ESTIMATING THE REGIONAL ECONOMIC SIGNIFICANCE OF AIRPORTS

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PREFACE

This document is a revision of our 1986 report, Measuring the Regional Economic Significance of Airports, Report No. DOT/FAA/PP/87-1. The earlier report was prepared in response to requests from the airport community for FAA guidelines for estimating measures of the importance of individual airports to their surrounding communities. Like the 1896 report, the present document was written primarily for airport managers and planners whose budget and/or time constraints require that impact analyses be conducted in house, rather than by a consultant. For this reason, our guidelines were prepared with small- and medium-sized public use airports in mind.

The general organization of the present document remains based on the distinction between transportation benefit and economic impact. The material in Chapter 3, however, is now presented in two separate chapters, one on definitions of economic impact and the calculation of preliminary estimates and one on the preparation of a more detailed economic impact assessment.

Throughout the report, data to be used in the rule-of-thumb estimation of transportation benefit and economic impact have been updated. In addition, in Chapter 3 there is a new section on the estimation of indirect impacts, based on a region's population and origin-destination traffic. Also, the earlier treatment of induced impacts, i.e., regional multipliers, has been refined to take the size of the region's population into account.

The authors are grateful to the many users of the 1986 report for their comments and suggestions. We owe special thanks to Robert J. Zuelsdorf of Wilbur Smith Associates, who provided us with data on indirect and induced impacts.

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CHAPTER 1

INTRODUCTION

1.1 Purpose

The United States has the world's most extensive airport system. The system is essential to national transportation, and there is a large Federal investment in it. However, most public airports are owned and operated by units of local government.

Public airports must compete for funds with other governmental activities. They are scrutinized during budget preparation and may be the subject of public debate, particularly if major improvements or new construction are anticipated. They may even be the target of proposed restrictions aimed at limiting aircraft noise levels. In such instances, the future of an airport is determined primarily through the local political process.

It is important that the public and their representatives appreciate the economic significance of airports if they are to continue to support them. This report is designed to assist analyses of the economic importance of airports. It is not intended for use in financial feasibility studies or cost/benefit analyses. Rather, it provides information that the average citizen may find useful when the current and future role of an airport is being discussed.

The report is directed to a wide audience with varying levels of sophistication in the field of economics. One objective is to encourage a standard approach to the measurement of the economic significance of airports. The report includes a uniform set of definitions, illustrations of the most useful analytical techniques, and descriptions of the conditions under which they are most appropriately applied. General methodologies are emphasized rather than specific instructions. The procedures described in the report can be used to evaluate the economic significance of an existing or proposed airport or to study the consequences of increased activity at an airport.

1.2 Available Measures

The two main indicators that may be measured and cited as evidence of an airport's importance are its economic impact and its transportation benefit. Economic impact is the regional economic activity, employment, and payroll that can be attributed, directly and indirectly, to the operation of a local airport. It describes the importance of aviation as an industry. Benefit is the service that a local airport makes available to the surrounding area. The services emphasized in this report are time saved and cost avoided by travelers, but benefits also include other advantages, such as improved transportation safety and comfort. Benefits are a measure of the improved transportation that the airport provides, and thus reflect the primary motive of a community in operating a public airport.

Profit, or the difference between income and costs, is a valid measure of the viability of a private business. However, public airports are generally operated as public utilities, with provision of service rather than profit as the primary motive. Thus profit is not particularly relevant to the regional economic significance of an airport. Financial feasibility, or the ability of an airport to pay its bills, is a related subject that is usually considered as part of the overall planning for a public airport. This report does not include guidance on how to determine the financial feasibility of an airport.

1.3 Applications

Information about the economic significance of airports has a wide variety of uses. It is an important element in airport master plans and system plans, because it helps to describe the basis for and consequences of the development of airports and the public involvement in them. The public is more likely to support airports when they are aware of the substantial positive effects on the surrounding area. Economic impact and benefit data can be useful in evaluating the effects of proposed airport use restrictions. Benefit data can be combined with income projections to help determine the viability of airport development proposals.

Analysts should consider the intended application of their work and its probable audience and design their analysis accordingly. Preliminary calculations derived from rules of thumb provide "ball-park" measures of an airport's significance and are appropriate only when quick-response information is required and precision is not essential. More detailed analytical techniques, which require more time and money to perform, are appropriate when a more precise estimate is needed. Detailed analyses may be used to support major investment decisions or as input into debates of a technical nature.

A frequent flaw in economic impact analysis is presentation of the results in a form that the average member of the audience finds boring or uninformative. The purpose of the study is usually to gain public understanding and support, and the final report should be designed with this in mind. A balance should be maintained between the effort in preparing an analysis and the effort in disseminating the results.

The following sections provide guidance on both simple rules of thumb and more sophisticated analytical techniques. Chapter 2 presents a methodology for the development of measures of transportation benefit. Chapter 3 offers suggestions for estimating economic impacts by means of some statistical rules of thumb, and Chapter 4 outlines a basic approach for conducting a comprehensive economic assessment. A brief summary is presented in Chapter 5.

CHAPTER 2

BENEFITS

2.1 Categories of Public Benefits

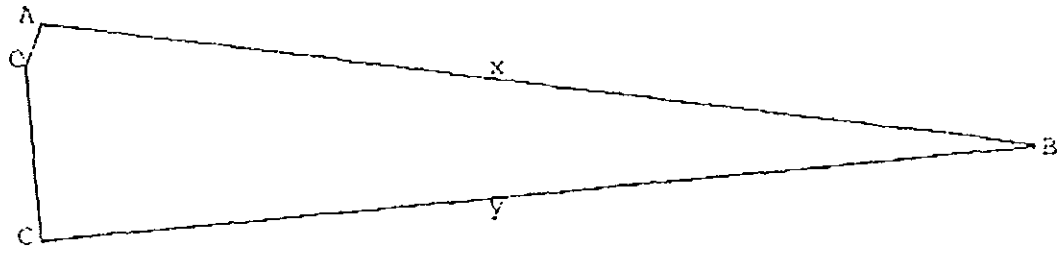
Benefits are the services that a community hopes to obtain by developing and maintaining an airport. They differ from economic impact, which is described in Chapter 3. Airports provide a variety of public benefits to the surrounding service areas. The most substantial of these are the time saved and cost avoided by using air transportation. These transportation benefits can be expressed in dollars, using the technique described in this chapter. Other benefits include the high levels of safety, comfort and convenience of aviation, the access that an airport provides to the national airport system, and enhancements to community well-being. These benefits cannot be expressed in dollars, but they can be explained and demonstrated by examples. In the case of reliever airports in metropolitan areas, a reduction in delays at airline airports can be cited and quantified.

2.2 Transportation Benefit

The primary benefits of an airport are usually the time saved and cost avoided by travelers who use it over the next best alternative. The following procedure measures the value of time saved and cost avoided by travelers as a result of an airport located at point A (see Figure 2-1). The nearest alternative airport is located at C, a farther distance from the point O where the trip originates. Individuals want to travel from O to B. The time saved by using airport A is the difference between the time for the O-C-B trip and the time for the more direct O-A-B trip. The benefit is the time saved per trip times the number of passenger trips, all multiplied by the value of the passengers' time. There is also a benefit as a result of reduced ground travel costs, since airport A is closer to the origin of trips than airport C. There could be additional benefits if the flight distance x were shorter than the alternative flight distance y. In

the examples below, it is assumed for the sake of simplicity that the flight distances are equal.

FIGURE 2-1
TRANSPORTATION BENEFIT OF AN AIRPORT



The variables that must be considered in the analysis are listed in Table 2-1. Most of them do not have to be determined for each analysis; typical values can be used instead. The critical variables that must be determined for each individual analysis are the number of based aircraft, the number of passengers in commercial air service, and the access distances to the airports at A and C. The total benefit is the sum of the time saving and travel cost reduction. The equations are shown separately and in the combined format. A more detailed analysis that considers the cost of aircraft flight time may be warranted if the distance x is substantially different from the distance y (see reference 6).

Time Saved

Annual Passengers = $FGN + Y$
O-C-B time = $b/P + y/S$
O-A-B time = $d/P + x/S$
Annual Benefit = $E(FGN + Y)(b/P + y/S - x/S - d/P)$

TABLE 2-1

TRANSPORTATION BENEFIT VARIABLES

Symbol	Variables	Typical Value (Use actual data when available.)
G	Itinerant operations per based aircraft per year (1)	300
N	Number of based aircraft at airport A	varies
d	Ground access distance to airport A (miles)	varies
E	Passenger time value ($/hour) (2)	30
F	Number of passengers per trip per general aviation aircraft (3)	2.5
P	Car speed (m.p.h.)	45
Q	Car costs, including amortization ($/mile) (4)	0.39
b	Ground access distance to alternative airport C (miles)	varies
Y	Annual passengers in commercial service	varies

Three additional variables are needed when use of the alternative airport substantially changes flight distance, i.e. $x \neq y$.

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

y	Alternative airport C to destination airport B flight distance	varies
S	General aviation or regional airline aircraft speed (m.p.h.)	varies

(1) An operation is either a landing or a takeoff. Aircraft based at airports with air traffic control towers averaged 302 itinerant operations in 1985.

(2) There is no source of precise data on the value of passenger time. The FAA uses $30 per hour for estimating the value of aircraft owners' and pilots' time for internal reporting purposes. The Aircraft Owners and Pilots Association (AOPA) reports that the average annual income of its members was $62,800 in 1990, which equates to $30.19 per hour. The FAA used $29.60 per hour as an estimate of the value of domestic airline passenger time in 1990 for computing the cost of air traffic delays.

(3) The average number of passengers per trip varies with aircraft type and is 1.4 for single engine piston aircraft with 3 seats or less, 2.4 for single engine piston aircraft with 4 seats or more, and 3.0 for multi-engine piston aircraft. See Reference (9).

(4) The American Automobile Association reports that a medium-sized automobile driven 15,000 miles a year costs $0.393 per mile to operate in 1992.

Reduced Ground Travel Cost

Annual Ground Trips = GN + Y[1]

O-C-B trip costs = Qb

O-A-B trip costs = Qd

Annual Benefit = (GN + Y)(Qb - Qd)

Total Benefit

Where x = y,
Total Annual Benefit = E(FGN + Y)(b/P - d/P) + (GN + Y)(Qb - Qd).
The transportation benefits from sample airports with various activity levels are illustrated in Table 2-2.

2.3 Rules of Thumb

The transportation benefits depend on several variables, particularly the additional ground travel involved in reaching an alternative airport. When that ground travel (b - d) is 20 miles, and the other variables are as shown in Table 2-1, the annual benefit from the airport is $12,330 per based aircraft plus $21.12 per passenger enplaned or deplaned in commercial service. A proportionate adjustment should be made to the benefits if the additional ground travel (b - d) is not equal to 20 miles. For instance, if b - d is equal to 10 miles, the benefits would be only half as great, or $6,165 per based aircraft and $10.56 per commercial passenger. If b - d is equal to 40 miles, the benefits would be twice as great, or $24,660 per based aircraft and $42.24 per passenger in commercial service. These figures can be used as

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[1]GN, the number of annual itinerant GA operations, is equal to the number of GA-related ground trips on the assumption that passengers making a GA trip together are acquainted and will share one automobile in travelling between the trip origin and the airport. Y, the number of annual commercial passengers, equals the number of ground trips related to commercial service on the assumption that each commercial passenger is travelling alone and requires a separate motor vehicle.

TABLE 2-2

APPROXIMATE BENEFITS FOR VARIOUS ACTIVITY LEVELS

Based Aircraft	Annual Commercial Passengers (1)	b - d: Reduction in Distance to Airport (2)	Value of Time Saved	Reduction in Travel Cost	Total Annual Transportation Benefit
10	0	20	$99,900	$23,400	$123,300
20	0	20	199,800	46,800	246,600
50	0	20	499,500	117,000	616,500
100	0	20	999,000	234,000	1,233,000
50	50,000	20	1,165,500	507,000	1,672,500
100	100,000	20	2,331,100	1,014,000	3,345,100
100	1,000,000	20	14,319,000	8,034,000	22,353,000

(1) Includes only origin and destination traffic; does not include through or transfer passengers.

(2) Highway mileage measured from the point where trips begin or end, typically the traveler's residence or place of business.

a rule of thumb to estimate the transportation benefits of an airport.

For example, an airport being studied has 25 based aircraft, and a regional airline served 6,000 passengers at the airport in the preceding year. The nearest alternative airport is 20 highway miles farther from the area served by the airport under study. The total annual transportation benefit from the airport is 25 aircraft times $12,330 per aircraft plus 6,000 passengers times $21.12 per passenger, or $434,970.

2.4 Effect of Increased Activity

An analysis can be used to determine the additional benefits that will result from increased activity at an airport. The increased activity may be the result of gradual growth in the demand for air transportation (passenger enplanements in the U.S. are forecast to increase at a rate of 4.0 percent per annum from 1991 thru 2003)[1], or it may occur rapidly as the result of an improvement to the airport or the introduction of new service. When the expected number of additional based aircraft and commercial passengers is known, the analytical technique or rule of thumb described in the preceding sections can be used to estimate the increased benefit. This information may be used to evaluate proposals to improve an airport or restrict airport growth.

2.5 Reduced Delays

A general aviation airport in a metropolitan area may be designated a reliever airport by the Federal Aviation Administration. In addition to providing access to the surrounding area, the airport relieves congestion at a busy airline airport by providing general aviation aircraft with an attractive alternative landing area. For instance, Teterboro Airport in New Jersey is a reliever for Newark Airport, serving over 400 aircraft that might otherwise land at Newark and add to congestion there.

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[1] FAA Aviation Forecast, February 1992.

The value of delay reduction resulting from a reliever airport can be computed by estimating the amount of traffic that would be added to the air carrier airport if the reliever were not available and then using an airport capacity model to compute annual delays before and after this traffic is added. For calendar year 1987, variable operating cost (crew, fuel, maintenance) averaged $1,465.00 per airborne hour for an air carrier aircraft plus $26.20 per passenger hour.[3] Aircraft delays increase exponentially as traffic is added to a congested airport, so the benefits of an effective reliever airport are usually quite large, and may be measured in millions of dollars.

2.6 Community Benefits

Some beneficial aspects of airports are significant but difficult to quantify. For example, airports contribute to the prompt diagnosis and treatment of disease. Blood and tissue samples are sent by air to medical facilities for analysis; isotopes, serum and antitoxin that cannot be stored locally are shipped by air whenever and wherever they are needed; organs for transplant operations are shipped by air; and patients often travel by air for dialysis and other treatment not available in their community.

A number of high schools, colleges and universities have aviation programs, and many offer degrees in these subjects. The programs are designed to train young people for careers in aviation. General aviation is a major training ground for the airline pilots of tomorrow. Such vocations may be conceived and nurtured at the local public airport.

Airports are vital civil defense facilities. They are extremely durable, and aviation is a key source of relief from natural disasters such as floods and earthquakes. They also support police, Civil Air Patrol, and National Guard activities and may be used by aircraft involved in pipeline patrol, detection of fuel and chemical spills, and forest fire detection and suppression.

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[3]Tables 2&21 - Report No. FAA-APO-89-10, Economic Values for evaluation of FAA Investment and Regulatory Programs.

While it is usually not possible to predict such uses or to express them in dollars, they can be illustrated by references to specific instances in which the local airport, or one in the general area, was used in an emergency. Anecdotal evidence and summaries of case studies can add a new dimension to discussions of airport benefits.

2.7 Stimulation of Business

Aviation is an essential form of business transportation, and it has helped to shape the size and structure of many major corporations. The presence of an airport and the types of service it provides are important considerations in the siting of business and industrial facilities. Large airports are magnets for warehousing, distribution centers, office parks, hotels, and other development. Smaller airports help to attract industry to small- and medium-sized communities, though they must work in concert with other factors such as the availability of a market, raw materials, labor, utilities, favorable treatment by local government, low taxes, community amenities, and sites that are economical to develop. As an important part of a rural area's transportation network, an airport is a factor in fostering business.

2.8 Access to the National Airport System

State and local agencies, working with the Federal government, have provided the United States with the world's most extensive and best equipped airport system. These airports accommodate about 40 percent of the commercial traffic in the world, and 60 percent of the general aviation traffic. It is through the local airport that an area gains access to this important national resource.

2.9 Recreation

About 50 percent of travel on commercial airlines and about 30 percent of general aviation trips are for recreation or vacation. The recreational uses of general aviation include sailplaning, sky-diving, flying home built aircraft, and local sightseeing. These are an important source of recreation and entertainment and also provide revenues that help to defray the cost of developing and operating airports.

2.10 Commercial Activities

There is a variety of commercial activities involving aviation above and beyond the carriage of passengers. Air cargo accounts for several distinct businesses, including air freight and express delivery or small parcels. Many high-value goods are shipped by air, and even relatively low-value, heavy goods, such as automobile parts, are often shipped by air to minimize inventory and warehousing costs. General aviation aircraft are used for such commercial activities as agricultural applications (e.g., crop dusting), pipeline and utility line patrols, transportation of checks and records of commercial transactions, and on-demand air taxi and charter services.

CHAPTER 3

ECONOMIC IMPACTS

3.1 Definitions of Economic Impacts

Economic impacts measure the importance of aviation as an industry, in terms of the employment it provides and the goods and services it consumes. While the benefits described in Chapter 2 are the primary motive for airport development, economic impacts are beneficial results that help to generate and sustain public support for airports. The following definitions cover virtually every type of economic impact applicable to airports:

Direct impacts are consequences of economic activities carried out at the airport by airlines, airport management, fixed base operators, and other tenants with a direct involvement in aviation. Employing labor, purchasing locally-produced goods and services, and contracting for airport construction and capital improvements are examples of airport activities that generate direct impacts.

Some direct impacts, like airport employment, occur on site; others, like local production of goods and services for use at the airport, may occur off site. The distinguishing feature of a direct impact is that it is an immediate consequence of airport economic activity.

Strictly speaking, direct impacts should represent economic activities that would not have occurred in the absence of the airport. If it were determined that, without the airport, some on-site employees would be doing comparable work elsewhere in the region without displacing other workers, their employment should not be part of the airport's contribution to local economic activity. This would be significant in a region with full or near full employment, where airport employment might draw workers away from other employers in the region, who then have to operate their businesses with less labor than they would otherwise employ. A similar problem is posed by the possibility that, in the absence of the airport, the region might have developed alternative modes of

common carrier transportation more extensively and thus created employment opportunities for workers now employed at the airport.

As a practical matter, however, it will rarely be cost effective to develop a base-case scenario that depicts the economy of the region without the airport. The time and resources required for this exercise will seldom warrant the resulting improvement in the estimates of employment, payroll, and expenditure impacts.

Expenditures by airlines, fixed based operators, and tenants generate direct impacts, but only those that induce local business activity are relevant for a regional economic assessment. For this reason, it is important to distinguish between (a) the local value-added component of expenditures and (b) the regional import component. Thus, airline expenditures on fuel generate local fuel storage and distribution services and the importation of fuel into the region. In most parts of the country, only the former component is relevant for the analysis.

Similar considerations apply to the expenditures of gift shops, restaurants, and other airport businesses that purchase regional imports for resale. They may apply as well to airport construction and capital improvements.

Indirect impacts derive primarily from off-site economic activities that are attributable to the airport. These activities include services provided by travel agencies, hotels, restaurants, and retail establishments. These enterprises, like airport businesses, employ labor, purchase locally produced goods and services, and invest in capital expansion and improvements.. Indirect impacts differ from direct impacts in that they originate entirely off site. The same caveats regarding regional imports apply.

Like direct impacts, indirect impacts should theoretically represent economic activities that would not have occurred in the absence of the airport. For this reason, it would be desirable to distinguish between tourists (and other visitors) who would not have travelled to the region if there were no airport and those who would have come anyway by some other form of transportation. Only the former are really relevant for the estimation of indirect

impacts. Unfortunately, it is seldom feasible to make this distinction. As a result, the impacts of expenditures of tourists and other visitors arriving at the airport may be overstated, particularly for regions that are easily accessible by rail, bus, and automobile.

Induced impacts are the multiplier effects of the direct and indirect impacts. These are the increases in employment and incomes over and above the combined direct and indirect impacts, created by successive rounds of spending. For example, most of the take-home income earned by airport employees is spent locally. Some of this spending becomes income to local individuals who provide services to the airport employees. Some of the spending by airport employees goes to local businesses and becomes income to the business owners and their employees. Then part of these second-round incomes are also spent locally and thus become income to another set of individuals. As successive rounds of spending occur, additional income is created.

Although some of the induced impacts occur locally, some are felt outside the region because of regional import components of the goods and services purchased. It is important, therefore, that the specific multiplier factors selected for the analysis take regional imports into account. More economically self-sufficient regions have higher multipliers than do regions that are more dependent on regional imports, because more of the spending and respending is done in the area. Similarly, two or more counties considered together as one economic region will have higher multipliers than will each individual county. Suggestions for selecting and applying multipliers are presented later in this chapter.

Total impacts are the sum of the direct, indirect, and induced impacts.

Widespread adoption of the above definitions would contribute to the comparability of different airport impact assessments. The following sections indicate how these definitions can be useful to analysts in suggesting the kinds of data that should be collected and the ways in which these data should be analyzed.

3.2 Preliminary Estimates

This section presents rules of thumb for developing rough estimates of an airport's economic impacts, comparable to the rules of thumb cited in Section 2.3 for estimating benefits. More precise estimates may be obtained by using the methodology presented in Chapter 4.0.

Rules of thumb have been developed for two categories of airports:

1. Air carrier airports
2. General aviation airports

Air Carrier Airports

Step 1. determine employment at the airport.
If total airport employment is known, the analyst may proceed to Step 2. If airport employment is not known, it can be estimated by the following rule:

> For an airport serving more than 1 million passengers a year, with more than 10 operations employees and 100 or more total employees, the airport has 650 employees for every million commercial passengers a year, including through passengers. The uncertainty associated with this statistically derived coefficient (See Appendix A) can be indicated by a plus-and-minus 20 percent interval, with lower and upper limits of 520 and 780. For example, an airport with 10 million commercial passengers a year would almost certainly falling in the interval from 5,200 to 7,800. This rule does not apply to smaller commercial service airports, but it should be fairly easy to count employees directly at these facilities.

Note that this estimate does not include any large aircraft manufacturing or maintenance activity, which may account for substantial additional employment at some airports. These situations are discussed in Step 3.

Step 2. Convert airport employment into airport payrolls.

A review of airport impact studies indicates that annual airport payroll per employee at high activity air carrier airports is approximately $32,000 (in 1992 dollars). To continue the example started in Step 1, the airport's estimated payroll would then be 6,500 times $32,000, or $208,000,000. The lower and upper limits would be $166,400,000 and $249,600,000.

Step 3. Determine employment and payrolls at aviation-related businesses.

In some cases, an aviation manufacturing plant, aviation maintenance facility, or other type of aviation-related business is located on or near the airport site. If it is clear that such facilities would not have located in the region in the absence of the airport, their employment and payroll impacts should be included in the analysis. Because these impacts will not be captured by the rule of thumb in Step 1, employment and payroll data will have to be obtained directly from the facility operators.

Step 4. Calculate indirect impacts of the airport.

Indirect impacts are expenditures in the region for off-site services related to the airport. These include local taxes for non-corporate based aircraft and expenditures by travel agents. But the dominant off-site expenditures are made by visitors to the area for food, lodging, entertainment, local transportation, and related services. In most instances, visitor expenditures represent practically all of the region's indirect impacts. As with direct impacts, however, only expenditures for goods and services produced locally should be counted. The meat cooked and served by a local restaurant is likely to have originated outside of the region. In this case, only the cooking and serving represent local economic activity. Likewise, retail sales should be net of the cost of the merchandise itself if the items are produced outside of the region.

Annual visitor expenditures are calculated by multiplying expenditures per visitor by the number of visitors. If these

values have already been estimated with data from a recent survey of passengers, they should be used, provided that the expenditures are net of regional imports. If regional imports have not been deducted, a rough estimate of local value-added economic activity may be obtained by multiplying the unadjusted results by 0.55. (See Appendix B).

In the absence of a defensible estimate of annual visitor expenditures, a default value may be calculated by the following simple 6-step procedure.

a. Determine the population of the relevant region. This could be a metropolitan statistical area (MSA), a primary metropolitan statistical area (PMSA), a consolidated metropolitan statistical area (CMSA), a county, or two or more counties.

b. Determine the annual number of arriving passengers at the airport. If this figure is not available from local sources, a call to the Office of Airline Statistics, U.S. Department of Transportation (202/366-4373) should provide the number of arriving passengers from their 10 percent origin-destination (OD) survey. This number should then be multiplied by 10. This figure is usually equal to the total annual enplanements minus transfer passengers.

c. Divide the arriving passenger (AP) figure from Step b by the population figure (POP) from Step a. AP/POP is a rough measure of the extent to which an area attracts visitors, both business and pleasure. For example, as shown in Appendix B, AP/POP for Orlando, Florida is 6.7, whereas the AP/POP for Fargo, North Dakota is 1.3. If AP/POP is less than 1, the indirect impacts of the airport are likely to be negligible and should be ignored. This situation could be the result of heavy reliance by visitors and local travelers on a larger airport in a nearby metropolitan area.

d. If AP/POP is equal to or greater than 1, an estimate of the region's value-added expenditures per visitor may be obtained from Table 3-1. (The derivation of Table 3-1 is explained in Appendix B.) For example, for a region with a population of 300,000 and AP/POP of 3, the default value of expenditures per visitor is $220.

TABLE 3-1
Expenditures per Visitor
Adjusted for Regional Imports
1991=100

AP/POP Population (000)	<1	1	2	3	4	5	6	7	8
50	*	$165	$190	$215	$240	$264	$290	$314	$340
100	*	166	191	216	240	266	290	316	341
200	*	168	193	218	242	268	292	318	343
300	*	170	195	220	244	270	294	320	345
400	*	172	196	222	246	272	296	321	347
500	*	174	198	224	248	274	298	323	349
750	*	178	203	228	253	278	303	329	353
1000	*	183	208	233	258	283	308	333	358
1500	*	193	218	243	268	292	318	343	368
2000	*	202	228	252	276	302	327	353	377
2500	*	212	237	262	287	312	337	362	387
3000	*	222	247	272	297	322	347	372	397
3500	*	232	256	282	306	331	357	381	407
4000	*	241	266	291	316	341	366	391	416
5000	*	260	286	310	336	361	385	411	435
6000	*	280	305	330	355	380	405	430	455

e. The AP figure obtained from Step b includes local residents returning to the airport as well as outside visitors. To estimate the number of visitors, multiply the amount of AP traffic by 0.5. For visitor-dominated regions, a factor of 0.6 or 0.7 can be used. For airports that are used primarily by residents, a factor as low as 0.3 may be appropriate.

f. Finally, multiply the value obtained from Table 3-1 in Step d by the estimate of the annual number of visitors from Step e. The result will be a default value for the region's indirect impacts.

The 6-step procedure is illustrated by the following example for our hypothetical airport:

a. The metropolitan area has a population of 750,000.

b. The U.S. DOT 10-percent origin-destination survey shows that the annual number of arriving passengers at the airport is 500,000. Multiplying this figure by 10 provides an estimate of 5,000,000.

c. Division of the 5,000,000 arriving passengers by the population (750,000) yields an AP/POP of 6.67.

d. According to Table 3-1, a region with a population of 750,000 and an AP/POP of 6.67 has an estimated value-added expenditure per visitor of approximately $320 (two-thirds of the difference between $303 and $329).

e. Multiplication of the region's estimated AP (5,000,000) by 0.5 yields an estimate of 2,500,000 visitors to the region.

f Multiplication of $320, obtained from Table 3-1, and 2,500,000, the number of visitors, provides an estimate of regional indirect impacts of $800,000,000.

Step 5. Calculate induced impacts of airport and aviation-related employment and payrolls.

As defined in Section 3.1, induced impacts are the multiplier effects of employment, payroll, and other direct (and indirect) consequences of airport activity. Unfortunately, there is no single multiplier factor that applies to every region.

The appropriate multiplier factor depends on the degree of economic self sufficiency of the region, not on the level of airport activity. The more self dependent the region, the greater will be the extent to which expenditures by airports and airport employees keep turning over within the region, creating additional incomes with each new round of spending. On the other hand, the more dependent the region, the more it will spend on goods and services

imported into the region from other parts of the U.S. Because the size of the population of the region is a reasonable proxy for degree of self sufficiency, it is possible to relate multiplier factors to population size. Use of the following recommended factors requires a knowledge of the size of the population of the relevant region, which could be a metropolitan area, a county, etc.

Population	Multiplier Factor
<100,000	0.5
100,000 - 500,000	0.6
500,000 - 3,000,000	0.75
>3,000,000	1.0

These multiple factors are based on a series of studies conducted by Wilbur Smith Associates.

For our hypothetical airport, a multiplier factor of 0.75 is appropriate, because the region has a population of 750,000. Applying this multiplier to the airport payroll, estimated in Step 2 at $208,000,000, yields an induced impact of $156,000,000. When the multiplier factor is applied to the airport's indirect impacts, estimated in Step 4, additional induced impacts of $600,000,000 are obtained. Total induced impacts are thus estimated to be $756,000,000.

Step 6. Calculate total economic impacts.

Finally, the total annual economic impact of the airport is estimated as the sum of the direct, indirect, and induced (multiplier) impacts. For our hypothetical airport, the total impact is calculated as follows:

Direct	$208,000,000
Indirect	800,000,000
Induced	756,000,000
Total	$1,764,000,000

Although the total economic impact of $1.8 billion a year for the hypothetical airport may seem large, it is actually an underestimate, because airport payrolls are the only direct impacts considered. Other expenditures by airlines, fixed base operators, and tenants are not included in the analysis. These expenditures should be added to the direct economic impacts whenever the data are available.

General Aviation Airports

At an airport where the principal use is by general aviation, the steps outlined above, with the exception of Step 4, should be followed. For most GA airports, the number of arriving passengers is unlikely to generate appreciable indirect impacts. In Step 1, employment and payroll data may be available from the airport manager. The scant data on GA airports suggests a rough ratio of one employee for every 7.2 based aircraft,[4] but this may be lower at small airports and higher at large ones. Local expenditures may also be determined and added to the direct payroll impacts. Steps 2, 3, 5 and 6 could then be carried out as described above.

Table 3-2 illustrates the application of rule-of-thumb procedures to airports of various activity levels. These activity levels correspond to those in Table 2-2. The principal advantage of the rules of thumb proposed in this section is that their implementation requires little time and a minimum of resources. However, they yield only rough approximations. A methodology for conducting a more thorough impact assessment is presented in the next chapter.

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[4]From data on fixed base operators by employment-size class, reported in the 1980 Survey of Airport Services (23), median FBO employment, including the FBO manager, is 4.5 for the nation as a whole. The average number of FBO's per airport is 1.1. Average FBO employment at an airport is thus 1.1 times 4.5, or approximately 5.0. The average number of permanently based aircraft per airport is 36.2. This figure divided by the average airport FBO employment of 5.0 yields a ratio of 7.2 based aircraft per FBO employee.

TABLE 3-2

APPROXIMATE IMPACTS FOR VARIOUS ACTIVITY LEVELS[1]

Based Aircraft	Total Annual Commercial Passengers (including through passengers)	Estimated Employment	Payroll per employee[2]	Total payroll	Induced income[3]	Direct Plus Induced income
10	0	1	$29,000	$29,000	$14,500	$43,500
20	0	3	29,000	87,000	43,500	130,500
50	0	7	29,000	203,000	101,500	304,500
100	0	14	29,000	406,000	203,000	609,000
50	50,000	42	29,000	1,218,000	609,000	1,827,000
100	100,000	84	29,000	2,436,000	1,218,000	3,654,000
100	1,000,000	840	29,000	24,360,000	12,180,000	36,540,000

[1]Direct impacts in table include only employment and payrolls. Expenditures should be added if available.

[2]The figure of $22,000 used in the earlier report was adjusted to reflect the 1992 cost of living.

[3]In the examples shown in this table, it is assumed that 0.5 is the appropriate multiplier factor to be applied to the direct impact.

Chapter 4

Preparation of an Economic Impact Assessment

This chapter describes the methodology for conducting a detailed economic impact study. It identifies the phases in assessing an airport's economic impact and offers suggestions for implementing them. Particular emphasis is given to the preparation of the study design (Phase 2). Each phase is made up of specific tasks. Although the order in which the tasks are discussed suggests a chronological scheduling of research effort, the tasks can often be carried out simultaneously or in some other order. Because of the relative complexity of the process and the extensive research and data collection that may be required, an individual or a small organization may not have the necessary expertise and resources to carry out a detailed assessment, and professional assistance may be required.

Phase 1. Preliminary Planning

The planning phase of the assessment is critical, because it articulates the purpose and thus defines the orientation of the research effort. The planning phase also identifies the resources to be employed in carrying out the project. Phase I includes the following tasks:

Stating the Purpose of the Assessment

A statement of the purpose of the project will typically reflect some actual or perceived requirement. This could be a regulatory mandate related to airport development planning, or it might be a need to document an airport's economic contribution to an area to gain financial and/or political support for the facility.

The statement of purpose should indicate the target audience, e.g., state aviation officials, state and local elected officials, or the general public. If more than one audience is anticipated, it may be appropriate to publish the report in more than one format.

Formulating the Research Questions

The planning phase should specify the kinds of information, both general and specific, to be included in the final report. This information should include estimates of direct, indirect, induced, and total impacts. An examination of some prior studies would be helpful in identifying additional, more specific kinds of information. Various studies have included such data as the average value of homes owned by airport employees, the average monthly rent paid by airport employees, the total number of people being supported by airport payrolls, and the annual expenditures of airport employees for food, housing, clothing, medical care, etc.

The regions to be covered by the study should be identified. Studies that identify the geographical boundaries of the affected regions can state their findings with greater specificity than those that do not.

It might be useful to assess future consequences as well as current impacts. This would be particularly useful for the preparation of airport master plans. Given this requirement, researchers would collect projections of such variables as enplaned passengers, airport employment, airport payrolls and expenditures, airport construction, air cargo, and general aviation operations.

Selecting the Project Resources

If the initiating agency does not have the time or the expertise to carry out the assessment project, all or part of the work can be contracted out. The selection of project resources will be shaped by the complexity of the task and the sponsoring agency's experience in conducting similar studies. Credible research has been performed by state agencies, trade associations, universities, and consulting firms.

Reviewing the Literature

If the project team is unfamiliar with the airport impact literature, a selective review of it is recommended. For an excellent example of the application of the suggestions offered in

our original 1986 FAA guidelines, the reader is referred to IMPACT! The Economic Impact of Civil Aviation on the U.S. Economy, prepared by Wilbur Smith Associates (24). A literature survey will suggest the kinds of data that are available and their sources. The literature falls into two general categories: methodologies and specific studies.

While some of the methodological literature emphasizes overall research strategy, some provides specific suggestions regarding the design of questionnaires (1), (3), (17) (25). Some methodological advice is restricted to the economic impacts of general aviation airports (8), (19).

Studies of the economic impacts of specific airports have been carried out for virtually every type of airport. These include large hub airports, e.g., (4), (16), medium hub airports, e.g., (2), (20), small hub airports, e.g., (14), (21), and reliever and general aviation airports, e.g., (10), (12).

Phase 2. Development of the Study Plan

Development of the study plan entails defining the questions to be answered, the alternative methods of answering them, and then selecting specific procedures for collecting and analyzing data. If possible, it should be designed by the organization that will implement it. A contractor should develop the study plan in collaboration with the sponsoring agency to ensure that the research contributes effectively to the goals of the study. The methodology should be organized in terms of the tasks of estimating the airport's direct, indirect, induced, and total economic impacts as follows:

Direct Impacts

The starting point should be a clear statement of the impacts to be estimated. In general, an airport's direct impacts are the immediate economic consequences of employing labor, purchasing locally-produced goods and services, and contracting for airport construction and capital improvements by airlines, fixed base operators, aviation-related facilities, and other businesses

operating at the airport. Direct impacts originate at the airport, but some, like expenditures for locally-produced supplies, are felt away from the airport site. Decisions can then be made regarding which impacts to quantify.

The direct impacts selected for quantification should then be linked with specific impact measures. The principal measures of on-site direct impacts are airport employment, airport payrolls, and expenditures for capital construction. Measures of off-site direct impacts include airport expenditures for materials, equipment, fuel, and utilities.

Data should be collected directly from businesses such as airlines, concessions, fixed base operators, air cargo operators, other airport tenants, and aviation-related businesses. If project resources permit, personal interviews are preferable to mailed questionnaires, because they ensure that each question is understood and answered completely and unambiguously.

Although the survey probably should be tailor-made to accommodate the unique characteristics of the airport being studied, the study plan should provide for the study of questionnaires that have been used in other airport impact assessments. (These are often presented in appendices of reports.)

The following kinds of information regarding each airport tenant are likely to be useful in subsequent analysis, and these should be specified:

1. Type of business (airline, rental car agency, restaurant, gift shop, fixed base operator, air freight operator, etc.)

2. Number of employees working at the airport or providing support services

3. Total annual payroll of these employees

4. Local expenditures during the past year on services, materials and equipment, including vehicle fuel,

aviation fuel, maintenance and repair, advertising, electricity, telephone service, and capital improvements at the airport.

5. Annual total dollar sales (especially if the RIMS II approach is to be used; see pp. 32-33.)

The end product of this task should be a set of data on such variables as airport employment, payrolls, sales and expenditures. These data, along with data on indirect impacts, will be components of the total estimated impacts. They will also be used in the estimation of induced impacts.

Indirect Impacts

The study design should outline procedures for measuring impacts derived from economic activities of off-site enterprises that serve the airport's users, e.g., travel agencies, hotels, restaurants, and retail stores. Like airport businesses, they too employ workers, purchase locally produced goods and services, and invest in capital projects.

Travel agency data may be collected directly by interview or a mailed questionnaire. If the region has a large number of travel agencies, a sample survey should be considered. The kind of information to be obtained is essentially the same as that collected from airport tenants, i.e., data on employment, payrolls, and expenditures. It is particularly important that the agencies estimate the percentage of their business that is related to local use of the airport.

Data on local expenditures of tourists and other visitors to the area who arrive at the airport can be estimated by a survey of hotels and travel agencies or obtained by an air passenger survey. Prior to the survey, a meeting should be held with airport management to gain its cooperation and to plan a sampling procedure that will not interfere with airport operations. Passenger surveys are often regarded as intrusive and every effort should be made to keep them as brief and painless as possible, while maintaining statistical validity and obtaining the necessary information.

Information to be requested from departing non-local passengers should include the following:

1. Principal purpose of visiting the area (business, convention, vacation, etc.)

2. The number of trips to the airport in the past year

3. The number of days spent in the area

4. The approximate sums of money spent locally on lodging, food and beverages, gifts, entertainment, transportation, etc.

These sample data are then the basis for extrapolating total annual expenditures by tourists and other visitors to the area. The expenditure patterns of hotels, restaurants, and other enterprises that cater to visitors do not have to be determined unless, as discussed below, highly refined estimates of induced impacts are desired.

The final output of this task should be a set of estimates of such measures as

(1) airport-related employment, payrolls, and local expenditures of travel agencies, and

(2) annual expenditures of tourists and other visitors for lodging, food, entertainment, gifts, etc.

Induced and Total Impacts

The study design should specify a procedure for measuring induced impacts, the result of successive rounds of spending that originate with the direct and indirect impacts discussed above. The sum of the direct, indirect, and induced impacts represents the total employment and income impacts of the airport.

Induced impacts are typically measured by multiplying the sum of the direct and indirect impacts by some factor. Some past studies

applied different multiplier factors to individual components of direct and indirect impacts. As discussed above, multiplier values should reflect the peculiar economic characteristics of the region in which the airport is located, especially the extent to which the region is economically self sufficient. Development of the study design requires consideration of the following three options for estimating induced impacts: the economic base model, an econometric model, and a regional input-output model.

One approach to estimating regional multipliers is the economic base model (13). This model relates changes in goods sold within the region ("nonbasic" or "service") to changes in goods sold outside the region ("basic"). This model is simple in theory and inexpensive to construct. However, because it divides local economic activity into only two broad categories, the economic base multiplier is an average for the entire basic sector, and this may not accurately reflect the specific induced consequences of the airport's direct and indirect impacts. In addition the classification of a region's industries as either basic or service is somewhat arbitrary. For example, manufacturing, which is typically classified as a basic sector, often has some local orientation, e.g., food processing and printing. Also, banking, a service sector, may serve a market larger than the region being studied. Despite these limitations, however, the economic base model has been widely used for regional economic analysis.

A second approach is to develop an econometric model of the region that quantifies the relationships among a number of key economic variables, e.g., income, consumption expenditures, and the regional price level (13). These models are similar in nature to macroeconomic models of national economies and are usually based on time series data. Regression analysis is the principal statistical tool used to estimate the economic relationships. Regional econometric models are capable of estimating a single multiplier, and this can then be applied to the estimated direct and indirect impacts to derive the total economic impacts of the airport. Assistance for developing or applying this kind of model can typically be obtained from an economic consulting firm or a university.

Econometric models developed for regional analysis have two principal limitations. First, most of the required data are often available only at the state and metropolitan area levels. County level modeling may thus not be possible. Second, regional models tend to be costly to develop in terms of time and labor.

A third approach is to use an input-output (I-O) framework of analysis. This is particularly useful for taking into account the dependency of each economic sector on every other sector. This approach will also yield estimates of the differential multiplier effects of direct and indirect impacts on separate regional sectors.

Regional I-O models can be constructed with region-specific data, but they are frequently based on a national I-O table. Adjustments are then made on the basis of key differences between the region's economy and that of the nation. Because the development of a regional I-O model requires a great amount of detailed data analysis and a knowledge of I-O theory, it may be appropriate to seek assistance from a consulting firm or university research unit with experience in I-O analysis.

An alternative solution is to purchase multiplier factors estimated for the region from the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. These factors are available for any county or set of contiguous counties in the United States. At present (1992), the cost of these multipliers is $1,500 per region, regardless of the number of counties in the region.

The BEA's Regional Input-Output Modeling System (RIMS II) multipliers are derived from the national input-output (I-O) table, which shown the input and output structure of 531 U.S. industries. The national I-O matrix is made region specific by the use of location quotients, which are measures of a regional industry's share of total regional economic activity relative to that industry's share of national economic activity. A technical discussion of the derivation of the RIMS II multipliers is found in the BEA's Regional Input-Output Modeling System (22). RIMS II multipliers have been used in impact studies of a number of airports, e.g., Anchorage International Airport (5), Jacksonville

International Airport (7), Roanoke Regional Airport (18), and Washington National Airport (11).

Each set of RIMS II multipliers includes three tables: an employment multiplier table, a total earnings multiplier table, and a total multiplier table. In addition, BEA will provide a household direct coefficient table upon request. The total earnings multipliers are the most relevant for the economic impact assessment. They can be applied to either a general category of expenditures, e.g., airline expenditures, or to specific expenditure items, e.g., airline expenditures on up to 39 separate classifications of items, e.g., fuel and maintenance and repair. More refined estimates of multiplier effects can be obtained by applying separate multipliers to individual expenditure components.

RIMS II multipliers can thus be used to estimate the airport's total impact on employment and income, both for the region as a whole, and, if desired, for specific industries within the region. It should be noted that the application of the RIMS II multipliers leads directly to total impacts and does not identify induced impacts explicitly. These, however, can be calculated by simply subtracting direct and indirect impacts from the total. An example of the use of RIMS II multipliers is presented in Appendix C.

Impacts of Increased Activity

One of the most useful aspects of the study may be to estimate the economic impacts of future changes in the use of the airport, particularly as the result of increased passenger traffic. An airport's economic impacts, like its benefits, can be expected to change over time as airport activity changes. Economic impacts can be projected into the future by using the estimated relationship between airport employment and the number of commercial passengers shown in Figure A-1 in Appendix A. However, an adjustment should be made to reflect productivity improvements that are expected in the economy. Productivity increases on the order of two percent per year in airline costs and employment and one percent per year in other sectors may be anticipated.

Phase 3. Implementation of the Study Plan

The actual conduct of the research will reflect the emphasis, availability of data, and time and resources available. Some general program management techniques are useful in scheduling and coordinating the effort. Diagrams of the sort used by such network techniques as the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT) are particularly useful for ensuring that tasks are performed in the proper sequence and completed in a timely manner.

Additionally, provisions should be made for frequent assessments of the various tasks within the study plan. Revisions and adjustments to the study plan and schedule may be necessitated by unforeseen early successes or problems.

Phase 4. Presentation and Review of the Economic Assessment Report

The successful completion of the study should result initially in a draft technical report suitable for review. The draft report should be a detailed account of the purpose of the study, analytical techniques employed, data analyzed, and the conclusions of the research. Subsequently, the comments on the draft report should be incorporated into the final technical report.

The review process can be very helpful both in assuring the accuracy of the results and in increasing the general acceptability and eventual use of the study. If possible, individuals or organizations who have specific knowledge of the situation or who may be affected by the study should provide comments.

Finally, an effort should be made to publicize and distribute the results of the study. A brief, well illustrated brochure should present the results in easily understood terms. The brochure should be suitable for inexpensive reproduction, as a large number will be distributed. A briefing package, with a series of slides or viewgraphs and an accompanying script, can be used by airport management to present the study results to local officials, service organizations, and the general public. A 15-minute presentation is usually suitable. An initial program to introduce the study

findings may include a press release, a briefing for representatives of the media, and a letter report to interested parties. Magazine or newspaper inserts may be prepared and financed by advertising from airport tenants and their suppliers. Reports for distribution to the general public are typically short brochures that present the principal findings of the research.

CHAPTER 5

SUMMARY

Analytical techniques are available to quantify the transportation benefits and the economic impacts of airports. Rules of thumb, consistent with those analytical techniques, can provide preliminary but imprecise estimates by relating airport activity to benefits and to economic impact in terms of the jobs and payroll that result from the airport. Table 4-1 illustrates typical figures for airports with various activity levels.

Table 4-1

APPROXIMATE BENEFITS AND IMPACTS FOR VARIOUS ACTIVITY LEVELS

	Benefits				Direct Plus Induced Impact
Based Aircraft	Annual Commercial Passengers	Value of Time Saved	Reduction in Travel Cost	Total Annual Benefit	Annual Payroll
10	0	$99,900	$23,400	$123,300	$43,500
20	0	199,800	46,800	246,600	130,500
50	0	499,500	117,000	616,500	304,500
100	0	999,000	234,000	1,233,000	609,000
50	50,000	1,165,500	507,000	1,672,500	1,827,000
100	100,000	2,331,100	1,014,000	3,345,100	3,654,000
100	1,000,000	14,319,000	8,034,000	22,353,000	36,540,000

Source: Tables 2-2 and 3-1.

APPENDIX A

Relation between Airport Employment and Commercial Passengers

The rule of thumb presented in Section 3.2 for estimating an airport's employment on the basis of annual commercial passengers, including through passengers, is developed from simple regression analysis. Figure A-1 shows the plot of points and the estimated regression line for the 64 airports in the sample (Table A-1). The equation of the regression line is

Airport employment = 650.5*passengers (millions),

where passengers are the sum of arriving plus departing travelers.

The r-square between observed and predicted airport employment is 0.80. The t value of 9.8 indicates that the regression coefficient is statistically significant at the 1 percent level. It will be noted that the equation was estimated through the origin for simplicity. In a separate regression that permitted an intercept term, the difference between the estimated intercept and zero was found to be not statistically significant.

FIGURE A-1: AIRPORTS WITH MORE THAN ONE MILLION PASSENGERS

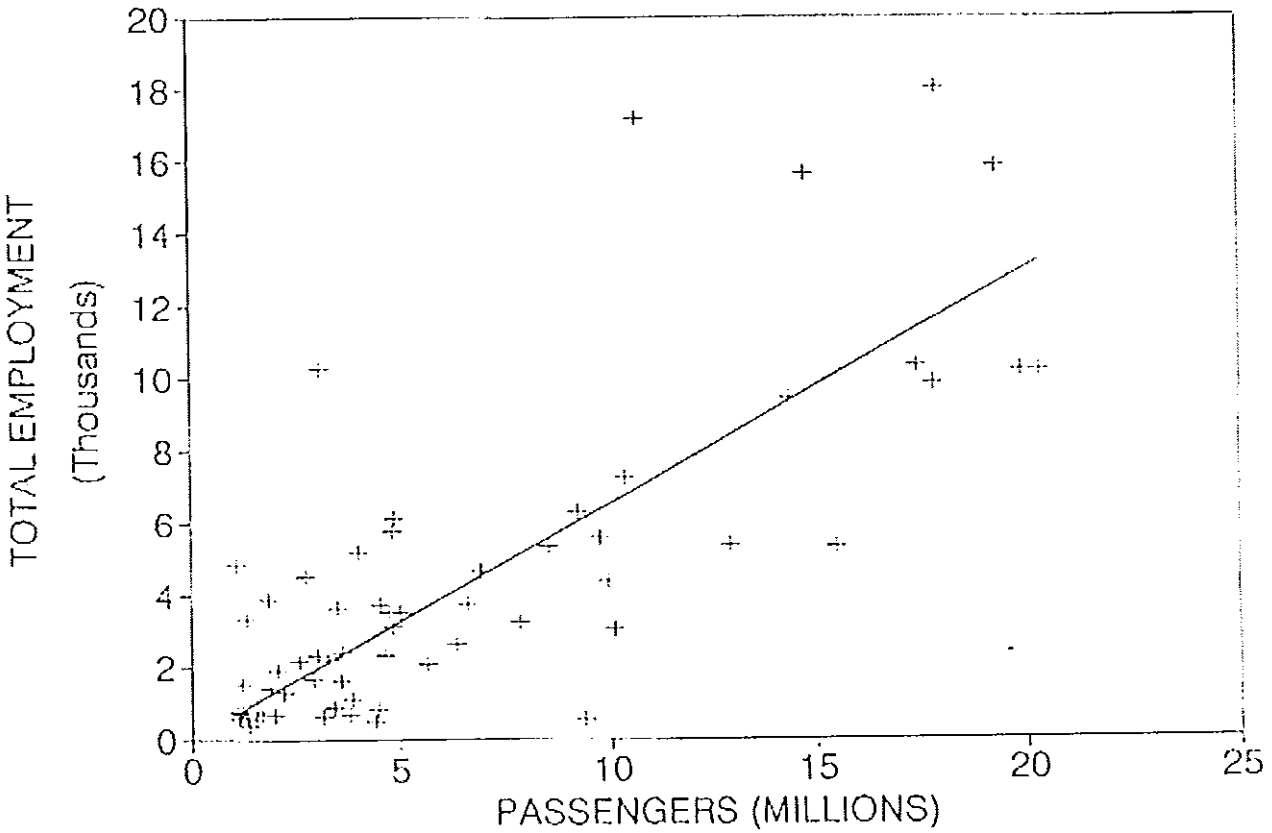

TABLE A-1
AIRPORTS WITH MORE THAN 1 MILLION PASSENGERS

STATE	AIRPORT	TOTAL EMPLOYMENT	MILL. OF PASSENGERS
MO	St. Louis-Lambert	10214	20.299
MI	Detroit Metro-Wayne	10200	19.881
HI	Honolulu International	15826	19.329
MN	Minneapolis-St. Paul	18041	17.923
AZ	Phoenix-Sky Harbor	9850	17.818
PA	Greater Pittsburgh	10332	17.434
NV	Las Vegas McCarran	5300	15.509
TX	Houston International	15659	14.798
WA	Sea Tac International	9463	14.356
NC	Charlotte	5406	12.944
TN	Memphis International	17190	10.681
DC	Washington-Dulles	7270	10.387
CA	San Diego	3027	10.118
FL	Tampa International	4402	9.984
UT	Salt Lake City Intl	5600	9.787
MO	Kansas City-International	528	9.396
MD	Baltimore Washington International	6311	9.255
FL	Ft. Lauderdale-Hollywood	5350	8.582
TX	Houston Hobby	3232	7.869
LA	New Orleans International	4662	6.964
OH	Cleveland Hopkins	3765	6.638
TN	Nashville Metropolitan	2649	6.355
CA	San Jose International	2077	5.667
TX	San Antonio International	3500	5.028
TX	Dallas Love	6143	4.877
NC	Raleigh-Durham	3140	4.855
IN	Indianapolis International	5791	4.850
OH	Dayton International	3500	4.762
FL	Palm Beach International	2312	4.636
CA	Ontario International	3717	4.543
NM	Albuquerque International	828	4.467
CA	Santa Ana-John Wayne	495	4.418
CA	Oakland International	5200	4.019
TX	Austin-Mueller	1098	3.867
CA	Sacramento Metropolitan	649	3.793
OH	Port Columbus Intl	2400	3.612
WI	Milwuakee-Gen. Mitchell	1621	3.580
NY	Buffalo International	3650	3.523
NV	Reno Cannon	850	3.426
VA	Norfolk International	2195	3.330
CA	Burbank-Glendale-Pasadena	606	3.171
AZ	Tucson International	10220	3.152
OK	Oklahoma City-Will Rogers	2312	3.039
FL	Jacksonville International	1636	2.931
AK	Anchorage	4530	2.753
FL	Ft. Myers-Southwest Fla	2150	2.584
NE	Omaha-Eppley	1288	2.243
KY	Louisville-Standiford	1240	2.214

TABLE A-1 (continued)
AIRPORTS WITH MORE THAN 1 MILLION PASSENGERS

STATE	AIRPORT	TOTAL EMPLOYMENT	MILL. OF PASSENGERS
NC	Greensboro	1889	2.070
RI	Warwick-T F Green State	642	1.993
VA	Richmond International	1401	1.907
AL	Birmingham Municipal	3880	1.875
WA	Spokane International	700	1.697
FL	Sarasota-Bradenton	763	1.583
IA	Des Moines International	543	1.573
CO	Colorado Springs	376	1.407
KSB	Wichita Mid-Continent	3311	1.372
MI	Grand Rapids-Kent	600	1.357
TN	Knoxville-McGhee Tyson	714	1.219
CA	Long Beach	1550	1.214
SC	Columbia Metropolitan	793	1.208
TX	Midland Regional	580	1.159
GA	Savannah	4822	1.114
SC	Greenville Spartanburg	728	1.111

APPENDIX B

Derivation of Table 3-1 for Estimating Expenditures Per Visitor

The values in Table 3-1 are based on a statistical relationship between expenditures per visitor (EPV), regional population (POP), and number of arriving passengers (AP) for 35 airports. Data on expenditures per passenger were obtained from IMPACT, Wilbur Smith Associates, 1989. This sample includes a wide range of airport sizes and represents airports from many regions of the country. The original data set is presented in Table B-1.

Table B-1

ORIGINAL DATA SET

Id	City	St	$Exp/visitor	Population (000)	AP (000)
ANC	Anchorage	AK	437	227	495
PHX	Phoenix	AZ	726	1715	5910
BUR	Burbank	CA	383	12372	1395
LAX	Los Angeles	CA	543	12372	13600
ONT	Ontario	CA	403	12372	1890
SFO	San Francisco	CA	631	5684	9070
SBP	San Luis Obispo	CA	566	208	30
STS	Santa Rosa	CA	498	5684	2190
DCA	Washington	DC	492	3430	6670
IAD	Washington	DC	600	3430	1755
MCO	Orlando	FL	654	824	5485
ATL	Atlanta	GA	429	2380	7160
BOI	Boise	ID	324	189	430
ORD	Chicago	IL	647	8035	10900
BOS	Boston	MA	317	4027	8490
MSP	Minneapolis	MN	191	2231	4095
BIS	Bismarck	ND	168	86	125
DVL	Devil's Lake	ND	115	13	0
FAR	Fargo	ND	145	143	190
GFK	Grand Forks	ND	175	69	70
JMS	Jamestown	ND	143	24	0
MOT	Minot	ND	163	61	85
RKS	Rock Springs	WY	172	43	5
ISN	Williston	ND	143	24	5
LAS	Las Vegas	NV	354	536	5005
BUF	Buffalo	NY	247	1205	1475
ISP	Long Island	NY	671	17677	475
EWR	New York	NY	706	17677	8270
JFK	New York	NY	706	17677	3885
LGA	New York	NY	706	17677	8710
RDM	Redmond-Bend	OR	206	71	35
MDT	Harrisburg	PA	212	570	335

Table B-1 (cont.)

Id	City	St	$Exp/visitor	Population (000)	AP (000)
PHL	Philadelphia	PA	418	5755	4590
PIT	Pittsburgh	PA	288	2372	2985
DAL	Dallas	TX	191	3348	1800

Consolidation of the data in Table B-1 was required because of the inclusion of some large, multi-airport metropolitan areas. There are data for three of the five greater Los Angeles airports (LAX, ONT, BUR), for all four significant New York City airports (EWR, JFK, LGA, ISP), both Washington, D.C. airports, O'Hare but not Midway in Chicago, and Dallas Love but not DFW in Dallas-Fort Worth. In some cases there were separate EPV estimates by airport, but there was a single number for the three NYC airports.

For each of these large metropolitan areas, one observation was constructed for use in the statistical analysis. The consolidated metropolitan statistical area (CMSA) population and the number of arriving passengers for all airports in the CMSA were used. The EPV is an average of individual EPVs, weighted by the individual numbers of arriving passengers. Missing airports, such as LGB and SNA in Los Angeles, were assumed to satisfy the average calculated for the airports for which there were data. This may be a problem for the Dallas observation, where our data are for the smaller airport, which is also the one that might be preferred by the more cost-conscious travelers. The results of this data consolidation are presented in Table B-2, which served as the final data set for the statistical analysis.

Table B-2

FINAL FORM OF THE DATA SET

Id	City	St	$Exp/visitor	Population (000)	AP/Pop	AP (000)
LAS	Las Vegas	NV	354	536	9.34	5005
MCO	Orlando	FL	654	824	6.66	5485
PHX	Phoenix	AZ	726	1715	3.45	5910
ATL	Atlanta	GA	429	2380	3.01	7160
	Washington metro	DC	532	3430	2.46	8425
SFO	San Francisco	CA	631	5684	2.29	13025
BOI	Boise	ID	324	189	2.28	430
ANC	Anchorage	AK	437	227	2.18	495

TABLE B-2 (cont.)

Id	City	St	$Exp/visitor	Population (000)	AP/Pop	AP (000)
DAL	Dallas metro	TX	191	3348	2.15	7210
BOS	Boston	MA	317	4027	2.11	8490
MSP	Minneapolis	MN	191	2231	1.84	4095
	Chicago metro	IL	647	8035	1.62	13040
	Los Angeles metro	CA	530	12372	1.56	19275
BIS	Bismarck	ND	168	86	1.45	125
MOT	Minot	ND	163	61	1.39	85
FAR	Fargo	ND	145	143	1.33	190
PIT	Pittsburgh	PA	288	2372	1.26	2985
BUF	Buffalo	NY	247	1205	1.22	1475
	New York metro	NY	705	17677	1.21	21340
GFK	Grand Forks	ND	175	69	1.01	70
PHL	Philadelphia	PA	418	5755	0.80	4590
MDT	Harrisburg	PA	212	570	0.59	335
RDM	Redmond-Bend	OR	206	71	0.49	35
STS	Santa Rosa	CA	498	5684	0.39	2190
ISN	Williston	ND	143	24	0.21	5
SBP	San Luis Obispo	CA	566	208	0.14	30
RKS	Rock Springs	WY	172	43	0.12	5
DVL	Devil's Lake	ND	115	13	0.00	0
JMS	Jamestown	ND	143	24	0.00	0

A regression of EXP on POP and AP/POP produced the following result:

$$EPV = 208 + .029*POP + 37.4* (AP/POP)$$

The R squared is 0.49, and the coefficients are significant at the 5 percent level. The regression results are the basis of Table B-3.

TABLE B-3
EXPENDITURES PER VISITOR
1987=100

AP/POP Population (000)	<1	1	2	3	4	5	6	7	8
50	*	$247	$284	$322	$359	$396	$434	$471	$509
100	*	248	286	323	360	398	435	473	510

TABLE B-3 (cont.)

AP/POP Population (000)	<1	1	2	3	4	5	6	7	8
200	*	251	289	326	363	401	438	476	513
300	*	254	292	329	366	404	441	479	516
400	*	257	294	332	369	407	444	481	519
500	*	260	297	335	372	410	447	484	522
750	*	267	304	342	379	417	454	492	529
1000	*	274	312	349	387	424	461	499	536
1500	*	289	326	364	401	438	476	513	551
2000	*	303	341	378	416	453	490	528	565
2500	*	318	355	393	430	468	505	542	580
3000	*	332	370	407	445	482	519	557	594
3500	*	347	384	422	459	496	534	571	609
4000	*	361	399	436	474	511	548	586	623
5000	*	390	428	465	503	540	577	615	652
6000	*	419	457	494	532	569	606	644	681

It will be noted that the expenditures per visitor in Table B-3 are in 1987 dollars. Between 1987 and December, 1991, however, the consumer price index (CPI) increased by 21.4 percent. Table B-4 reflects this increase in the CPI.

TABLE B-4
EXPENDITURES PER VISITOR
1991=100

AP/POP Population (000)	<1	1	2	3	4	5	6	7	8
50	*	$300	$345	$391	$436	$481	$527	$572	$618
100	*	301	347	392	437	483	528	574	619
200	*	305	351	396	441	487	532	578	623
300	*	308	354	399	444	490	535	582	626
400	*	312	357	403	448	494	539	584	630
500	*	316	361	407	452	498	543	588	634
750	*	324	369	415	460	506	551	597	642
1000	*	333	379	424	470	515	560	606	651
1500	*	351	396	442	487	532	578	623	669
2000	*	368	414	459	505	550	595	641	686
2500	*	386	431	477	522	568	613	658	704

TABLE B-4
EXPENDITURES PER VISITOR
1991=100

AP/POP Population (000)	<1	1	2	3	4	5	6	7	8
3000	*	403	449	494	540	585	630	676	721
3500	*	421	466	512	557	602	648	693	739
4000	*	438	484	529	575	620	665	711	756
5000	*	473	520	565	611	656	700	747	792
6000	*	509	555	600	646	691	736	782	827

A final adjustment was required to make the expenditures per visitor reflect regional economic activity only and not a mixture of regional economic activity plus regional imports. This was done by a 4-step procedure as follows:

1. Data on how visitor expenditures are divided among major spending categories were obtained from 11 airport impact studies. The median percentages for medium-sized airports are 34 percent for lodging, 27 percent for restaurants, 15 percent for retail establishments, 12 percent for entertainment, and 12 percent for local transportation. For all five categories of visitor spending, there was very little difference between large and medium-sized airports.

2. For each of the five spending categories, it was assumed that "value added," as reported in the U.S. Department of Commerce's input-output tables, originates locally. "Value added" is the sum of employee compensation, indirect business taxes (e.g., property taxes), profit, and net interest. As percentages of total output, the value added for lodging is 60 percent, for restaurants 40 percent, for retail establishments 70 percent, for entertainment 50 percent, and for local transpiration 70 percent.

3. The value added percentages from Step 2 were averaged, using the visitor expenditure percentages from Step 1 as weights. The resulting weighted average is 0.55.

4. Each entry in Table B-4 was multiplied by 0.55 to obtain estimates of visitor expenditures that represent local economic activity. The results are the entries in Table 3-1 in the text.

APPENDIX C

ESTIMATING ECONOMIC IMPACTS USING THE RIMS II MULTIPLIERS

This appendix describes the RIMS II multipliers, describes the manner in which they are used, and presents a sample set of calculations for determining regional impacts.[1] RIMS II multipliers are intended to show the total regional effects on industrial output, personal earnings and employment for any county or group of contiguous counties in the United States resulting from any industry activity. Industry descriptions are defined according to the 1977 Bureau of Economic Analysis (BEA) national input-output tables. Induced impacts for any airport-related businesses can be estimated by applying the RIMS II multipliers to activities within the air transportation industrial sector.

RIMS II multipliers are given in three tables: total output multipliers, earnings multipliers, and employment multipliers. In addition, BEA will also provide a household direct coefficient table upon request. The total output multiplier table is used to compute the total impact of a change in demand. These multipliers identify the demands placed on a particular region from the future growth of a business activity. The earnings multipliers measure the impacts on earnings (income) and employment. The employment multipliers are used in calculating the total number of jobs created by final changes in demand. Of the three sets of multipliers, the earnings multipliers are the most suitable for estimating the economic impacts of a particular business activity. The direct coefficient table can be used to determine sales of a particular regional industry when airport expenditures are the only available information.

Each aviation business related to a targeted airport is assigned a Standard Industrial Classification code. The aviation-related business is identified with a corresponding RIMS II code number. Table C-1 presents business activities that are most likely encountered in aviation-related economic studies. These activities can be matched with corresponding RIMS II code numbers. The RIMS II code number will identify the specific multiplier factor to be applied to the affected business.

The RIMS II model uses sales by aviation businesses to estimate the final demand at targeted airports. Business activities are evaluated and defined according to their level of economic

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[1]Much of this discussion is drawn from Douglas S. McLeod, Recommended Regional Economic Impact Procedures for Aviation Related Projects, Draft Report for Presentation to the Transportation Research Board Annual Meeting, January, 1987 (15).

consequences to the targeted airport. These activities are grouped into direct and indirect impacts. Business information gathered at each airport includes:

1. magnitude of sales
2. size of purchase
3. identity of purchase
4. number of employees
5. size of payroll

In general, sales should be multiplied by RIMS II multipliers to determine economic impacts. However, if data are lacking for some specific types of business activity, other information,such as expenditures, payroll earnings and number of employees can be used. The following calculations illustrate the RIMS II methods of computing economic impacts from data on airport sales, payroll and employment.

Table C-1

AVIATION RIMS II CODE NUMBERS

Business	RIMS II Number
AIRPORT MANAGEMENT	
Administration	650500
Construction	110400
AIRLINES	650500
FIXED-BASED OPERATORS	
Aircraft Servicing	650500
Aircraft Rental	720300
Aerial Spraying	010100
FEDERAL FACILITIES	
Air National Guard	780400
Air Traffic Control	650500
Airport Mail Facilities	650500
Airways Facilities	650500
Armed Forces	780400
Customs Patrol	650500
Forestry Service	040000
Weather Service	730300
ONSITE AVIATION-RELATED	
Advertising	730300
Aircraft Manufacturing	600100
Aircraft Sales (retail)	690200
Airport Parking	750000
Airport Security	650100
Airport Terminal Services	650500
Auto Rental	750001
Auxiliary Aircraft Parts Manufacturing	600400
Aviation School	770402
Avionics Manufacturing	620100
Avionics Repair	730300
Barber Shops	720200
Book Stores	690200
Building Maintenance and Cleaning	730100
Coin-Operated Amusement	760200
Drinking Places	740000
Drug Stores	690200
Engine and Propeller Manufacturing	610700
Fire Departments	790300
Flight Insurance	700500
Flying Clubs	770400

Table C-1 (cont.)

AVIATION RIMS II CODE NUMBERS

Business	RIMS II Number
Flying Instructions	770403
Food Services	690100
Freight Forwarding	650701
Gift Shops	690200
Hotels/Motels	720100
News Dealers	690200
Personnel Supply Services	730100
Police Department	790300
Repair Shops	730300
Restaurants	740000
Taxi Service	650100
Tobacco Shops	650100
Travel Agents	650702

1. Applying RIMS II Approach to Sales Data

I. Assumptions

A. Business - Fixed based operator (from survey)
B. RIMS II Code Number - 650500 (from Table C-1)
C. Sales - $100,000 (from survey)
D. RIMS II earnings multiplier for code number 650500 - 0.6131 (from RIMS II tables)

II. Earnings Impact Calculations

Sales times earnings multiplier
$100,00 x 0.6131 = $61,310

2. Applying RIMS II Approach to Payroll Data

1. Assumptions

A. Business - Engine and propeller manufacturer (from survey)
B. RIMS II Code Number - 610700 (from Table C-1)
C. Sales - None provided (from survey)
D. Payroll - $300,000 (from survey)
E. RIMS II earnings multiplier for code number 610700 - 0.7120 (from RIMS II tables)

II. Earnings Impact Calculations

A. Obtain direct coefficient household multiplier for applicable RIMS code number (610700) - 0.3676 (from RIMS II tables).
B. Calculate economic base multiplier by dividing RIMS II earnings multiplier (0.7120) by direct coefficient household multiplier (0.3676) = 1.9369.
C. Determine earnings by multiplying payroll by economic base multiplier.

$300,00 x 1.9369 = $581,070

3. Applying RIMS II Approach to Employment Data

I. Assumptions

A. Business - Aerial sprayer (from survey)
B. RIMS II Code Number - 010100 (from Table C-1)
C. Sales - None provided (from survey)
D. Employees - 3 (estimated from airport manager)
E. RIMS II earnings multiplier for code number 010100 - 0.5662 (from RIMS II tables)

II. Earnings Impact Calculations

A. Obtain direct coefficient household multiplier for applicable RIMS code number (010100) - 0.2619 (from RIMS II tables).

B. Calculate economic base multiplier by dividing RIMS II earnings multiplier (0.5662) by direct coefficient household multiplier (0.2619) = 2.1619.

C. Obtain average earnings per job - $15,000 (from SIC number, RIMS II code number and county).

D. Determine payroll by multiplying the estimated number of employees (3) times the average earnings per job ($15,000) = $45,000.

E. Determine earnings by multiplying payroll by economic base multiplier

$45,000 x 2.1619 = $97,286.

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