

# Measuring Secondary Economic Impacts Using Regional Input-Output Modeling System

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**Public decision makers use economic impact studies to justify the existence or expansion of airports and other infrastructure. The studies demonstrate that the airport produces an economic benefit that offsets its perceived environmental, social, or financial costs. Unfortunately, informed policy making has suffered because these studies have differed greatly in their methodologies. The studies have relied on assumptions and have used terms that render a comparison of competing projects impossible. Although there have been some attempts at creating standards for these studies, their complexity—and the competitiveness of the practitioners—has made agreement difficult. This paper attempts to provide a standard for estimating secondary airport-dependent economic impacts using the Regional Input-Output Modeling System (RIMS II) multipliers.**

An airport provides a wide range of economic benefits to a region. Some of these benefits are more apparent than others. An airport “brings the world closer” to residents of a region, adding value to a community. An airport encourages tourism, and tourism increases regional revenues. An airport also reaches beyond its role as part of the transportation network, and provides on- and off-site employment opportunities, generating more economic activity throughout the region.

Airport operation requires the services of numerous vendors, including passenger and cargo airlines, airport gift shops, and airline caterers. Goods and services purchased by airline passengers from these sectors constitute the *primary impact* of an airport.

For example, an airline’s catering generates demand for food items, such as fruit and meat and disposable products such as plastic cups. Providing food service aboard an aircraft requires inputs produced by other companies. These inputs, which are used to produce the goods and services that represent the primary impact, constitute the *secondary impact* of an airport. These inputs and outputs represent successive rounds of spending. In this way, an initial expenditure “multiplies” into a much larger impact as the money circulates throughout the economy.

Although several methodologies have been developed to measure secondary impacts, this paper deals exclusively with the Regional Input-Output Modeling System (RIMS II) available for purchase from the U.S. Department of Commerce.

[To obtain tables and additional information on RIMS II multipliers, contact the Regional Economic Analysis Division, Bureau of Economic Analysis, BE-61, U.S. Department of Commerce, Washington, D.C. 20230, (202) 523-0594.]

The examples used in this paper come from the author’s research using RIMS II multipliers as part of economic impact studies (EIS) of Dallas/Ft. Worth Airport (1989), Baltimore/Washington International Airport (1986), Washington Dulles Airport (1985), Washington National Airport (1985), and Hong Kong’s Kai Tak Airport (1988).

## ECONOMIC IMPACT STUDIES

An EIS study looks at current situations and calculates future trends. The EIS shows how an airport affects a region’s economy during a year designated as the base year. As passenger and cargo activity and facility operation increase over time, the EIS shows how the economic impact on the region also rises. Because no airport can handle unlimited increases in activity, the EIS demonstrates how future limitations on airport capacity will limit the future economic impact on the region. The EIS then calculates the present value of this loss to the local economy from the inability of the airport to satisfy potential demand.

An EIS estimates impacts that depend on activities occurring on site, such as baggage handling, and those occurring off site, such as car rentals. These impacts can be divided into primary, secondary, and total impacts. Primary impacts are found using data collection and data analysis. Detailed EISs show these impacts by changes in employment, payrolls, tax revenues, final demand, and total output, as well as in local purchases and in leakages of money from the region. Table 1 shows a representative table of on-site impacts from an EIS.

To determine these impacts, the study team collects as much data as possible from each of the different airport sectors and, using statistical and econometric techniques, extrapolates from a sample to a survey population. The study team estimates secondary impacts using RIMS II.

## RIMS II

Since 1758, when French economist François Quesnay published *Tableau Economique*, the input-output nature of the

TABLE 1 ON-AIRPORT ECONOMIC IMPACT SUMMARY FOR THE YEAR 2000

Sectors: Impact	Psngr. Aviation	Cargo Aviation	Airline Suppliers	Airport Concess.	Gov't. Agen.	Total On-Airport
Employment						
Primary	14,570	1,607	4,881	2,405	2,151	25,614
Secondary	4,818	2,243	5,917	4,436	3,680	21,095
Total	19,388	3,851	10,798	6,841	5,832	46,709
Output (\$000)						
Primary	\$935	\$205	\$393	\$252	\$251	\$2,038
Secondary	\$1,374	\$302	\$398	\$375	\$362	\$2,814
Total	\$2,309	\$507	\$791	\$627	\$613	\$4,852
Earnings (\$000)						
Primary	\$420	\$64	\$124	\$36	\$60	\$707
Secondary	\$113	\$52	\$139	\$104	\$86	\$497
Total	\$533	\$116	\$263	\$140	\$146	\$1,204
Loc Purch (\$000)	\$130	\$56	\$115	\$116	\$91	\$510
Leakages (\$000)	\$347	\$76	\$139	\$89	\$92	\$745
Tax Revenues (\$000)						
Corporate	\$8	\$1	\$2	\$1	\$0	\$12
Personal	\$3	\$5	\$1	\$1	\$1	\$6.5
Secondary	\$1	\$5	\$1	\$1	\$1	\$4.5
Total	\$12	\$2	\$4	\$3	\$2	\$21

economy has been recognized. However, it was not until the 1930s that the analytical framework of the Leontief Inversion led to the creation of a national input-output matrix that could actually measure these interindustry transactions.

During the mid-1970s, the Regional Economic Analysis Division of the Bureau of Economic Analysis (BEA), U.S. Department of Commerce, designed the Regional Industrial Multiplier System (RIMS). Later, an improved version, RIMS II, extended the national input-output multiplier concept to regional uses and concerns. Essentially, RIMS II consists of the same technical coefficients as the national model but accommodates varying flows of imports to and exports from regions consisting of one or more contiguous counties within the United States. BEA updates the national model every 5 years and recalibrates the regional models every year using local data.

EISs have used RIMS II multipliers to show the change in total regional output, total earnings, and total employment from a change in final demand that may arise from a new investment or policy change. Final demand includes sales to government, industry, and other regions as well as capital formation. Unlike an input, final demand requires consumption for its own sake and not for the sake of producing some other kind of good.

As with most other fields of economics, real-world application of these multipliers requires as much artistic skill as scientific knowledge. Generating total impacts requires measuring the final demand of each industrial sector dependent on the airport and then multiplying that value by the appropriate RIMS II multiplier. The difficulties lie in determining which multiplier to use for what purpose and, more important, in determining the airport-dependent final demand for each relevant industrial sector.

#### USING RIMS II

RIMS II employs the same structure used in the national input-output matrix, listing 39 inputs for over 500 industries. The RIMS II matrices come in three varieties (plus a new employment multiplier table not discussed here). The matrices provide the following multipliers:

- Total output multiplier—helps estimate the total impact within the study area from primary final demand. Consisting of sales to final demand, sales to other firms, and wage payments within the study area, the total output multiplier represents a total of primary and secondary final demand. Total

output measures the sum of transactions and thus constitutes double calculations. Some researchers are attracted to this multiplier because of the "big numbers," not because it discloses important data.

- **Earnings multiplier**—estimates the total, primary, and secondary earnings created by primary final demand expenditures within the study area. Earnings consists of wage and payroll payments to the household sector of the economy. Total earnings constitutes the sum of primary and secondary earnings.

- **Direct impact multiplier**—represents the proportion of primary final demand created by wage payments and purchases by firms from within the study area. The 39th row of the direct multiplier is called the *household multiplier*, which represents the percentage of final demand paid to households in the form of wage payments within the study area. If data on wages are not available from primary sources, the household multiplier may be used to create an estimate of wages.

### Selecting Airport-Dependent Industrial Sectors

Although the RIMS II matrices do not include the "airport" industry per se, they do contain multipliers of those industries that provide goods and services necessary to meet the needs of airline passengers. As shown in Table 2, these industries include the goods and services a traveler might require when leaving home, passing through the airport onto an airline, flying to the destination airport, and reaching a final destination via some form of ground transportation. Each of the industries represented in this trip synopsis has a corresponding RIMS II industry number. The hundreds of columns in the RIMS II matrix are listed in numerical order by industry number.

Table 2 shows various airport-related services with their associated RIMS II and standard industrial classification (SIC) numbers. The terms used here are those found in the SIC manual. The table shows that RIMS II may treat different types of enterprises similarly even though they may have different SIC numbers. It helps to identify an industry in the SIC manual, which is more specific, and then use the four-digit SIC number to find the corresponding RIMS II industry number.

After initially grouping firms with the same RIMS II industry number, the EIS estimates airport-dependent final demand for each industry. This process requires extensive surveying and econometric analysis as well as an understanding of the nature of airports, aviation, and other transportation-related services.

### Determining Final Demand

The relevant measurement for analyzing the primary or first-round impact of an airport is final demand. Final demand consists of

- net earnings of labor and proprietors,
- purchases of inputs into the production of the transportation-related service [including inputs produced locally (local purchases) and those imported into the region (leakages)], and
- payments to the owners of land, capital, and equipment.

TABLE 2 INDUSTRIAL SECTORS FOR AIRPORT ECONOMIC IMPACT STUDIES

Industry Title	SIC Number	RIMS II Industry Number
Certificated Airlines	4511	65.0500
Uncertificated Airlines	4521	65.0500
Airline Caterers	5812	74.0000
Aircraft Cleaners	4582	65.0500
Baggage Handlers	4583	65.0500
Snack Bars	5812	74.0000
News Stands	5994	69.0200
Novelty Shops	5947	69.0200
Flight Insurance Stands	6411	70.0500
Ground Transit	4111	65.0200
Car Rentals	7512	75.0001
Hotels	7011	72.0100
Restaurants	5812	74.0000
Travel Agents	4722	65.0702
Freight Forwarders	4712	65.0701
Foreign Exchange	6052	70.0100
Airport Security	7393	73.0106

Source: Standard Industrial Classification Manual and Industry Classification of the Input-Output Tables.

The measurement of final demand comes from adding together sales (to the final consumer and not to another producer of airport-dependent services), organizational budgets, and commissions.

Under no circumstances should the EIS use *revenues* to determine the final demand of an airline. Revenues flow to the corporate headquarters that budget each airline station for local purchases, wages, fees, and so on. Similarly, revenues cannot measure final demand for travel agents and freight forwarders. These suppliers must pass roughly 90 percent of their revenues to the transportation or service providers. Commissions, rather than sales, are the relevant measure of final demand for these industries.

### Organizing Primary Data

A major airport may have 20 or more airlines serving it and hundreds of travel agents, hotels, and freight forwarders that receive a portion of their revenues as a consequence of the airport. Table 3 shows several key aggregations of airport-dependent sectors along with their corresponding RIMS II multipliers (for a particular impact region).

TABLE 3 KEY RIMS II MULTIPLIERS

Sector	Output Multiplier	Earning Multiplier	Direct Multiplier	Household Multiplier
Passngr Airline	2.4696	0.5709	0.5895	0.3046
Cargo Airline	2.4696	0.5709	0.5895	0.3046
Suppliers	2.0127	0.6788	0.6890	0.3115
Concessions	2.4874	0.5618	1.9461	0.2929
Grnd Trnsprt	2.7793	0.7876	0.7066	0.4861
Hotels	2.7290	0.6680	0.7029	0.3533
Travel Agent	3.0383	0.9196	0.8263	0.5826
Freight Fwrđ	3.0003	0.8249	0.7903	0.4561

Source: The Dallas Economic Impact Region Multipliers, Bureau of Economic Analysis, U.S. DOC, 1987.

Cargo and passenger airlines have the same RIMS II multipliers since they have the same RIMS II industry numbers. Their separation in an analysis or a presentation would not, therefore, depend on RIMS II but on other factors, among them the different airport activity variables used to forecast future impacts.

### Creating Multipliers

This section describes creating a set of multipliers for an industry not covered in RIMS II when such an industry is, in reality, an agglomeration of several industries. Airline suppliers such as aircraft cleaners, baggage handlers, and caterers provide inputs into the airline production process. Because they are often located on-site, many EISs include them as a final demand sector. Because these services represent a number of different industries, the RIMS II multipliers in Table 3 represent a weighted average of an individual industry's RIMS II multipliers. Most studies measure the impact of airline suppliers separately from that of airlines and treat the suppliers as just another airport concession. But concessions sell to a traveler whereas suppliers sell to an airline. If airline suppliers are to be considered as a separate sector, then their total final demand must be subtracted from the total airline station budgets. This subtraction is necessary in order to avoid counting the value of the payment from airlines to suppliers twice. Similarly, the payments of all on-site suppliers to the airport authority must be subtracted from their budgets or sales before adding the budget for the airport authority to the total impact results.

Table 4 shows how the total earnings multiplier for the supplier sector would be developed for a hypothetical airport. A supplier data base would contain the names of each of the companies that fit the general classification of supplier. These companies would be sorted according to their RIMS II industry number. In the example shown in Table 4, the supplier sector has been sorted by baggage handling, building services, airport security, and airline caterers. Each of these four industries has a total earnings multiplier associated with it found

in the earnings matrix. (Similarly, the industry would have each of the other types of multipliers shown in Table 3.)

The airport-dependent final demand for each firm must be found by using data collection and analysis techniques. The total earnings for baggage handling (\$59,142) is found by multiplying the earnings multiplier (0.6877) by airport-dependent final demand (\$86,000). After finding total earnings for the other categories, divide the sum of the total earnings (\$483,233) by the sum of the total airport-dependent final demand (\$668,000) to find the weighted multiplier for the supplier sector (0.7234). This procedure creates multipliers for broad industry classifications not covered by the RIMS II industry classifications.

Other multipliers that also produce useful information can be derived by combining the RIMS II multipliers and other data. For example, a local purchase multiplier would be constructed to determine what part of the primary impact consists of purchases of local goods and services. A leakage multiplier would be constructed to determine how much of the final demand leaves the region from imports of goods or services from outside. Derivation of the local purchase multiplier and the leakage multiplier is as follows:

$$\text{Local purchases} = \text{direct multiplier} - \text{household multiplier}$$

$$\text{Leakage multiplier} = 1 - \text{direct multiplier} - \text{profit multiplier}$$

The profit multiplier is the specific profit rate for a given industrial sector, found from secondary source material such as U.S. Department of Commerce publications that show the profit-to-sales ratio for various industrial sectors.

### ESTIMATING IMPACTS

Table 5 provides a detailed example of how the RIMS II multipliers found in Table 2 can be applied to the airline

TABLE 4 DERIVATION OF SUPPLIER SECTOR MULTIPLIERS: TOTAL EARNINGS

Companies	Airport* Dependent Final Demand	RIMS II Industry Number	Total Earnings Multiplier	Total Earnings
<u>Baggage Handling</u>		65.0500	0.6877	
Airline Services				
Unlimited	\$86,000			\$59,142
<u>Building Services</u>		73.0102	0.8140	
World Service Company	\$78,000			\$63,492
<u>Airport Security</u>		73.0106	0.9303	
Globe Security	\$120,000			\$111,636
Smith Security, Inc.	\$56,000			\$52,097
<u>Airline Caterers</u>		74.000	0.6002	
Dobbs Int'l Services	\$78,000			\$46,816
Marriott In-Flite	\$140,000			\$84,028
Sky Chefs In-Flight	<u>\$110,000</u>			<u>\$66,022</u>
Total	\$668,000			\$483,233
<i>Weighted Multiplier</i>			<i>0.7234</i>	

\*All values are hypothetical.

TABLE 5 APPLICATION OF RIMS II TO THE AIRLINE SECTOR

Total Airline Station Budget	\$125,000,000
Total Suppliers Budgets	\$25,000,000
Total Airline Final Demand	\$100,000,000
Total Earnings	\$57,090,000
Primary	\$30,460,000
Secondary	\$26,630,000
Total Output	\$246,960,000
Primary	\$100,000,000
Secondary	\$146,960,000
Local Purchases	\$28,490,000
Leakages	\$41,050,000

sector. In this example, the airline sector of an airport with total airline station budgets of \$125 million spent \$25 million on airline suppliers, including fees to the airport authority. The remaining \$100 million constitutes the airline final demand.

The airline sector was responsible for generating \$57,090,000 in total earnings within the region, which is the sum of primary and secondary earnings. Primary earnings is the same as wages found either through data collection or by using the household multiplier (Wages = Final Demand × Household Multiplier). Total earnings was found by multiplying final demand by the total earnings multiplier. Secondary earnings, then, is the difference between total and primary earnings. Total earnings is the most important measure of value in terms of benefits to the people of the region.

The airline sector generated \$246,960,000 in total output, which is the sum of primary output (final demand) and secondary output. Secondary output is sales, revenues, and budgets created from the subsequent rounds of spending after, and as a result of, the primary round of spending. Since output adds the total value of all transactions, it counts the same inputs over and over again. The more self-contained an economy, the greater the total output multiplier. Consequently, the total output multiplier does not present a true picture of

the airport's value. A region that imports most of its products would have a low total output multiplier.

The airlines would have spent \$28,490,000 for local purchases of goods and services. This was found by multiplying final demand by the local purchase multiplier created in the derivation of other multipliers given earlier. They would have spent \$41,050,000 on leakages. The leakage multiplier was also derived in this calculation.

## CONCLUSION

RIMS II is not a difficult tool to use if approached systematically. The two key concerns for the user are:

- Appropriate selection of a RIMS II multiplier for the given industry, and

- Correct and accurate estimation of final demand for that industry.

With the three RIMS II matrices, plus additional publicly available data, the user can employ a wide variety of multipliers that will help convey important information regarding the impact of an airport. RIMS II multipliers enable the estimation of secondary and total impacts. These impacts, along with both primary impacts and qualitative information describing the benefit of the airport, build the case that an airport has an intrinsic value to a region.

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