fees and passenger charges. Recall that we had applied a fee of $6.58 per passenger to arrive at this set of direct charges. Thus, in order to estimate how many enplanements the $145,000 would cover, one need only divide $145,000 by $6.58. Therefore, based on this definition, the “breakeven” level of enplanements is 22,036 more than the reference case. The reference case being either the Base Case or Alternative 1.Alternative 1 probably is a more realistic reference since experience suggests that the current terminal can handle at least Alternative 1’s enplanement level of 90,000 annually. Thus a new terminal could be readily justified by a promised level of passenger activity at least exceeding 112,400 enplanements annually. This is clearly an over-estimate of the enplanements that would be needed for fiscal revenues to attain parity with Mercer County’s fiscal costs. Nonetheless, it is just as clear that it sets the upper bound of the enplanements needed, with the 90,400 enplanements attained in 1998 serves as a very loose lower bound.

This last statement segues nicely to the next definition of “breakeven.” In this case, let it be defined by the collection of direct and indirect fiscal revenues received by Mercer County and its towns required to cover Mercer County’s share of the investment in a $25 million air passenger terminal. Here, we apply the average total fiscal revenues per enplanement from Alternative 1 in Table 17—about $11.24. That is we divide $145,000 by $11.24 to get the number of enplanements over 90,400 that constitute the lower bound of enplanements that would be required for Mercer County to breakeven on a $25 million terminal. The answer in this case is that about 12,900 more enplanements would be needed.

In summary, the Breakeven Alternative is fairly well defined. Somewhere between 103,300 and 112,400 enplanements would be needed for Mercer County to be able to justify a new terminal that costs $25 million.

6 CONCLUSIONS

Trenton-Mercer Airport's economic impact on Mercer County and the State of New Jersey run both broadly and deeply. Its present operations involve about $114.3 million in business revenue 650 workers directly in Mercer County alone. Those jobs are associated with $46.2 million in income for an average pay of about $64,700. This activity fosters about another 100 jobs and $4.4 million in pay within the County. It also stimulates 273 more jobs, $14.8 million in income, and $52.8 million in business revenues statewide. Most of the jobs and income are associated with the transportation, services, and retail industries. But all major sectors of the economy are affected.

The airport also generates its own revenues via passenger charges and vehicle landing fees. In 2005, revenues from these sources amounted to $86,302. This was when commercial air passenger travel at the airport had reached a nadir of nearly 13,100 enplanements. In addition the economic impact analysis reveals that another $61,900 in local tax revenues could be associated with the activity at the airport. Thus about $148,000 in local fiscal revenues associated with the airport's commercial passenger traffic volume are estimated to have been collected within Mercer County in 2005.

If a new $25 million airport terminal is decided upon, Mercer County would be expected to find funding for 95% of the investment—a total of $1.25 million. Even this small share could be at least partially offset by matching funds from either the State of New Jersey or the Port Authority of New York and New Jersey. Nonetheless, assuming a 100-year payback period, a 7 percent nominal bond rate, and 2 percent inflation during the payback period, the cost would be easily offset by the passenger charges and landing fees if it can induce enplanements to rise above the breakeven enplanement level, which lies somewhere between 103,300 and 112,400 enplanements annually. This level is high since it is presumed that the current terminal can readily handle the 90,400 enplanements it shouldered in 1998. The additional 12,900 to 22,030 enplanements above this level would generate the $145,000 in fiscal revenues required to pay for the bond issuance that was assumed to provide the funds for Mercer County's $1.25 million investment in the two-gate terminal.

APPENDIX A:
REPORT ON THE SURVEYS

The firm of ASWinc was retained to perform the airport economic survey. Airport tenants consist of those directly associated with the aviation industry and others who rent or lease space on the airport but are not associated with the aviation industry (although they may provide services to those in the former category). Included in the aviation industry tenants were several private corporate flight departments, a fixed base operator, a flight school, and a scheduled commercial airline. Non-aviation tenants included car rental agencies and a restaurant in the terminal building. Accordingly, ASWinc developed two distinct surveys questionnaires with identical core questions addressing jobs, payroll, the type of work undertaken by the business, and annual expenditures for 2002. The survey questionnaires are attached at the end of this report.

Trenton-Mercer Airport management informed the tenants regarding the survey which was subsequently distributed by ASWinc in the fall of 2003. In all, questionnaires were received from 19 airport tenants. Two major tenants declined to participate in the survey while seven of the respondents provided employment data but not expenditure data. Table A.1 below summarizes the response data.

Table A.1: Summary of Expenditure and Payroll Data

	Aviation	**Non-Aviation**	**Total Airport**
Total Expenditures	**$11,689,863.00**	**$3,791,522.00**	**$15,481,385.00**
Total Payroll	**$ 6,396,384.00**	**$6,821,825.00**	**$13,218,209.00**

Source: ASWinc, 2003

APPENDIX B: INPUT-OUTPUT ANALYSIS: TECHNICAL DESCRIPTION AND APPLICATION

This appendix discusses the history and application of input-output analysis and details the input-output model, called the R/Econ™ I-O model, developed by Rutgers University. This model offers significant advantages in detailing the total economic effects of an activity (such as construction and business operations in Newport), including multiplier effects.

ESTIMATING MULTIPLIERS

The fundamental issue determining the size of the multiplier effect is the "openness" of regional economies. Regions that are more "open" are those that import their required inputs from other regions. Imports can be thought of as substitutes for local production. Thus, the more a region depends on imported goods and services instead of its own production, the more economic activity leaks away from the local economy. Businessmen noted this phenomenon and formed local chambers of commerce with the explicit goal of stopping such leakage by instituting a "buy local" policy among their membership. In addition, during the 1970s, as an import invasion was under way, businessmen and union leaders announced a "buy American" policy in the hope of regaining ground lost to international economic competition. Therefore, one of the main goals of regional economic multiplier research has been to discover better ways to estimate the leakage of purchases out of a region or, relatedly, to determine the region's level of self-sufficiency.

The earliest attempts to systematize the procedure for estimating multiplier effects used the economic base model, still in use in many econometric models today. This approach assumes that all economic activities in a region can be divided into two categories: "basic" activities that produce exclusively for export, and region-serving or "local" activities that produce strictly for internal regional consumption. Since this approach is simpler but similar to the approach used by regional input-output analysis, let us explain briefly how multiplier effects are estimated using the economic base approach. If we let $\mathbf{x}$ be export employment, $\mathbf{l}$ be local employment, and $\mathbf{t}$ be total employment, then

$$\mathbf{t} = \mathbf{x} + \mathbf{l}$$

For simplification, we create the ratio $\mathbf{a}$ as

$$\mathbf{a} = \mathbf{l}/\mathbf{t}$$

so that $\mathbf{l} = \mathbf{at}$

then substituting into the first equation, we obtain

$$\mathbf{t} = \mathbf{x} + \mathbf{at}$$

By bringing all of the terms with t to one side of the equation, we get

$$\mathbf{t} - \mathbf{at} = \mathbf{x} \text{ or } \mathbf{t}\,(1-\mathbf{a}) = \mathbf{x}$$

Solving for $\mathbf{t}$, we get $\mathbf{t} = \mathbf{x}/(1-\mathbf{a})$

Thus, if we know the amount of export-oriented employment, **x,** and the ratio of local to total employment, **a**, we can readily calculate total employment by applying the economic base multiplier, 1/(1-**a**), which is embedded in the above formula. Thus, if 40 percent of all regional employment is used to produce exports, the regional multiplier would be 2.5. The assumption behind this multiplier is that all remaining regional employment is required to support the export employment. Thus, the 2.5 can be decomposed into two parts the direct effect of the exports, which is always 1.0, and the indirect and induced effects, which is the remainder—in this case 1.5. Hence, the multiplier can be read as telling us that for each export-oriented job another 1.5 jobs are needed to support it.

This notion of the multiplier has been extended so that **x** is understood to represent an economic change demanded by an organization or institution outside of an economy—so-called final demand. Such changes can be those effected by government, households, or even by an outside firm. Changes in the economy can therefore be calculated by a minor alteration in the multiplier formula:

$$\Delta \mathbf{t} = \Delta \mathbf{x}/(1-\mathbf{a})$$

The high level of industry aggregation and the rigidity of the economic assumptions that permit the application of the economic base multiplier have caused this approach to be subject to extensive criticism. Most of the discussion has focused on the estimation of the parameter **a**. Estimating this parameter requires that one be able to distinguish those parts of the economy that produce for local consumption from those that do not. Indeed, virtually all industries, even services, sell to customers both inside and outside the region. As a result, regional economists devised an approach by which to measure the *degree* to which each industry is involved in the nonbase activities of the region, better known as the industry's *regional purchase coefficient*. Thus, they expanded the above formulations by calculating for each ***i*** industry

$$\mathbf{l}_i = \mathbf{r}_i \mathbf{d}_i$$

and $$\mathbf{x}_i = t_i - \mathbf{r}_i \mathbf{d}_i$$

given that $\mathbf{d}_i$ is the total regional demand for industry ***i***'s product. Given the above formulae and data on regional demands by industry, one can calculate an accurate traditional aggregate economic base parameter by the following:

$$\mathbf{a} = \mathbf{l}/\mathbf{t} = \Sigma \mathbf{l}_{ii}/\Sigma \mathbf{t}_i$$

Although accurate, this approach only facilitates the calculation of an aggregate multiplier for the entire region. That is, we cannot determine from this approach what the effects are on the various sectors of an economy. This is despite the fact that one must painstakingly calculate the regional demand as well as the degree to which they each industry is involved in nonbase activity in the region.

As a result, a different approach to multiplier estimation that takes advantage of the detailed demand and trade data was developed. This approach is called input-output analysis.

REGIONAL INPUT-OUTPUT ANALYSIS: A BRIEF HISTORY

The basic framework for input-output analysis originated nearly 250 years ago when François Quesenay published *Tableau Economique* in 1758. Quesenay's "tableau" graphically and numerically portrayed the relationships between sales and purchases of the various industries of an economy. More than a century later, his description was adapted by Leon Walras, who advanced input-output modeling by providing a concise theoretical formulation of an economic system (including consumer purchases and the economic representation of "technology").

It was not until the twentieth century, however, that economists advanced and tested Walras's work. Wassily Leontief greatly simplified Walras's theoretical formulation by applying the Nobel prize–winning assumptions that both technology and trading patterns were fixed over time. These two assumptions meant that the pattern of flows among industries in an area could be considered stable. These assumptions permitted Walras's formulation to use data from a single time period, which generated a great reduction in data requirements.

Although Leontief won the Nobel Prize in 1973, he first used his approach in 1936 when he developed a model of the 1919 and 1929 U.S. economies to estimate the effects of the end of World War I on national employment. Recognition of his work in terms of its wider acceptance and use meant development of a standardized procedure for compiling the requisite data (today's national economic census of industries) and enhanced capability for calculations (i.e., the computer).

The federal government immediately recognized the importance of Leontief's development and has been publishing input-output tables of the U.S. economy since 1939. The most recently published tables are those for 1987. Other nations followed suit. Indeed, the United Nations maintains a bank of tables from most member nations with a uniform accounting scheme.

Framework

Input-output modeling focuses on the interrelationships of sales and purchases among sectors of the economy. Input-output is best understood through its most basic form, the *interindustry transactions table* or matrix. In this table (see exhibit B.1 for an example), the column industries are consuming sectors (or markets) and the row industries are producing sectors. The content of a matrix cell is the value of shipments that the row industry delivers to the column industry. Conversely, it is the value of shipments that the column industry receives from the row industry. Hence, the interindustry transactions table is a detailed accounting of the disposition of the value of shipments in an economy. Indeed, the detailed accounting of the interindustry transactions at the national level is performed not so much to facilitate calculation of national economic impacts as it is to back out an estimate of the nation's gross domestic product.

For example, in exhibit B.1, agriculture, as a producing industry sector, is depicted as selling $65 million of goods to manufacturing. Conversely, the table depicts that the manufacturing industry purchased $65 million of agricultural production. The sum across columns of the interindustry transaction matrix is called the *intermediate outputs vector*. The sum across rows is called the *intermediate inputs vector*.

A single *final demand* column is also included in exhibit B.1. Final demand, which is outside the square interindustry matrix, includes imports, exports, government purchases, changes in inventory, private investment, and sometimes household purchases.

The *value added* row, which is also outside the square interindustry matrix, includes wages and salaries, profit-type income, interest, dividends, rents, royalties, capital consumption allowances, and taxes. It is called value added because it is the difference between the total value of the industry's production and the value of the goods and nonlabor services that it requires to produce. Thus, it is the *value* that an industry *adds* to the goods and services it uses as inputs in order to produce output.

The value added row measures each industry's contribution to wealth accumulation. In a national model, therefore, its sum is better known as the gross domestic product (GDP). At the state level, this is known as the gross state product—a series produced by the U.S. Bureau of Economic Analysis and published in the Regional Economic Information System. Below the state level, it is known simply as the regional equivalent of the GDP—the gross regional product.

Exhibit B.1
Interindustry Transactions Matrix (Values)

	Agriculture	Manufacturing	Services	Other	Final Demand	Total Output
Agriculture	10	65	10	5	10	$100
Manufacturing	40	25	35	75	25	$200
Services	15	5	5	5	90	$120
Other	15	10	50	50	100	$225
Value Added	20	95	20	90		
Total Input	100	200	120	225		

Input-output economic impact modelers now tend to include the household industry within the square interindustry matrix. In this case, the "consuming industry" is the household itself. Its spending is extracted from the final demand column and is appended as a separate column in the interindustry matrix. To maintain a balance, the income of households must be appended as a row. The main income of households is labor income, which is extracted from the value-added row. Modelers tend not to include other sources of household income in the household industry's row. This is not because such income is not attributed to households but rather because much of this other income derives from sources outside of the economy that is being modeled.

The next step in producing input-output multipliers is to calculate the *direct requirements matrix*, which is also called the technology matrix. The calculations are based entirely on data from exhibit B.1. As shown in exhibit B.2, the values of the cells in the direct requirements matrix are derived by dividing each cell in a column of figure 1, the interindustry transactions matrix, by its column total. For example, the cell for manufacturing's purchases from agriculture is 65/200 = .33. Each cell in a column of the direct requirements matrix shows how many cents of each producing industry's goods and/or services are required to produce one dollar of the consuming industry's production and are called *technical coefficients*. The use of the terms "technology" and "technical" derive from the fact that a column of this matrix represents a recipe for a unit of an industry's production. It, therefore, shows the needs of each industry's production process or "technology."

Next in the process of producing input-output multipliers, the *Leontief Inverse* is calculated. To explain what the Leontief Inverse is, let us temporarily turn to equations. Now, from exhibit B.1, we know that the sum across both the rows of the square interindustry transactions matrix (**Z**) and the final demand vector (**y**) is equal to vector of production by industry (**x**). That is,

$$\mathbf{x} = \mathbf{Zi} + \mathbf{y}$$

where **i** is a summation vector of ones. Now, we calculate the direct requirements matrix (**A**) by dividing the interindustry transactions matrix by the production vector or

$$\mathbf{A} = \mathbf{ZX}^{-1}$$

Exhibit B.2
Direct Requirements Matrix

	Agriculture	Manufacturing	Services	Other
Agriculture	.10	.33	.08	.02
Manufacturing	.40	.13	.29	.33
Services	.15	.03	.04	.02
Other	.15	.05	.42	.22

where $\mathbf{X}^{-1}$ is a square matrix with inverse of each element in the vector **x** on the diagonal and the rest of the elements equal to zero. Rearranging the above equation yields

$$\mathbf{Z} = \mathbf{AX}$$

where **X** is a square matrix with the elements of the vector **x** on the diagonal and zeros elsewhere. Thus,

$$\mathbf{x} = (\mathbf{AX})\mathbf{i} + \mathbf{y}$$

or, alternatively,

$$\mathbf{x} = \mathbf{Ax} + \mathbf{y}$$

solving this equation for **x** yields

$$\mathbf{x} = \quad (\mathbf{I}\text{-}\mathbf{A})^{-1} \quad \mathbf{y}$$

Total = Total * Final
Output Requirements Demand

The Leontief Inverse is the matrix $(\mathbf{I}\text{-}\mathbf{A})^{-1}$. It portrays the relationships between final demand and production. This set of relationships is exactly what is needed to identify the economic impacts of an event external to an economy.

Because it does translate the direct economic effects of an event into the total economic effects on the modeled economy, the Leontief Inverse is also called the *total requirements matrix.* The total requirements matrix resulting from the direct requirements matrix in the example is shown in exhibit B.3.

Exhibit B.3
Total Requirements Matrix

	Agriculture	Manufacturing	Services	Other
Agriculture	1.5	.6	.4	.3
Manufacturing	1.0	1.6	.9	.7
Services	.3	.1	1.2	.1
Other	.5	.3	.8	1.4
Industry Multipliers	.33	2.6	3.3	2.5

In the direct or technical requirements matrix in exhibit B.2, the technical coefficient for the manufacturing sector's purchase from the agricultural sector was .33, indicating the 33 cents of agricultural products must be directly purchased to produce a dollar's worth of manufacturing products. The same "cell" in exhibit B.3 has a value of .6. This indicates that for every dollar's worth of product that manufacturing ships out of the economy (i.e., to the government or for export), agriculture will end up increasing its production by 60 cents. The sum of each column in the total requirements matrix is the *output multiplier* for that industry.

Multipliers

A *multiplier* is defined as the system of economic transactions that follow a disturbance in an economy. Any economic disturbance affects an economy in the same way as does a drop of water in a still pond. It creates a large primary "ripple" by causing a *direct* change in the purchasing patterns of affected firms and institutions. The suppliers of the affected firms and institutions must change their purchasing patterns to meet the demands placed upon them by the firms originally affected by the economic disturbance, thereby creating a smaller secondary "ripple." In turn, those who meet the needs of the suppliers must change their purchasing patterns to meet the demands placed upon them by the suppliers of the original firms, and so on; thus, a number of subsequent "ripples" are created in the economy.

The multiplier effect has three components—direct, indirect, and induced effects. Because of the pond analogy, it is also sometimes referred to as the *ripple effect*.

- A *direct effect* (the initial drop causing the ripple effects) is the change in purchases due to a change in economic activity.

- An *indirect effect* is the change in the purchases of suppliers to those economic activities directly experiencing change.

- An *induced effect* is the change in consumer spending that is generated by changes in labor income within the region as a result of the direct and indirect effects of the economic activity. Including households as a column and row in the interindustry matrix allows this effect to be captured.

Extending the Leontief Inverse to pertain not only to relationships between *total* production and final demand of the economy but also to *change*s in each permits its multipliers to be applied to many types of economic impacts. Indeed, in impact analysis the Leontief Inverse lends itself to the drop-in-a-pond analogy discussed earlier. This is because the Leontief Inverse multiplied by a change in final demand can be estimated by a power series. That is,

$$(\mathbf{I}-\mathbf{A})^{-1}\,\Delta\mathbf{y} = \Delta\mathbf{y} + \mathbf{A}\,\Delta\mathbf{y} + \mathbf{A}(\mathbf{A}\,\Delta\mathbf{y}) + \mathbf{A}(\mathbf{A}(\mathbf{A}\,\Delta\mathbf{y})) + \mathbf{A}(\mathbf{A}(\mathbf{A}(\mathbf{A}\,\Delta\mathbf{y}))) + \ldots$$

Assuming that $\Delta\mathbf{y}$—the change in final demand—is the "drop in the pond," then succeeding terms are the ripples. Each "ripple" term is calculated as the previous "pond disturbance" multiplied by the direct requirements matrix. Thus, since each element in the direct requirements matrix is less than one, each ripple term is smaller than its predecessor. Indeed, it has been shown that after calculating about seven of these ripple terms that the power series approximation of impacts very closely estimates those produced by the Leontief Inverse directly.

In impacts analysis practice, $\Delta \mathbf{y}$ is a single column of expenditures with the same number of elements as there are rows or columns in the direct or technical requirements matrix. This set of elements is called an *impact vector*. This term is used because it is the *vector* of numbers that is used to estimate the *economic impacts* of the investment.

There are two types of changes in investments, and consequently economic impacts, generally associated with projects—*one-time impacts* and *recurring impacts*. One-time impacts are impacts that are attributable to an expenditure that occurs once over a limited period of time. For example, the impacts resulting from the construction of a project are one-time impacts. Recurring impacts are impacts that continue permanently as a result of new or expanded ongoing expenditures. The ongoing operation of a new train station, for example, generates recurring impacts to the economy. Examples of changes in economic activity are investments in the preservation of old homes, tourist expenditures, or the expenditures required to run a historical site. Such activities are considered changes in final demand and can be either positive or negative. When the activity is not made in an industry, it is generally not well represented by the input-output model. Nonetheless, the activity can be represented by a special set of elements that are similar to a column of the transactions matrix. This set of elements is called an economic disturbance or impact vector. The latter term is used because it is the vector of numbers that is used to estimate the impacts. In this study, the impact vector is estimated by multiplying one or more economic *translators* by a dollar figure that represents an investment in one or more projects. The term translator is derived from the fact that such a vector *translates* a dollar amount of an activity into its constituent purchases by industry.

One example of an industry multiplier is shown in exhibit B.4. In this example, the activity is the preservation of a historic home. The *direct impact* component consists of purchases made specifically for the construction project from the producing industries. The *indirect impact* component consists of expenditures made by producing industries to support the purchases made for this project. Finally, the *induced impact* component focuses on the expenditures made by workers involved in the activity on-site and in the supplying industries.

Exhibit B.4
Components of the Multiplier for the
Historic Rehabilitation of a Single-Family Residence

DIRECT IMPACT	INDIRECT IMPACT	INDUCED IMPACT
Excavation/Construction Labor Concrete Wood Bricks Equipment Finance and Insurance	Production Labor Steel Fabrication Concrete Mixing Factory and Office Expenses Equipment Components	Expenditures by wage earners on-site and in the supplying industries for food, clothing, durable goods, entertainment

REGIONAL INPUT-OUTPUT ANALYSIS

Because of data limitations, regional input-output analysis has some considerations beyond those for the nation. The main considerations concern the depiction of regional technology and the adjustment of the technology to account for interregional trade by industry.

In the regional setting, local technology matrices are not readily available. An accurate region-specific technology matrix requires a survey of a representative sample of organizations for each industry to be depicted in the model. Such surveys are extremely expensive.[9] Because of the expense, regional analysts have tended to use national technology as a surrogate for regional technology. This substitution does not affect the accuracy of the model as long as local industry technology does not vary widely from the nation's average.[10]

Even when local technology varies widely from the nation's average for one or more industries, model accuracy may not be affected much. This is because interregional trade may mitigate the error that would be induced by the technology. That is, in estimating economic impacts via a regional input-output model, national technology must be regionalized by a vector of regional purchase coefficients,[11] **r**, in the following manner:

$$(\mathbf{I}\text{-}\mathbf{rA})^{-1}\,\mathbf{r}\cdot\Delta\mathbf{y}$$

[9]The most recent statewide survey-based model was developed for the State of Kansas in 1986 and cost on the order of $60,000 (in 1990 dollars). The development of this model, however, leaned heavily on work done in 1965 for the same state. In addition the model was aggregated to the 35-sector level, making it inappropriate for many possible applications since the industries in the model do not represent the very detailed sectors that are generally analyzed.

[10]Only recently have researchers studied the validity of this assumption. They have found that large urban areas may have technology in some manufacturing industries that differs in a statistically significant way from the national average. As will be discussed in a subsequent paragraph, such differences may be unimportant after accounting for trade patterns.

[11]A regional purchase coefficient (RPC) for an industry is the proportion of the region's demand for a good or service that is fulfilled by local production. Thus, each industry's RPC varies between zero (0) and one (1), with one implying that all local demand is fulfilled by local suppliers. As a general rule, agriculture, mining, and manufacturing industries tend to have low RPCs, and both service and construction industries tend to have high RPCs.

or

$$\mathbf{r}\cdot\Delta\mathbf{y} + \mathbf{rA}\,(\mathbf{r}\cdot\Delta\mathbf{y}) + \mathbf{rA}(\mathbf{rA}\,(\mathbf{r}\cdot\Delta\mathbf{y})) + \mathbf{rA}(\mathbf{rA}(\mathbf{rA}\,(\mathbf{r}\cdot\Delta\mathbf{y}))) + \ldots$$

where the vector-matrix product **rA** is an estimate of the region's direct requirements matrix. Thus, if national technology coefficients—which vary widely from their local equivalents—are multiplied by small RPCs, the error transferred to the direct requirements matrices will be relatively small. Indeed, since most manufacturing industries have small RPCs and since technology differences tend to arise due to substitution in the use of manufactured goods, technology differences have generally been found to be minor source error in economic impact measurement. Instead, RPCs and their measurement error due to industry aggregation have been the focus of research on regional input-output model accuracy.

A COMPARISON OF THREE MAJOR REGIONAL ECONOMIC IMPACT MODELS

In the United States there are three major vendors of regional input-output models. They are U.S. Bureau of Economic Analysis's (BEA) RIMS II multipliers, Minnesota IMPLAN Group Inc.'s (MIG) IMPLAN Pro model, and CUPR's own REcon™ I–O model. CUPR has had the privilege of using them all. (R/Econ™ I–O builds from the PC I–O model produced by the Regional Science Research Corporation's (RSRC).)

Although the three systems have important similarities, there are also significant differences that should be considered before deciding which system to use in a particular study. This document compares the features of the three systems. Further discussion can be found in Brucker, Hastings, and Latham's article in the Summer 1987 issue of *The Review of Regional Studies* entitled "Regional Input-Output Analysis: A Comparison of Five Ready-Made Model Systems." Since that date, CUPR and MIG have added a significant number of new features to PC I–O (now, R/Econ™ I–O) and IMPLAN, respectively.

Model Accuracy

RIMS II, IMPLAN, and RECON™ I–O all employ input-output (I–O) models for estimating impacts. All three regionalized the U.S. national I–O technology coefficients table at the highest levels of disaggregation (more than 500 industries). Since aggregation of sectors has been shown to be an important source of error in the calculation of impact multipliers, the retention of maximum industrial detail in these regional systems is a positive feature that they share. The systems diverge in their regionalization approaches, however. The difference is in the manner that they estimate regional purchase coefficients (RPCs), which are used to regionalize the technology matrix. An RPC is the proportion of the region's demand for a good or service that is fulfilled by the region's own producers rather than by imports from producers in other areas. Thus, it expresses the proportion of the purchases of the good or service that do not leak out of the region, but rather feed back to its economy, with corresponding multiplier effects. Thus, the accuracy of the RPC is crucial to the accuracy of a regional I–O model, since the regional multiplier effects of a sector vary directly with its RPC.

The techniques for estimating the RPCs used by CUPR and MIG in their models are theoretically more appealing than the location quotient (LQ) approach used in RIMS II. This is because the former two allow for crosshauling of a good or service among regions and the latter does not. Since crosshauling of the same general class of goods or services among regions is quite common, the CUPR-MIG approach should provide better estimates of regional imports and exports. Statistical results reported in Stevens, Treyz, and Lahr (1989) confirm that LQ methods tend to overestimate RPCs. By extension, inaccurate RPCs may lead to inaccurately estimated impact estimates.

Further, the estimating equation used by CUPR to produce RPCs should be more accurate than that used by MIG. The difference between the two approaches is that MIG estimates RPCs at a more aggregated level (two-digit SICs, or about 86 industries) and applies them at a desegregate level (over 500 industries). CUPR both estimates and applies the RPCs at the most detailed industry level. The application of aggregate RPCs can induce as much as 50 percent error in impact estimates (Lahr and Stevens, 2002).

Although both RECON™ I–O and IMPLAN use an RPC-estimating technique that is theoretically sound and update it using the most recent economic data, some practitioners question their accuracy. The reasons for doing so are three-fold. First, the observations currently used to estimate their implemented RPCs are based on 20-years old trade relationships—the Commodity Transportation Survey (CTS) from the 1977 Census of Transportation. Second, the CTS observations are at the state level. Therefore, RPC's estimated for substate areas are extrapolated. Hence, there is the potential that RPCs for counties and metropolitan areas are not as accurate as might be expected. Third, the observed CTS RPCs are only for shipments of goods. The interstate provision of services is unmeasured by the CTS. IMPLAN replies on relationships from the 1977 U.S. Multiregional Input-Output Model that are not clearly documented. RECON™ I–O relies on the same econometric relationships that it does for manufacturing industries but employs expert judgment to construct weight/value ratios (a critical variable in the RPC-estimating equation) for the non-manufacturing industries.

The fact that BEA creates the RIMS II multipliers gives it the advantage of being constructed from the full set of the most recent regional earnings data available. BEA is the main federal government purveyor of employment and earnings data by detailed industry. It therefore has access to the fully disclosed and disaggregated versions of these data. The other two model systems rely on older data from *County Business Patterns* and Bureau of Labor Statistic's ES202 forms, which have been "improved" by filling-in for any industries that have disclosure problems (this occurs when three or fewer firms exist in an industry or a region).

Model Flexibility

For the typical user, the most apparent differences among the three modeling systems are the level of flexibility they enable and the type of results that they yield. R/Econ™ I–O allows the user to make changes in individual cells of the 515-by-515 technology matrix as well as in the 11 515-sector vectors of region-specific data that are used to produce the regionalized model. The 11 sectors are: output, demand, employment per unit output, labor income per unit output, total value added per unit of output, taxes per unit of output (state and local), nontax value added per unit output, administrative and auxiliary output per unit output, household consumption per unit of labor income, and the RPCs. Te PC I–O model tends to be simple to use. Its User's Guide is straightforward and concise, providing instruction about the proper implementation of the model as well as the interpretation of the model's results.

The software for IMPLAN Pro is Windows-based, and its User's Guide is more formalized. Of the three modeling systems, it is the most user-friendly. The Windows orientation has enabled MIG to provide many more options in IMPLAN without increasing the complexity of use. Like R/Econ™ I–O, IMPLAN's regional data on RPCs, output, labor compensation, industry average margins, and employment can be revised. It does not have complete information on tax revenues other than those from indirect business taxes (excise and sales taxes), and those cannot be altered. Also like R/Econ™, IMPLAN allows users to modify the cells of the 538-by-538 technology matrix. It also permits the user to change and apply price deflators so that dollar figures can be updated from the default year, which may be as many as four years prior to the current year. The plethora of options, which are advantageous to the advanced user, can be extremely confusing to the novice. Although default values are provided for most of the options, the accompanying documentation does not clearly point out which items should get the most attention. Further, the calculations needed to make any requisite changes can be more complex than those needed for the R/Econ™ I–O model. Much of the documentation for the model dwells on technical issues regarding the guts of the model. For example, while one can aggregate the 538-sector impacts to the one- and two-digit SIC level, the current documentation does not discuss that possibility. Instead, the user is advised by the Users Guide to produce an aggregate model to achieve this end. Such a model, as was discussed earlier, is likely to be error ridden.

For a region, RIMS II typically delivers a set of 38-by-471 tables of multipliers for output, earnings, and employment; supplementary multipliers for taxes are available at additional cost. Although the model's documentation is generally excellent, use of RIMS II alone will not provide proper estimates of a region's economic impacts from a change in regional demand. This is because no RPC estimates are supplied with the model. For example, in order to estimate the impacts of rehabilitation, one not only needs to be able to convert the engineering cost estimates into demands for labor as well as for materials and services by industry, but must also be able to estimate the percentage of the labor income, materials, and services which will be provided by the region's households and industries (the RPCs for the demanded goods and services). In most cases, such percentages are difficult to ascertain; however, they are provided in the R/Econ™ I–O and IMPLAN models with simple triggering of an option. Further, it is impossible to change any of the model's parameters if superior data are known. This model ought not to be used for evaluating any project or event where superior data are available or where the evaluation is for a change in regional demand (a construction project or an event) as opposed to a change in regional supply (the operation of a new establishment).

Model Results

Detailed total economic impacts for about 500 industries can be calculated for jobs, labor income, and output from R/Econ™ I–O and IMPLAN only. These two modeling systems can also provide total impacts as well as impacts at the one- and two-digit industry levels. RIMS II provides total impacts and impacts on only 38 industries for these same three measures. Only the manual for R/Econ™ I–O warns about the problems of interpreting and comparing multipliers and any measures of output, also known as the value of shipments.

As an alternative to the conventional measures and their multipliers, R/Econ™ I–O and IMPLAN provide results on a measure known as "value added." It is the region's contribution to the nation's gross domestic product (GDP) and consists of labor income, non-monetary labor compensation, proprietors' income, profit-type income, dividends, interest, rents, capital consumption allowances, and taxes paid. It is, thus, the region's production of wealth and is the single best economic measure of the total economic impacts of an economic disturbance.

In addition to impacts in terms of jobs, employee compensation, output, and value added, IMPLAN provides information on impacts in terms of personal income, proprietor income, other property-type income, and indirect business taxes. R/Econ™ I–O breaks out impacts into taxes collected by the local, state, and federal governments. It also provides the jobs impacts in terms of either about 90 or 400 occupations at the users request. It goes a step further by also providing a return-on-investment-type multiplier measure, which compares the total impacts on all of the main measures to the total original expenditure that caused the impacts. Although these latter can be readily calculated by the user using results of the other two modeling systems, they are rarely used in impact analysis despite their obvious value.

In terms of the format of the results, both R/Econ™ I–O and IMPLAN are flexible. On request, they print the results directly or into a file (Excel® 4.0, Lotus 123®, Word® 6.0, tab delimited, or ASCII text). It can also permit previewing of the results on the computer's monitor. Both now offer the option of printing out the job impacts in either or both levels of occupational detail.

RSRC Equation

The equation currently used by RSRC in estimating RPCs is reported in Treyz and Stevens (1985). In this paper, the authors show that they estimated the RPC from the

1977 CTS data by estimating the demands for an industry's production of goods or services that are fulfilled by local suppliers (*LS*) as

$$\boldsymbol{LS = D^{e(-1/x)}}$$

and where for a given industry

$\boldsymbol{x = k\, Z_1^{a_1} Z_2^{a_2}\, P_j\, Z_j^{a_j}}$ and D is its total local demand.

Since for a given industry RPC = *LS*/*D* then

$$\ln\{-1/[\ln(\ln \boldsymbol{LS}/\ln \boldsymbol{D})]\} = \ln \mathbf{k} + \mathbf{a}_1 \ln \boldsymbol{Z}_1 + \mathbf{a}_2 \ln \boldsymbol{Z}_2 + \mathbf{S}_j\, \mathbf{a}_j \ln \boldsymbol{Z}_j$$

which was the equation that was estimated for each industry.

This odd nonlinear form not only yielded high correlations between the estimated and actual values of the RPCs, it also assured that the RPC value ranges strictly between 0 and 1. The results of the empirical implementation of this equation are shown in Treyz and Stevens (1985, table 1). The table shows that total local industry demand ($\boldsymbol{Z}_1$), the supply/demand ratio ($\boldsymbol{Z}_2$), the weight/value ratio of the good ($\boldsymbol{Z}_3$), the region's size in square miles (Z_4), and the region's average establishment size in terms of employees for the industry compared to the nation's (Z_5) are the variables that influence the value of the RPC across all regions and industries. The latter of these maintain the least leverage on RPC values.

Because the CTS data are at the state level only, it is important for the purposes of this study that the local industry demand, the supply/demand ratio, and the region's size in square miles are included in the equation. They allow the equation to extrapolate the estimation of RPCs for areas smaller than states. It should also be noted here that the CTS data only cover manufactured goods. Thus, although calculated effectively making them equal to unity via the above equation, RPC estimates for services drop on the weight/value ratios. A very high weight/value ratio like this forces the industry to meet this demand through local production. Hence, it is no surprise that a region's RPC for this sector is often very high (0.89). Similarly, hotels and motels tend to be used by visitors from outside the area. Thus, a weight/value ratio on the order of that for industry production would be expected. Hence, an RPC for this sector is often about 0.25.

The accuracy of CUPR's estimating approach is exemplified best by this last example. Ordinary location quotient approaches would show hotel and motel services serving local residents. Similarly, IMPLAN RPCs are built from data that combine this industry with eating and drinking establishments (among others). The results of such aggregation process is an RPC that represents neither industry (a value of about 0.50) but which is applied to both. In the end, not only is the CUPR's RPC-estimating approach the most sound, but it is also widely acknowledged by researchers in the field as being state of the art.

ADVANTAGES AND LIMITATIONS OF INPUT-OUTPUT ANALYSIS

Input-output modeling is one of the most accepted means for estimating economic impacts. This is because it provides a concise and accurate means for articulating the interrelationships among industries. The models can be quite detailed. For example, the current U.S. model currently has more than 500 industries representing many six-digit North American Industrial Classification System (NAICS) codes. The CUPR's model used in this study has 517 sectors. Further, the industry detail of input-output models provides not only a consistent and systematic approach but also more accurately assesses multiplier effects of changes in economic activity. Research has shown that results from more aggregated economic models can have as much as 50 percent error inherent in them. Such large errors are generally attributed to poor estimation of regional trade flows resulting from the aggregation process.

Input-output models also can be set up to capture the flows among economic regions. For example, the model used in this study can calculate impacts for a county as well as the total Ohio state economy.

The limitations of input-output modeling should also be recognized. The approach makes several key assumptions. First, the input-output model approach assumes that there are no economies of scale to production in an industry; that is, the proportion of inputs used in an industry's production process does not change regardless of the level of production. This assumption will not work if the technology matrix depicts an economy of a recessional economy (e.g., 1982) and the analyst is attempting to model activity in a peak economic year (e.g., 1989). In a recession year, the labor-to-output ratio tends to be excessive because firms are generally reluctant to lay off workers when they believe an economic turnaround is about to occur.

A less-restrictive assumption of the input-output approach is that technology is not permitted to change over time. It is less restrictive because the technology matrix in the United States is updated frequently and, in general, production technology does not radically change over short periods.

Finally, the technical coefficients used in most regional models are based on the assumption that production processes are spatially invariant and are well represented by the nation's average technology. In a region as large and diverse as Ohio, this assumption is likely to hold true.

APPENDIX C: ECONOMETRIC ANALYSIS OF THE DETERMINANTS OF ENPLANEMENTS FOR AIRPORTS WITH 130,000-410,000 ANNUAL ENPLANEMENTS

In this appendix, we estimate the number of enplanements in the year 2002 for a sample of 77 small airports with an average of 6 gates and a maximum of 15 gates. The average number of enplanements for these airports is 250,000.

As shown in Exhibit C.1, the variables used to explain annual enplanements in 2002 are air distance to the nearest major airport, the number of gates, the quadratic number of gates, binary variables for the presence of key gate counts, and binary variables to identify operating airlines at each terminal. In general, the closer one is to a major airport, the lower the level enplanements will be at a smaller airport. More gates tend to enable more enplanements (about 18,000 more enplanements per gate on average). The major negative jump in enplanements with the addition of a third gate likely indicates that three-gate airports are those that are in an expansion mode. Thus the 4-gate coefficient compensates for the spurious drop displayed in the 3-gate option.

These results perhaps illustrate how some airlines exploit niches in the market. Notice that the coefficients for America West Airlines, Conair, and US Airways are not statistically significantly different from zero. Indeed, the coefficient for US Airways has a negative influence on enplanements. This implies that either their turnaround times in 2002 were lower than average in most airports or that they specialized in particularly low-volume passenger venues. Either way, such a specialty does not bode well for airports seeking greater enplanement volumes. The lackluster operations of US Airways before and after 2002 at the Trenton-Mercer Airport underline this issue.

Exhibit C.1:
Determinants of Annual Enplanements for Airports with 130,000 to 400,000 Annual Enplanements

Enplanements 2002		Coefficient
Distance to nearest airport		-70.12
Number of gates		17,794.03
Square number of gates		-534.96
Gate 3 dummy		-57,577.67
Gate 4 dummy		68,446.01
Gate 7 dummy	(*)	-36,539.71
Gate 10 dummy	(*)	35,409.46
Atlantic Southeast Airlines		28,706.00
Southwest Airlines		117,448.10
America West Airlines	(*)	38,232.97
Conair	(*)	24,544.69
Continental		66,224.88
US Airways	(*)	-14,615.94
United Airlines		28,282.51
Intercept		96,640.85

Notes: R^2= 0.656
[*] Not statistically significant at 10 percent level.

Meanwhile the analysis reveals that Atlantic Southeast Airlines, Southwest Airlines, Continental, and United Airlines maintain competitive dominance. The coefficients in the regression for this set of binary variables are both positive and statistically different from zero. Thus something about the manner in which these airlines conducted business in 2002, made them stand out in a positive vein. That is, it would behoove management at the Trenton-Mercer Airport to learn what made these airlines' operation different from the rest (e.g., faster turnaround times, lower ticket prices, better customer service) and attempt to secure agreements with such airlines for increasing the airport's enplanement levels.

We also used the above regression equation to estimate the marginal change in enplanements by gate. This was done by evaluating the equation with one gate increases, up to a total of 10 gates. The effects in the variation of enplanements are exhibited in Exhibit C.2. The effects depend upon the linear increment of a gate, the quadratic diminution of a gate, and the binary variables for Gates 3 and Gates 4. Gates counts of 7 10 are not considered because their coefficients are not statistical significant.

In the case of the Trenton-Mercer Airport, the number of enplanements may increase about 16,200 annually by adding a second gate. Based upon the analysis here, adding a third gate would unrealistically lead to a net decrease of enplanements, which might recover only by adding both a fourth and a fifth gate. The number of enplanements with five gates would increase about 22,500 enplanements, i.e., adding only approximately 6,300 enplanements by adding gates 3, 4, and 5 over a second gate. The model suggests that smaller airports either maintain 1-2 gates or over 5 gates. Few tend to operate with 3-4 gates.

Exhibit C.2: Expected Enplanement Returns to Adding Gates

Gates before	Gates after	Enplanement effects: Linear	Quadratic	Gate 3	Gate 4	Addition of Enplanements	Accumulation of Enplanements
1	2	17,794	-1,605	0	0	16,189	16,189
2	3	17,794	-2,675	-57,578	0	-42,458	-26,269
3	4	17,794	-3,745	-57,578	68,446	24,918	-1,352
4	5	17,794	-4,815	-57,578	68,446	23,848	22,496
5	6	17,794	-5,885	-57,578	68,446	22,778	45,274
6	7	17,794	-6,954	-57,578	68,446	21,708	66,982
7	8	17,794	-8,024	-57,578	68,446	20,638	87,620
8	9	17,794	-9,094	-57,578	68,446	19,568	107,188
9	10	17,794	-10,164	-57,578	68,446	18,498	125,686

APPENDIX D: LITERATURE REVIEW OF THE EFFECTS OF TECHNOLOGICAL CHANGE IN THE AVIATION INDUSTRY ON SPATIAL DEVELOPMENT PATTERNS

In spite of dramatic advances in communications technology, the need for business managers to conduct face-to-face meetings has increased over the past three decades. Numerous factors, however, impair the ability of business people to travel by air, as well as increasing their business costs. These factors include reduced air service provided by commercial carriers, inconvenience and delays caused by stringent security measures at major jetports, increasing flight delays at the country's busiest airports, and the high cost of urban real estate around commercial airports. These issues are especially problematic in the New York metropolitan area, with the three commercial jetports (JFK International, Newark Liberty International, and LaGuardia) consistently among the airports with the greatest delays. The aviation industry's response to these challenges includes technological advances in two major areas: advanced aircraft technology and sophisticated air traffic management technology. These technologies should not only optimize the use of existing airport facilities, they are designed to make it possible to provide safe, reliable air travel to hundreds of airports not served by commercial airlines today. It remains to be seen, however, if businesses will respond positively to these new technologies and how those establishments' behavior will change the geography of economic development patterns.

Further, public policy makers at state and local levels play key roles in determining the extent to which new aviation technologies are implemented, and thus what air travel alternatives are made available to establishments. While the benefits of airports such as increased economic activity are distributed regionally, their negative externalities often are felt only locally. As a result, in many states local zoning boards rather that state authorities control the types of improvements that can be made to local airports. Local political pressures thus can make it difficult to implement even minor airport improvements (sometimes improvements that do not affect the fundamental operation of the airport, such as the construction of additional hangars). This is especially the case when local decision-makers are faced with negative aspects of airport improvement and lack an understanding of the positive economic effects of airport improvement, creating a disjoint decision-making process.

In spite of advances in telecommunications technology that once was heralded as having the potential to make business travel obsolete, the need for face-to-face communications has in fact increased over the past 30 years. Researchers (ter Hart and Piersma, 1990) have found, for example, that the need for face-to-face contact appears to be a key factor in the financial industry's location decisions. Why is it important? Thrift (1994) suggests it is the financial sector's need for expertise that filters and interprets the information quickly and for the tacit information attached to the social contact that facilitates the explicit information exchanged. That is, such contact is important because it engenders trust, which helps in the information filtering process by reducing information uncertainty. After all, if you are going to engage in a multi-million dollar transaction with someone else, you probably want the assurance that only personal contact provides.

Three factors, however, make it more difficult for establishments to realize the benefits of commercial air travel: diminishing commercial air service, increasing congestion and flight delays, and increasing urban real estate prices. We now elaborate on each of these in turn.

The Importance of Business Air Travel

Diminishing Commercial Air Service

At the same time that establishments need access to reliable air travel, availability of commercial air service is decreasing at manyairports around the country. According to the Government Accounting Office (2002), for some 200 commercial airports the total number of scheduled daily departures of passenger airplanes declined by 19 percent during the year ending October 2001. Although carriers had clearly reduced total departure levels at small communities before the September 11 terrorist attacks, airlines reduced departures more in the aftermath of September 11. Analyses of industry service levels show that communities of all sizes shared in service reductions. At the typical small community, the number of departures dropped by three flights per day, from nine to six. The report notes that when one or more carriers pulled out of a community, passengers often lost connecting service to other destinations.

Congestion and Flight Delays

As early as Vranas et al. (1994), the cost of congestion to United States airlines exceeded $2 billion per year. They attribute the problem to limited capacity at the primary commercial airports. Brueckner (2002) notes that air traffic delays grew dramatically in the late 1990s, becoming a major public policy issue. Referring to FAA reports, Daniel (1995) pegs the total cost of airline congestion to both the airlines and passengers at over $5 billion per year.

Increasing Real Estate Prices

Increasing real estate prices in urban areas make it more and more costly for establishments to locate near major financial centers and headquarters cities, which are destinations for many flights for face-to-face visits (Brueckner, 2003). Thus, it is no surprise that Haughwout and Inman (2002) find that the number of airline hubs in a metropolitan area's main airport has a positive effect upon both suburban population growth and the central city's income growth. Brueckner (2003) further suggests that a 10 percent rise in enplanements causes ceteris paribus a 1 percent rise in employment in a metropolitan area. In an unpublished paper employing panel data, Green (2006) finds that boardings, originations, and the presence of an airline hub induced population and employment growth in 83 metropolitan areas between 1990 and 2000. Thus, the advent of hub-and-spoke flight scheduling along with the decline in viable commercial airline venues, means that costs of accessing commercial airports also appear to be rising due to inconvenient commute durations.

The Aviation Industry Response

In response to increasing congestion and delays at major airports and to reduced flight availability, especially to less populous cities, a range of technologies are being developed that will increase the number of airports that can provide reliable business air travel from hundreds to thousands. These technologies fall in three categories: next generation light turbine aircraft and helicopters, airport capabilities, and advanced air traffic management.

Aircraft Technology

At least four aircraft manufacturers are developing a new generation of very light turbine-powered aircraft intended to operate from small community airports. The Cessna Aircraft Company, Eclipse Aviation, Adam Aircraft, and the Embraer Aviation Company have begun developing light turbine-powered aircraft that will be priced significantly below existing corporate aircraft. Intended to operate to and from regional and community airports, these aircraft share similar operating characteristics: they have an optimum range of up to 1,300 nautical miles, can carry four to six passengers, are designed to be operated by a single pilot, and will fly at altitudes above those used by commercial airliners. All four aircraft use advanced engine technology to operate quietly and more fuel efficiently than current aircraft, resulting in significant savings in seat-mile costs, while providing higher speeds and thus shorter flight times.

The low operating costs and the ability to operate to and from small community airports have stimulated the growth of a new air taxi service intended to provide point-to-point air travel to business and personal travelers, filling the gaps left by decreasing commercial airline service and even providing service to cities not previously served by the airlines.

Air Traffic Management Technology

The Next Generation Air Travel System (NGATS) is an umbrella name for a set of technologies that will improve the overall air travel system by optimizing the use of airspace. Falling into nine categories, these technologies combine to make more efficient use of the existing airspace, thus increasing its capacity and safety (JPDO 2006). The nine distinct but interrelated operational improvements are: (1) Broad Area and Precision Navigation; (2) Airspace Access and Management; (3) Trajectory-Based Air Traffic Management; (4) Reduced Separation Between Aircraft; (5) Flight Deck Situational Awareness and Delegation; (6) Air Traffic Management Decision Support; (7) Improved Weather Data and Dissemination; (8) Reduced Cost to Deliver ATM Services; and (9) Greatly Expanded Airport Network and Improved Terminals.

In addition, NASA is leading a public/private industry consortium entitled “Small Aircraft Travel System” (SATS). SATS is intended to result in new technologies that improve the usability of small community airports. NASA, in partnership with the Department of Travel/Federal Aviation Administration (FAA) and state & local aviation and airport authorities, leads a research & development program focused on maturing technologies needed for a small aircraft travel system. The project's initial focus is to prove that four new operating capabilities will enable safe and affordable access to virtually any runway in the nation in most weather conditions. These operating capabilities rely on on-board computing, advanced flight controls, “Highway in the Sky” displays, and automated air traffic separation and sequencing technologies (NASA 2006).

These capabilities give smaller regional and community airports the ability to support business travel that cannot be supported today by eliminating the need to install capital-intensive ground-based equipment needed to provide approach and landing guidance to aircraft arriving at the airport. This also will allow air traffic managers to safely handle the increase in air traffic that is likely to occur with the advent of new aircraft and airport technology.

Effects of Technological Change on Business Location Decisions

In order to assess the impact of the new air travel technologies, the reactions of establishments to new air travel alternatives must be determined. Here the research team will ask what technologies are being developed and when they will be implemented. Next, the team will determine the sensitivity of establishments to enhanced air travel capabilities, and whether or not those establishments are likely to take advantage of the new enabling technologies.

If we can show that convenient access (or lack of convenient access) to air travel affects establishments asymmetrically and that establishments that are sensitive to convenient access to air travel differ statistically from other establishments, implementation of the new technology should have a dispersing effect of travel-sensitive establishments. This is because they should make areas in close proximity to small airports more appealing as locations for doing business. This shift may be accelerated as airlines eliminate low-profit routes due to rising fuel prices (Perez 2006).

Characteristics of Air Travel-Sensitive Establishments

The research team will determine the characteristics of travel sensitive establishments by focusing on three primary areas:

- Industry class
- Economic contributions based on payroll levels and numbers of jobs
- Regional economic integration

If certain industries are more travel-sensitive than others, then implementing air travel improvements will have asymmetric impacts on establishments' location decisions. For example, industries in which marketing & sales (M&S) staff play a key role in the success of the establishment may be more sensitive to convenient access to air travel, especially if the M&S staff travel frequently to meet with clients. Manufacturing establishments may also be sensitive to convenient access to air travel if their engineering and technical staff needs to meet with clients at their locations.

Effects of Technological Change on Spatial Development Patterns

Finally, are air travel-sensitive establishments more or less economically integrated in their regions than their less air travel-sensitive counterparts? Do these establishments require business inputs such as support services that are located only in certain areas? Does their presence stimulate the growth of other local business, thus creating their own "multiplier effect"? What types of barriers to entry and exit apply to these establishments? What establishments will be the first to relocate to areas served by smaller airports, and what types of establishments will follow them?

As smaller airports improve and point-to-point air service is introduced, the regions around them will be better able to compete for establishments that are air travel-sensitive. This should result in a new paradigm for locating business establishments with smaller airports experiencing a greater share of these establishments as they relocate away from areas around traditional commercial service airports. This in turn should stimulate the growth of support services around the smaller airports, resulting in new patterns of economic growth and development.

The Importance of Face to Face Contact

Initial research on the factors that affect business location decisions was performed by Schmenner (1982). He noted that some establishments listed the presence of an airport sufficiently close for using corporate aircraft as an important locational consideration. More recently, Cohen (2000) noted that access to air transportation ranks high on the priority list for establishments selecting sites for headquarters locations.

Daft, Lengel, and Trevino 1987) found that face-to-face communications has a “special ability to communicate the types of decisions made by senior managers.” Ota and Fujita’s (1993) model of information exchange among corporate headquarters at a single information-rich location and between each headquarters at that location and its production plants at information-poor locations explained not only export-based businesses’ decentralization tendencies but also the centralization tendencies of headquarters operations.

The need for face-to-face contact appears to be a key factor in the financial industry’ location decisions (ter Hart and Piersma, 1990). Why is it important? Thrift (1994) suggests it is the financial sector’s need for expertise that filters and interprets the information quickly and for the tacit information attached to the social contact that facilitates the explicit information exchanged. That is, such contact is important because it engenders trust, which helps in the information filtering process by reducing information uncertainty. Athanassiou and Nigh (2000) go a bit further by finding that top management team members need “to meet face-to-face to share the individual tacit knowledge stocks and create a shared team-level perspective of the multinational establishment’s overseas activities and environments.” Thus they conclude that face-to-face communications is particularly necessary for problem-solving tasks involving ambiguity and uncertainty. Moss (2000, p. 3) cites airports and the Internet as “backbone systems…vital for the location of new information-based industries.”

Declining Air Travel Service and Costs to Businesses

Perez and Trottman (2006) note that airlines have sought to maximize their load factors (the percentage of seats on an aircraft filled with passengers). In some cases, airlines have even cut all service on less profitable routes. The authors proffer as evidence of this trend a decrease of 21 percent in the combined fleet size of the major airlines: American, Continental, Delta, Northwest, United, and US Airways had a total of 3,469 aircraft in 2000 and only 2,747 in 2005, a decrease of 21 percent. Thus while higher load factors have yielded improved profitability for these establishments, passengers now have fewer options for and less flexibility in their travel plans. This runs against the apparent increasing demand for flights that enable face-to-face communications.

Braga (2006) notes that establishments near Sarasota, Florida, are relocating to facilities outside the state due to Florida’s tightening commercial real estate market. Florida’s home prices are exacerbating matters further since they make it difficult to attract and retain workers. In fact, in most areas of the nation, wages nearly keep pace with real estate values, which means that establishments' payrolls (and, hence, costs of doing business) are higher than they might otherwise be if they opt to remain near cities with commercial airports, particularly those airports with large enplanement counts, rather than relocate to less-expensive regions.

Effects of Technology on Air Travel

Reynolds-Feighan (2001) found that point-to-point service, characterized by Southwest Airlines, is characterized by low levels of concentration and relatively short (less than 500 miles) flight distances, characteristics that match the new very light jet model. Adrangi, Chow and Raffiee (1999) noted that changing technology has fundamentally influenced the air travel industry throughout its history.

The deregulation of the U.S. airline industry provides examples of geographical shifts in areas served by airline companies. Goetz and Sutton (1997) note that airline service to non-hub cities has, in many cases, declined relative to the service provided at hub airports, and in some cases has actually been terminated. In recent years cities such as Mobile, Alabama, and Knoxville, Tennessee, have seen service levels fall while fares rise. Moreover, service to cities such as Corvallis, Oregon, and Montpelier, Vermont, has been dropped altogether. Even in cases where service continues, smaller markets tend to be dominated by a single airline. Such change increases passengers' dependence on the airline, enhancing the airline's ability to offer monopolistic fares. Goetz and Sutton also find that the spatial patterns in commercial airline service are consistent with those in other industries. Larger markets receive better, less- expensive service, while fares rise in the more concentrated ones. Similar results were seen in the Australian transport industry, with larger markets being favored at the expense of smaller ones.

Effect of Air Travel on Economic Development

Green (2006) analyzes the impact of airports on economic development and has concluded that rather than replacing meetings, technology such as the internet make it easier for people to meet each other, stimulating the demand for eventual face-to-face meetings. Hence, communities with airports fare better than those without them.

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