Measuring the Regional Transportation Benefits and Economic Impacts of Airports

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In this paper, methods of measuring the importance of an airport to the economy of the surrounding area are described. Various measures of economic significance, the circumstances in which they are applicable, and guidelines for their estimation are presented. The two main measures that may be quantified and cited as evidence of an airport's importance are its transportation benefits and its economic impacts. Transportation benefits are the services that a local airport makes available to the community. The two services emphasized in this paper are time saved and cost avoided by travelers, but benefits also include other advantages, such as improved safety and comfort. Economic impacts are the regional economic activities, employment, and payrolls that can be attributed directly and indirectly to the operation of a local airport.

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 is 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.

If the public is to continue supporting airports, the public and its representatives must appreciate the economic significance of airports. This paper 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 basic guidance on how some simple rules of thumb can be used to obtain first-cut approximations of the value of an airport to the area that it serves. Suggestions for conducting a more comprehensive assessment are contained in Section 3.3 of the FAA's recent report, *Measuring the Regional Economic Significance of Airports (1).*

This paper 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 paper 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. The procedures described in the paper 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.

The two main indicators that may be measured and cited as evidence of an airport's importance are its transportation benefits and its economic impacts. Transportation benefits are the services that a local airport makes available to the surrounding area. The two services emphasized in this paper 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. Economic impacts are the regional economic activities, employment, and payrolls that can be attributed, directly and indirectly, to the operation of a local airport. They describe the importance of aviation as an industry.

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 aware of the substantial positive effects on the surrounding area. Economic impact and benefit data can be useful in evaluating the effects of airport use restrictions or curfews. Benefit data can be combined with income projections to help determine the viability of airport development proposals.

TRANSPORTATION BENEFITS

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 section. 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.

The primary benefits of an airport are usually the time saved and cost avoided by travelers who use it instead of the next best alternative. The following procedure measures the value of time saved and cost avoided by travelers as a result of a primary airport located at Point A (see Figure 1). The nearest

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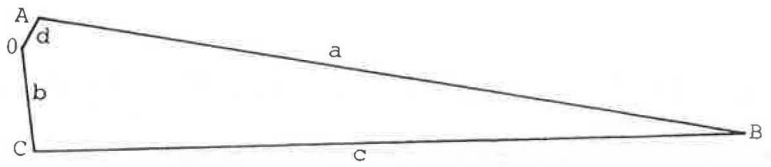

FIGURE 1 Transportation benefit of an airport.

alternative airport is located at Point C, which is located farther from Point O, where the trip originates. The time saved by using Airport A would be 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, because Airport A is closer to the origin of trips than Airport C. There could be additional benefits if x, the flight distance between Airports A and B were shorter than y, the alternative flight distance between Airports C and B. In the following analysis, it is assumed for the sake of simplicity that the flight distances x and y are equal.

The variables that must be considered in the analysis are listed in Table 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 Airports A and C. The total benefit is the sum of the time saving and travel cost reduction. The equations are shown separately and combined. The cost of aircraft flight time may be considered if the distance x is substantially different from the distance y *(2)*.

Time saved

$$\begin{aligned} \text{Annual passengers} &= FGN + Y \\ \text{O–C–B time} &= b/P + y/S \\ \text{O–A–B time} &= d/P + x/S \\ \text{Annual benefit} &= E(FGN + Y)(b/P + y/S - x/S - d/P) \end{aligned}$$

Reduced ground travel cost

$$\begin{aligned} \text{Annual ground trips} &= GN + Y \\ \text{O–C–B trip costs} &= Qb \\ \text{O–A–B trip costs} &= Qd \\ \text{Annual benefit} &= (GN + Y)(Qb - Qd) \end{aligned}$$

GN, the number of annual itinerant general aviation (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 share one automobile in traveling between the trip origin and the airport. FGN is the number of annual GA passengers. 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 traveling alone and requires a separate motor vehicle. P is the ground transit speed in miles per hour; S is the GA regional aircraft speed in miles per hour. E is the passenger time value in dollars per hour; and Q is automobile cost, including amortization, in dollars per mile.

Total annual benefit

If $x = y$, the 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.

The transportation benefits depend on several variables, particularly the additional ground travel involved in reaching an alternative airport. When ground travel $(b - d)$ is 20 mi, and the other variables are as given in Table 1, the annual benefit from

TABLE 1 ENVIRONMENTAL PARAMETERS

Symbol	Variable	Typical Value[a]
G	Itinerant operations per based aircraft per year[b]	300
N	Number of based aircraft at Airport A	Varies
d	Ground access distance to Airport A (mi)	Varies
E	Passenger time value ($/hr)[c]	25
F	Number of passengers per trip for GA aircraft[d]	2.5
P	Car speed (mph)	45
Q	Car cost, including amortization ($/mi)[e]	0.24
b	Ground access distance to alternative Airport C (mi)	Varies
Y	Annual number of passengers in commercial service	Varies
x	Direct flight distance from origin Airport A to destination Airport B[f]	Varies
y	Alternative Airport C to destination Airport B flight distance[f]	Varies
S	GA or regional airline aircraft speed (mph)[f]	Varies

[a] Actual data used where available.

[b] An operation is either a landing or a takeoff. Aircraft based at airports with air traffic control towers averaged 302 itinerant operations each in 1985.

[c] There is no source of precise data on passenger time. The FAA uses $25/hr 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 260,000 members is $53,200, which is equivalent to $25.58/hr. The FAA used $22.30/hr as an estimate of the value of airline passenger time in 1984 for computing the cost of air traffic delays.

[d] The average number of passengers per trip varies with aircraft type and is 1.5 for single-engine piston aircraft with three seats or less, 2.3 for single-engine piston aircraft with four seats or more, and 3.1 for multiengine piston aircraft *(4)*.

[e] The American Automobile Association (AAA) reports that a medium-sized automobile driven 15,000 mi/year cost $0.243/mi to operate in 1985.

[f] Variable needed to compute total annual benefit when use of the alternative airport substantially changes flight distance, that is $x \neq y$.

TABLE 2 APPROXIMATE BENEFITS FOR VARIOUS ACTIVITY LEVELS

Based Aircraft	Annual Commercial Passengers[a]	Reduction in Distance to Airport $(b - d)$[b]	Value of Time Saved ($)	Reduction in Travel Cost ($)	Total Annual Transportation Benefit ($)
10	0	20	83,333	14,400	97,733
20	0	20	166,666	28,800	195,466
50	0	20	416,665	72,000	488,665
100	0	20	833,330	144,000	977,330
50	50,000	20	972,165	312,000	1,284,165
100	100,000	20	1,944,330	624,000	2,568,330
100	1,000,000	20	11,943,330	4,944,000	16,887,330

[a]Includes only origin and destination traffic; does not include through or transfer passengers.
[b]Highway mileage measured from the point where trips begin or end, typically the traveler's residence or place of business.

the airport is $9,773 per based aircraft plus $15.91 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 mi. For instance, if $b - d$ is equal to 10 mi, the benefits would be $4,886 per based aircraft and $7.95 per commercial passenger. If $b - d$ is equal to 40 mi, the benefits would be $19,546 per based aircraft and $31.82 per passenger in commercial service. These figures can be used as 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 × $9,773 per aircraft) + (6,000 passengers × $15.91 per passenger), or $339,785.

An analysis can be used to determine the additional benefits that 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 United States are forecast to increase at a rate of 4.5 percent/year), 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 to restrict airport growth.

A GA airport in a metropolitan area may be designated a reliever airport by the FAA. In addition to providing access to the surrounding area, the reliever airport relieves congestion at a busy air carrier airport by providing GA aircraft with an attractive alternative landing area. For instance, Teterboro Airport in New Jersey is a reliever for Newark Airport, serving more than 400 aircraft daily that might otherwise land at Newark and add to congestion there.

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. The average cost of an airline delay in 1984 was $1,647.00/hr for airline operating expenses plus $22.30 per passenger-hour. 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.

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 subject area for the airline pilots of tomorrow. Aviation 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. Airports 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.

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

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 type of services 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.

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 GA traffic. It is through the local airport that an area gains access to this important national resource.

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

There are many commercial activities involving aviation in addition to the carriage of passengers. Air cargo accounts for several distinct businesses, including air freight and express delivery of 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. GA 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.

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. Although the benefits described in the previous section are the primary motive for airport development, direct economic benefits help to generate and sustain public support for airports. The following definitions include 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, such as airport employment, occur on site; others, such as 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 nearly full employment, where airport employment might draw workers away from other employers in the region, who then have to operate their businesses with fewer workers 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 is rarely 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 seldom warrant the resulting improvement in the estimates of employment, payroll, and expenditure impacts.

Expenditures by airlines, fixed base operators (FBOs), 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 traveled 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 exceeding 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 is also spent locally and thus becomes 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 factor 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 have higher multipliers than each individual county.

Total impacts are the sum of the direct, indirect, and induced impacts. Widespread adoption of the preceding definitions would contribute to the comparability of different airport impact assessments.

Rules of thumb for estimating economic impacts provide only rough approximations. They tend to yield low estimates because they do not capture the indirect impacts such as sales by travel agencies, restaurants, and hotels, or the direct impact of purchases by the airport and its tenants. More precise estimates may be obtained by using the methodology presented in the FAA report *(1)*.

Rules of thumb have been developed for the following broad categories of airports:

1. Air carrier airports with more than 4 million commercial passengers a year,
2. Air carrier airports with fewer than 4 million commercial passengers a year, and
3. GA airports.

Economic Impacts of Air Carrier Airports with More than 4 Million Commercial Passengers per Year

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 every 10,000 annual commercial passengers, including through passengers, the airport has approximately 8.8 employees. The uncertainty associated with this statistically derived coefficient *(1)* is ±20 percent, yielding lower and upper limits of 7.0 and 10.6 employees, respectively. For example, an airport with 10 million commercial passengers per year would have approximately 8,800 (range 7,000–10,600) employees.

Note that this estimate does not include any large aircraft manufacturing or maintenance activity that may account for substantial additional employment at certain airports. These activities are addressed in Step 3.

Step 2: Convert airport employment into airport payroll. A review of airport impact studies indicates that annual airport payroll per employee at high-activity air carrier airports is approximately $27,000 (in 1984 dollars). From Step 1, the airport's estimated payroll would then be 8,800 × $27,000, or $237.6 (range $189–$286.2) million.

Step 3: Determine employment and payroll 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 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. These impacts are not taken into account in Step 1, and the employment and payroll data have to be obtained directly from the facility operators.

Step 4: Calculate induced impacts of airport and aviation-related employment and payrolls. As defined, 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 induced impacts of direct and indirect impacts are larger for regions that are relatively self-sufficient economically and smaller for areas that are highly dependent on regional imports. Estimates of the multiplier for the total United States economy are typically about 1.0 for induced impacts. Thus, 1.0 should be the upper limit for rule-of-thumb estimation and should generally be applied to large metropolitan areas with relatively self-sufficient economies. For rural areas or areas with little manufacturing capability, and where purchases of goods and services have a high regional import component, a multiplier factor as low as 0.5 may be appropriate.

Applying a multiplier of 0.75 to the direct employment and payrolls in the preceding example yields induced employment and payroll of 6,600 (range 5,250–7,950) employees and $178.2 (range $141.75–$214.65) million, respectively. Induced impacts would be larger if direct impacts included the employment and payrolls of aviation-related activities.

Step 5: Calculate total economic impacts. The total economic impacts would then be estimated as the sum of the direct and induced employment and payroll impacts. In the example, 15,400 (range 12,250–18,550) jobs and $415.8 (range $330.75–$500.85) million in incomes would be attributed to the airport.

These figures are rough estimates that may substantially understate an airport's economic impacts for the following reasons:

1. Airport employment and payroll and those of aviation-related facilities are the only direct impacts considered. Other expenditures by airlines, FBOs, and tenants are not included in the analysis.
2. No indirect impacts derived from off-site economic activities are considered, for example, services provided by travel agencies, hotels, restaurants, and retail establishments for the benefit of airport users.

These factors should be added to the estimated total economic impacts whenever suitable data are available.

Air Carrier Airports with Fewer than 4 Million Commercial Passengers per Year

The following steps are similar to those just developed, varying somewhat in their implementation.

Step 1: Determine employment at the airport. Employment at a smaller, less active air carrier airport is likely to be easier to determine by a direct head count than at a high-activity airport with a large number of tenants. But if airport employment must be estimated, the following rule can be used.

The statistics indicate that for every 10,000 annual commercial passengers, including through passengers, the smaller airport has 8.4 (range 6.7–10.1) employees *(1)*. If, for example, an

airport has 1 million commercial passengers, estimated airport employment would be 840 (range 670–1,010).

Step 2: Convert airport employment into airport payroll. A review of reports on the economic impacts of airports indicates that the typical airport payroll per employee at low-activity airports is approximately $22,000 (in 1984 dollars). Thus the airport employment estimated at 840 in Step 1 would represent a payroll of $18.48 (range $14.74–$22.22) million.

Step 3: Determine employment and payrolls at aviation-related businesses. This step is implemented as described previously for high-activity airports.

Step 4: Calculate induced impacts of airport and aviation-related employment and payrolls. This step is implemented as described previously for more active airports. The appropriate multiplier factor depends on the degree of economic self-sufficiency of the region, not on the level of airport activity. If the region is unusually dependent on regional imports, a multiplier factor of 0.5 might be selected. This would yield induced employment of 420 (range 335–505) jobs; the induced incomes would be $9.24 (range $7.37–$11.11) million.

Step 5: Calculate total economic impacts. The total impacts can then be estimated by summing the direct and induced employment and payroll impacts. In the example, 1,260 (range 1,005–1,515) jobs would be attributed to the airport. In addition, the airport would be credited with adding incomes totaling $27.72 (range $22.11–$33.33) million to the region.

The discussion of the interpretation of rule-of-thumb estimates for high-activity airports also applies to low-activity airports. The caveats regarding the noninclusion of airport expenditures and indirect impacts apply in both cases.

GA Airports

At an airport where the principal use is GA, the five steps outlined previously may again be followed. In Step 1, employment and payroll data may be available from the airport manager. The scant data on GA airports suggest a rough ratio of one employee for every 7.2 based aircraft, but this ratio may be lower at small airports and higher at large ones. [From data on FBOs by employment-size class reported in the *1980 Survey of Airport Services (3)*, median FBO employment, including the FBO manager, is 4.5 for the nation as a whole. The average number of FBOs 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, which divided by the average airport FBO employment of 5.0, yields 7.2 based aircraft per FBO employee.] Local expenditures may also be determined and added to the direct payroll impacts. Steps 2 through 5 could then be carried out as described.

The data in Table 3 illustrate the application of rule-of-thumb procedures to airports of various activity levels corresponding to Table 2. Implementation of the rules of thumb proposed in this section requires little time and a minimum of resources. However, it yields only a rough approximation.

Estimates of employment and payroll developed by the statistical rules of thumb can be projected by simply applying the same rules to forecasts of based aircraft and commercial passengers. For example, if the number of annual commercial passengers is expected to increase by 10,000 between the present and the year 2000 at an airport with fewer than 4 million commercial passengers a year, airport employment would be projected to increase by 8.4 employees. If airport payroll per employee is approximately $22,000 (in 1984 dollars), the increase in payroll would be projected to be about $176,000. This would lead to an induced impact of $132,000, assuming a multiplier of 0.75, and thus a total increase in regional incomes of $308,000 per year.

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 (though imprecise) estimates by relating airport

TABLE 3 APPROXIMATE IMPACTS FOR VARIOUS ACTIVITY LEVELS

Airport Activity			Direct Impact[a]		Induced Impact[b]		Direct Plus Induced Impacts[c]	
Based Aircraft	Total Annual Commercial Passengers[d]	Estimated Employment[e]	Payroll per Employee ($)	Total Payroll ($)	Employment	Income ($)	Employment	Income ($)
10	0	1	22,000	22,000	1	16,500	2	38,500
20	0	3	22,000	66,000	2	49,500	5	115,500
50	0	7	22,000	154,000	5	115,500	12	269,500
100	0	14	22,000	308,000	11	231,000	25	539,000
50	50,000	42	22,000	924,000	32	693,000	74	1,617,000
100	100,000	84	22,000	1,848,000	63	1,386,000	147	3,234,000
100	1,000,000	840	22,000	18,480,000	630	13,860,000	1,470	32,340,000

[a]Direct impacts in table include only employment and payrolls. Expenditures should be added if available.
[b]In the examples presented in this table, it is assumed that 0.75 is the appropriate multiplier factor to be applied to the direct impact to obtain the induced impact.
[c]Indirect impacts are not shown because no rule of thumb has been developed for estimating them.
[d]Including through passengers.
[e]Employment for the first four examples is estimated by the employment rule of thumb for GA airports: one employee for every 7.2 based aircraft. Employment for the last three examples is estimated by the employment rule of thumb for air carrier airports with fewer than 4 million commercial passengers a year: 8.4 employees for every 10,000 passengers. Employment estimates are rounded to the nearest integer.

TABLE 4 APPROXIMATE BENEFITS AND IMPACTS FOR VARIOUS ACTIVITY LEVELS

Based Aircraft	Annual Commercial Passengers	Benefits			Direct Plus Induced Impact	
		Value of Time Saved ($)	Reduction in Travel Cost ($)	Total Annual Benefit ($)	Annual Payroll ($)	Number of Jobs
10	0	83,333	14,400	97,733	38,500	2
20	0	166,666	28,800	195,466	115,500	5
50	0	416,665	72,000	488,665	269,500	12
100	0	833,330	144,000	977,330	539,000	25
50	50,000	972,165	312,000	1,284,165	1,617,000	74
100	100,000	1,944,330	624,000	2,568,330	3,234,000	147
100	1,000,000	11,943,330	4,944,000	16,887,330	32,340,000	1,470

activity to benefits and to economic impact in terms of jobs and payroll that result from the airport. The data in Table 4 illustrate typical figures for airports with various activity levels.

These analytical techniques can also be used to predict the positive economic effects that are likely to result from increased aeronautical activity. For instance, if an airport with fewer than 4 million commercial passengers per year is forecast to have 50 additional based aircraft and 50,000 additional annual commercial passengers 10 years in the future, then it can be expected that there will be an accompanying increase in benefits of about $1,284,165 per year, and 74 jobs will be added to the local economy with a payroll impact of $1,617,000 per year.

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