A METHODOLOGICAL PROPOSAL TO ANALYZE THE ECONOMIC IMPACT OF AIRPORTS

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1.- Introduction.

National Airports Systems (NAS), pressed by public opinion, have devoted many efforts and financial resources to the study of the environmental impact of airports. It has been only recently that NAS have undertaken studies on the economic impact of airports activities. The objective of these reports are twofold: first of all to point out that airports not only generate environmental concerns but also generate production, income and many jobs. This is the **public relations side** of the report. Secondly, there is also a need to know the return of the investment in airports, measured in social terms. This is the **planning of business activity side** of the arguments in the studies. The development of methods of evaluating airport investment from the social or cost benefit perspective is important to align investment criteria in airports with those of rail and roads, where this kind of studies have a long tradition.

This is specially important when public institutions finance parts or all the infrastructures of airports but is also very relevant in front of the privatization waves that soak Europe in recent years. In the past the economic impact of an airport was estimated only when the capital investment needed a formal justification. However, airports are more and more commercial activities and, as such, they may be able to generate a satisfactory return on the investment.

One of the first studies on the economic impact of airports was developed by the Los Angeles International Airport (1988). By that time the Federal Aviation Administration (F.A.A.) of the US Department of Transportation had prepared a report on different methodological approaches to measure the importance of airports in the economy of surrounding areas. After theses many other researches were developed that proposed different methodologies and analyze many airports. In 1993 the European Region of Airports Council International (ACI EUROPE) launched a document with a methodological proposal for studies of economic impact of airports[1]. Even thought this kit does not provides a complete or detailed guide for doing economic impact studies, it was a very important effort to clarify and homogenize previous and disperse attempts made in the past.

[1]ACI (1993), “The Economic Impact Study Kit”.

The objective of this article is to analyze alternative methodologies available for the calculation of the economic impact of airports and to propose a particular approach, based on the cumulative experience of these kind of studies and the suggestions of aviation related institutions. The second section presents a general discussion on the basic principles supporting the alternative methodological perspectives. Section three defines the methodological proposal of the article with special emphasis on the problems of its application. Section four collects information on several economic impact studies for different airports and compare them. Section five presents the conclusions.

2.- General methodological perspectives.

The literature on the indicators of airports importance are based on two measurements: transportation benefits and economic impact. The **transportation benefits** approach is closely related to the cost-benefit analysis. The benefits are computed in terms of time savings, cost avoidance, transportation safety, etc. There are some other benefits very difficult to quantify: civil defense for cases like floods, forest fires, etc; degrees in aviation in schools and colleges; externalities derived from the access to other areas of the country, etc.

A second approach to the analysis of the importance of an airport is based on its **economic impact**. The first synthesis of alternative methodologies to evaluate the economic impact of airports was developed by the Federal Aviation Administration (F.A.A.) of the US Department of Transportation[2]. This document presents a classification of economic impacts in three categories: direct, indirect and induced. This categorisation has became common in many studies after it even though is, to an extent, arbitrary. The FAA (1986) document argues that, strictly speaking, the studies of economic impact should measure those activities that would not have taken place if the airport did not exist. For instance, workers at the airport could have been employees in other firms of the region without expelling other workers. If that was the case the impact on job creation of the airport should not take into account those workers.

[2]FAA (1986), “Measuring the Regional Economic Significance of Airports”.

A similar problem appears when we consider the development of alternative transportation modes in the absence of the airport. All the workers that could have been working on firms running those transportation facilities should not be considered as job creation due to the impact of the airport. Moreover, from the total economic impact of visitors there should be subtracted the impact of travelers that would have travel to the city or region under consideration even without the existence of the airport. We call this methodology, in a synthetic manner, the **differential estimation approach (DEA)**. It matches closely the basic economic concept of opportunity cost.

However, the F.A.A. recognizes that, from the practical perspective that approach, in strict terms, is unfeasible.

"As a practical matter, however, it will rarely be cost effective to develop a base-case scenario that depicts the economy of a 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" (pag. 16).

One of the first applications of the general methodology proposed by the F.A.A. was developed by Wilbur Smith Associates (1988) in their study on the economic impact of the Los Angeles International Airport. This report adopts the classification of impacts proposed by the F.A.A. (direct, indirect and induced) and uses the input-output methodology to estimate the induced impacts. The document does not attempts to calculate a base (contrafactual) case and compare it with the actual case but it estimates de impacts as they are produced, avoiding the additional complications of the strict differential approach. We can call this methodology **estimation of the economic impact as it is produced (AIIP)**.

The ACI Europe (1993) document glorifies the F.A.A. classification of impacts. In the section of the induced effects it even reports the same methods as the F.A.A. (1986) original report. With respect to the general methodological conception, the ACI embraces the "as it its produce" approach. The ACI kit does not consider any hypothesis on the employment or output that would have been produced in the absence of the airport. The only reference is a precautionary note on the over estimation of the economic impact by the use of large multipliers. In order to solve this problem it proposes to use the input-output methodology.

An alternative methodology, with many common elements with the previously discussed one, is the ADL model[3]. In this approach there is only distinction of two types of impacts: direct and indirect. However, the third phase of calculation of indirect impacts is like the induced effect in the terminology of the FAA or the ACI. The ADL model uses the input-output methodology as well as the concept of aggregate multiplier. In fact, the third phase indirect impact multiplier is like a sales multiplier. The three phases of the ADL model are:

a) estimation of direct operating costs and building costs. The operating costs considered are personnel, material, energy, consumer goods and services (for instance consultants).

b) identification of industry specific demand generated by the construction activities and the operations at the airport.

c) aggregation of indirect effects and calculation of the sales multiplier. Adding up the indirect effect, the industry specific effect and the direct effect it is possible to calculate the total effect.

[3]Arthur D. Little International Inc. (1993): How to assess total economic impact.

Most of the economic impact studies of european and american airports have used the classification of direct, indirect and induced effects as the base for the estimation of the total economic impact. However, there is an alternative approach that only considers as economic impact of the airport what is usually called direct impacts and a small part of the indirect. This approach is based on the economic concept of derived demand. It is argued that, for instance, people go to a touristic place because it has a nice beach, good climate, etc, not because it has an airport. The use of the airport is just a derived demand and, besides, it is complementary of other infrastructures like the railroads and highways that go from the airport to downtown, the hotels, etc. We are going to call this the **simplistic method** or **"for the airport by the airport**". In essence this methodology proposes to calculate only the direct and some of the indirect impacts of the airport[4]. It is true that it is easier to calculate the direct effect that all the indirect and induced effects because most of the information that you need to write the report is accounting information and other that you can easily obtain. Besides, it is clear that in order to calculate indirect and induced impacts we have to make some assumptions and choose a particular methodology. However, it is also true that the total economic impact of an airport cannot be reduced to the number of workers that work for the airport operator. The fact that a complete accounting of impacts is complicated should not be an excuse to avoid the calculation of all the economic effects, even if we have to make some assumptions. There are many more criticisms that apply to this methodology:

a) under the neutral look of this methodology there are also very strong assumptions. For instance, it assumes that all the workers at the airport would be unemployed in the absence of the airport which is at odd with the differential methodology. It also assumes that the economic activity that is not directly related to the airport would exist anyway. This is false because many firms decide their locations in function of the presence of a nearby airport, specially if they rely in the just in time concept for inventories management. Following the "for the airport by the airport" methodology the plant would exist even without the airport. However, it is obvious that the presence of an airport close to the firm affects the cost schedule of the plant and, therefore, has a large impact on the location decision.

b) Does demand generates its own supply or supply generates its own demand? Is the existence of the airport that generates tourism or the existence of tourism that generates the need

[4]Karyd and Brobeck (1992) use very descriptive names for the three impacs proposed by the FAA and the ACI kit: "Direct effects- the reality. Indirect effects-inflated. Induced effects-illusory or deceptive".

for the construction or remodeling of an airport? As in the economic theory of supply and demand it is impossible to identify causality without some additional structure. Following the simplistic approach to the measurement of the economic impact of airports, causality runs from demand to supply but this is just an assumption because there is not structural model that justifies this view. Moreover it is obvious that airport generate its own demand.

c) the true source of economic benefits are the airport services and the possibility of using them, more than the airport in itself. Airport services are better represented going from direct to indirect effects and from indirect to induced effects[5].

d) summarizing, the procedure for the airport by the airport is much more restrictive than any other methodology examined above because from the differential approach and the AIIP it is possible to derive the results of the simplistic approach but not viceversa. Therefore, the possibility of comparison of results from different airports is reduced.

This brief discussion on methodological approaches to the measurement of the economic impact of airports has made clear that there are two basic issues to solve before deciding on the most appropriate methodology:

a) the **additionality question** or how much new and additional economic activity has been generated by the existence of the airport and how much would exist even in the absence of it. This question is usually solved including special questions in the passengers questionnaire like "Would you have come to this city/town/region without having air connection?".

b) the **transferability (displacement) question** or how much of the economic activity is new and how much has been moved from other location or activity. For this purpose it is necessary to build a base case making contrafactual assumptions.

3.- A methodological proposal.

[5]C. J. Smith (1993): The contribution of airports to regional development, pag. 7.

In this section we develop a detailed exposition of the basic methodology to measure the economic impact of airports with some comments on what we consider the best choices in each of the areas. By economic impact we consider the effect of the airport and other activities related with it on output, income and employment. The economic impact has two types of elements, qualitative and quantitative, even though in this article we are going to consider essentially the quantitative aspects.

There are three questions to be solved previous to any collection of data or estimation:

a) the basic approach.
b) the definition of area of influence.
c) the choice of the year and its effects.

With respect to the first question this proposal suggests the use of the “as it is produced method”, though it is clear that the best approach is the differential one (DEA). In order to correct for questions like additionality and tranferability it considers sensibility analysis in a way it will become clear later. The differential approach is very expensive and complex and uses many assumptions being, therefore, very sensitive to small changes in basic hypothesis of the base case scenery.

A more complicated problem is the definition of the region affected by the economic impact of the airport. In a very wide sense all the country benefits from the effects of the airport. However, the larger is the area the weaker is the effect: if the are is very large the employment and income generated by the airport represents a very small part of total employment and output while if the area is too small the effect becomes very high.

These are not the only nor the most important considerations in the choice of the region size or definition. Data availability is much more important specially when the choice for the estimation of the induced impact is the input-output technique. For instance, if there are no input-output tables at the level of provinces but there exist at the state level it will not be possible to work at the province level.

Finally the choice of the year is also important for the total impact. Airport activity has a very large cyclical component that makes its economic impact very dependent on the situation of the national or regional economic cycle. This implies that if the report is referred to a peak year the total impact will over estimate the average impact while if the situation is a recession then the impact will be under estimated. The year of the data is important because given how expensive

and time consuming are economic impact studies they are produced with very low frequency.

The main classification of the impact in this proposal is the traditional: direct, indirect and induced. Figure 1.

3.1. Direct economic impacts.

The FAA (1986) report defines direct economic impact as *"the consequence of economic activities carried out at the airport by airlines, airport management, fixed base operators and other tenants with a direct involvement in aviation"*. While the FAA report considers that some direct impacts occur in site (employment) while others may be off site (production of some goods and services) the ACI (1993) report defines as direct impact only on site activities. The FAA criterion to define direct impact is based on the fact that this kind of impact is the immediate consequence of airport economic activity while the ACI definition is based on the on site/off site distinction. In practice the difference between these two concepts of direct impacts is very small.

Given those definitions of direct impacts the main activities included are:

Government:

- security
- immigration services
- customs
- department of agriculture
- civil aviation authority
- post office

Airport operator o authority:

- airport administration
- airport maintenance
- airport private security
- fire brigade
- air traffic control
- weather forecast services

Airlines and aviation services providers:

- airlines
- aircraft maintenance

- air cargo
- passengers and ground handling
- flight catering
- fuel service
- aviation schools

Commercial sector:

- tax free shops
- restaurants
- on site hotels
- car rentals and car parking
- retail shops
- currency exchange
- financial services on site

Ground transportation

- taxis
- buses

The main source for data on direct economic impacts is the airport operator or authority. Their income statements together with detailed information on expenses, revenues, employees, statistical reports, etc, are a tremendously important and accurate source of information.

The rest of the information has to be gathered using personal interviews and surveys to the companies with activities on the airport. Interviews are important when the size of the firm is large because they permit to deviate from the initial questions and qualify aspects that may be crucial. In particular, when a large company has many activities apart from aviation or it operates in several airports, it may be difficult to assign what part of total expenses and revenue are directly related to one concrete airport. In this cases additional information is required.

A company survey is an additional source of information. Questionnaire should be short and easy to understand. Of course, they should be pre-tested to ensure that questions are clear and unambiguous. In the case of concessions, the airport operator may have data on revenue and expenses of shops, restaurants, etc and it is possible to cross check the data obtained by the survey with the data handled by the airport authority[6].

[6]Obviously it will be easier to get those data whenever the concession fee is defined as a percentage of profits, sales or net tournover. When there is a fixed fee it is more difficult

The survey content varies and depends on the extent of the investigation. It should contain data on employment by categories, sales, investment, operating costs and expenses by categories. If the firm has some other activities or airports it should also ask for the percentage of the business that is directly related to the airport under consideration. If the spatial distribution of employment is also an aspect to analyze the survey will ask for the postal code or district/town where the employees of the firm live. If taxes are also an issue the survey will include questions related with the amount of different taxes paid by the company.

The treatment of the information obtain by interviews and surveys to the firms directly related to the airport is easy to handle with the exception of several complex issues. One of them is the effect of large and irregular investment projects carried out by the airport operator (new terminal, new runaways, etc) or airlines. In order to avoid considering that investment as produced in that particular year it is necessary to obtain information on investment of the operator or the company during the last five or six year and calculate an average. Another complicated issue is the question of double accounting: part of the revenue of the operator are expenses for many companies related directly with the airport (take-off fees, landing fees, concessions fees, etc). The investigation must carefully identify which items appear in several income statements but represent the same expense or revenue.

3.2. Indirect impacts

The indirect impacts are the consequence of economic activities of off-site firms that serve airport users. Opposite to the case of the direct impacts where, in general, there is no need for sampling techniques, the existence of hundreds of companies that potentially can serve travelers off-site forces the choice of a sample. Among them there are hotels, restaurants, travel agencies, shops, leisure activities, etc. However, it is very complicated to define in practical terms the population from which this sample has to be extracted.

The solution adopted in most of the studies on economic impact is to run a passengers

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that the airport operator collects information on sales, expenses or profits of the concessions.

survey with questions related to their expenses at the final destination city/town. The first relevant classification of the passenger is the distinction between residents and visitor. The reason is that residents will be in that area even in the absence of the airport. Only the off-site expenses of visitor are consider as indirect impact.

Most of the surveys include also questions on expenses in the airport, which allow an additional cross-check of the consistency of the direct impact results. Residents are asked for the town where they live and their expenses in site as well as the access mode to the airport, parking usage and number of trips that they do in one year[7].

[7]This variable together with the number of total passengers is critical to infer the proportion of visitors and calculate the absolute number of them.

The trip purpose is critical for the classification of visitors because it discriminates better than any other observable variable (regular/charter, national/international) groups of passengers with different average expenditure.. The reason is very simple: in the same flight there are people that pay very different fares and, therefore, the choice of the flight type as the discriminant variable to calculate average expenditure is not a good choice. It is much better to use trip purpose as basic classification for visitors. An example may clarify this issue: a businessman goes to the airport in a regular international flight without staying one Saturday night. The fare is much more expensive than the one of a student that stays Saturday might to save money. Obviously the reason why the businessman is willing to pay a very expensive fare is because the opportunity cost of his time is much higher than the opportunity cost of the student. Therefore, the average expenditure of these two persons in the companies of the area they visit will be very different and its aggregation to obtain an group average will be a mistake[8]. The questionnaire for visitors should include additional questions related with the number of nights in the destination town, the number of those kind of trips every year, the access mode to the airport and the expenses off-site separated by categories (hotel, restaurants, local transportation, shops, etc). Of course, the survey should also inquire about the sex and age of the passenger as well as the size of the group in which the visitor is traveling[9].

In many surveys of this kind visitors are also asked if they would have traveled to that destination in case it would not have flight connection. This question is use to generate alternative scenarios and deal with the issue of additionality.

Where should the survey be conducted? Given that the research has to be based on the expenditure in the destination, the best choice is to carry out the survey on the departure gates. It is important not to mix visitors arriving and visitors departing in order to avoid double

[8]It is clear that cross classification by trip purpose and type of flight could probably improve the precision of the estimation but will also ask for larger sample sizes.

[9]The main reason for this kind of questions is that in family groups one person answers for all the members of the family but the final calculation is per capita. Some other times there are groups of kids or organized trips.

accounting.

3.3. Induced impacts.

The induced impacts are the result of the multiplier effect of direct and indirect impacts generated by the recipients of them. For instance, an airport worker, with his salary, buys a car. That generates income for the car seller which he could spend in buying a TV. This will generate income for the TV seller, etc. This successive rounds of spending generate the multiplier effect on employment and income. It is important to consider only induced impacts in the local or regional context (depending on the choice of area of influence) because some of these effects will spill over other contiguous regions. Therefore the multiplier obtained should consider only the regional effect and not the leakages of spending outside the region.

There are several alternative methodologies for the evaluation of induced impacts. The FAA (1986) document[10] classify them into three categories[11].

a) the economic base model[12]. The base of this procedure is the distinction between goods sold within the region (non basic or services) and goods sold out of the regions (basic). This classification is very close to the models of international trade based on the tradable-non tradable distinction. The calculation procedure is simple but, because of this, has many shortcomings. The classification of a good as basic or non basic is very problematic, specially for complex goods. Moreover, the fact that there are only two types of goods[13] makes the multipliers a very aggregated average of basic, on one side, and non basic, on the other side, goods. Obviously, not

[10]The ACI (1993) document consider also the same three methods.

[11]The names that define the categories are not very descriptive of the approaches.

[12]Unfortunate name given that all the approaches are economically based.

[13]Which is a reasonable solution to reduce the complexity of the problem for analytical and mathematical models.

all the good in the basic category have the same induced impact and the same happen with the goods in the non basic category. The heterogeneity within each of this groups makes difficult to obtain accurate conclusions out of this procedure.

b) the econometric model. The main objective of this approach is to estimate a macroeconomic model of the regional economy taken into account variables such as consumption, income, taxes, public expenditure, etc. In order to avoid simultaneity biases the best choice is to estimate a simultaneous equations model. The result of this estimation is a keynesian multiplier that can be used to obtain the induce impact of the spending generated by the existence of the airport. There are two drawbacks in this procedure: first of all, probably there are no data at the regional level to estimate this model or there are too few observations. Most countries have statistics that cover all the relevant variables for this kind of model but, given that the objective of the research is the induced impact on the regional area, there is need for macroeconomic variables at the regional level. Secondly, there is a problem of aggregation: out of the estimation we obtain one multiplier and we apply it to very different goods and services. Only for a chance the structure of regional expenditure will be equal to the structure of spending generated by the airport and, therefore, the multiplier obtained using the regional model will not be appropriate for calculating the induced impacts of airport related expenditures.

c) the input-output model[14]. This procedure has a long lived tradition in the analysis of sectoral and desegregated changes in demand. Its main advantage is the consideration of sectoral differences in the calculation of the multipliers. The disadvantages are essentially related with the large amount of data needed to construct the input-output tables. This implies that input-output tables are only produced for large size regions and with a low frequency given that they are very expensive. In addition, the theoretical framework behind input-output tables assumes a particular type of production relationships[15] that do not allow between inputs.

In spite of these disadvantages, the input-output methodology is the most common approach to the analysis of regional economic impact. It has also been applied to the study of the economic impact of many airports and it is, without doubts, the best alternative of the three exposed above. The economic and the econometric model can only serve as a quick and

[14]For a classical view on this kind of model see O'Connor and Henry (1975) or Richardson (1972).

[15]Leontief production functions.

preliminary study of economic impact.

The input-output tables reproduce the intersectoral relationships, primary inputs and final demand with the structure depicted in figure 2. The closed model is defined by the matrix

$$[I - A]X = Y \rightarrow X = [I - A]^{-1}Y$$

relationship

where:

X is the vector of sectoral output (*n x 1*).

A is the matrix of technical coefficients (*n x n*).

[I-A] is the technological matrix

Y is the final demand vector.

Assuming that the technical coefficients are constant and proportional the quantities system allows the evaluation of the effects on production, income and employment of changes in final demand. For this purpose it is necessary to extend the basic model of quantities to include the requirement of primary inputs in final demand. This is the way to calculate the input-output multipliers that can be classified as:

- *output multipliers.* Let's define B as the inverse of the technological matrix

$$B = [I - A]^{-1}$$

Each element of the B matrix, b_{ij}, represents the increase in production of sector i needed to satisfy an increase of one unit in the final demand of sector j. Therefore, the sum of one column of matrix B represents the production of all the sectors that will be needed to satisfy de increase of one unit of final demand in sector j. Therefore, it depicts the impact on the economic system of the increase in one unit of final demand of sector j. The output multipliers are

$$MO_j = \sum_{i=1}^{n} b_{ij}$$

calculated as

- *income multipliers.* They represent the income generated by changes in final demand.

Like the keynesian multiplier, the initial increase in income due to changes in final demand have additional induced effects on the consumption of domestic economies that will produce and additional increase in final demand. This iteration process between consumption and income is produced in successive rounds. There are two versions of the income multiplier. The type I multiplier contains only the induced effect of direct and indirect changes in final demand. The type II income multiplier represents the induced effect by direct, indirect and the induced impact of changes in final demand.

$$MR_j^I = \sum_{i=1}^{n} v_i b_{ij}$$

$$MR^I = v'B$$

The type I income multiplier is defined as

where v_i is the ability of income generation by a unit of output of sector i, calculated as the unit coefficient of value added (value added in j over production in j).

For the calculation of type II income multipliers it is necessary to include in the matrix of intersectoral transactions the sector of domestic economies as if it was an additional productive sector.

In this way the matrix of intersectoral transactions will have an additional row and column. The elements of the last row of the new matrix, T^*, represent the domestic income generated directly in the obtention of one unit of sector j. The last column of the new matrix represents the direct requirement of product i for the production of one unit of private final consumption.

$$A^* = T^* (diag(X))^{-1}$$

The new matrix of intersectoral transactions is obtained as

where

A^* is the new matrix of technical coefficients

T^* is the new matrix of intersectoral transactions, including the domestic economies sector.

diag(X) is a diagonal matrix where the elements of the main diagonal are the values of the vector X.

$$B^{*} = [I - A^{*}]^{-1}$$

The new inverse matrix is, therefore [16],

The type II income multipliers are obtained from the last row of the new inverse Leontief matrix, B^{*}. We can write the new matrix of intersectoral transactions as a partitioned matrix

$$\begin{bmatrix} X \\ y \end{bmatrix} = \begin{bmatrix} A & cf \\ \omega' & 0 \end{bmatrix} \begin{bmatrix} X \\ y \end{bmatrix} + \begin{bmatrix} Y - CF \\ RE \end{bmatrix}$$

where

y is the value added vector.

cf is the vector of coefficients corresponding to domestic consumption.

CF is the domestic consumption vector.

Y is income.

[16]The output multiplier type II are based on the submatrix (nxn) on the upper left hand side partition of the matrix.

RE is income coming from external sources.

$$B^* = \begin{bmatrix} A & cf \\ \omega' & 0 \end{bmatrix}^{-1}$$

The inverse matrix of Leontief, B^* , is

$$MR_j^{II} = b^*_{n+1,j}$$

and, therefore, the type II multiplier can be written

- *employment multipliers.* Like income multipliers the employment multipliers can be type

$$ME_j^I = \sum_{i=1}^{n} l_i b_{ij}$$

$$ME^I = l'B$$

I or type II. The type I employment multipliers are

where

l_i is the labor coefficient calculated as the ratio of employment in sector j over output of sector j. The vector l contains the labor coefficients of all the sectors.

$$ME_j^{II} = \sum_{i=1}^{n} l_i b^*_{ij}$$

To obtain the type II multipliers matrix B has to substitute by matrix B^*.

There are some technical difficulties to be solved in order to construct the row and column of the domestic economies and, therefore, the type II multipliers[17]. In most of the cases some additional information, not included in the input-output tables, is required for the calculation of that row and column. However, from the theoretical perspective and the practical side[18] it is better to use the type II multipliers in order to calculate the induced impact.

[17]For a solution to this problem see Montalvo and Pérez (1996).

[18]The FAA (1986) document recommends the use of type II multipliers.

The detailed disaggregation implied by the input-output methodology requires the classification of direct and indirect effects using the same classification as the sectors considered in the input-output table.

3.4. Total impact.

The total impact is calculated as the sum of direct, indirect and induced impact.

4.- International comparisons.

The objective of this section is to present the results of different studies of economic impact of airports. This is a difficult objective given the number of alternative methodologies, definitions of area of influence, etc.

The ATAG (Air Transport Action Group) prepared, throught IATA, a report on the role of aviation in the international economy and the economic benefits resulting from this role[19]. The report was basically a summary of research previously undertaken by consultants and specialist worldwide. The ATAG recognizes that the conclusions of the studies that have analyzed the economic impact of airports on the local economy have varied widely. However, it presents a summary of average economic impact of airports which is reproduced in table 3.

Table 3: Impact of average 1 million passengers

Estimate**	Jobs		Economic impact* ($M)	
	Direct	All	Direct	All
High	2.000	7.500	200	1.500
Medium	1.500	6.000	70	600
Low	750	2.500	30	120

* The economic impact corresponds to US airports only and is calculated in 1990 US

[19] ATAG (1991), The economic benefits of air transport.

dollars. When necessary the data is uprated using US inflation index.

** The variation in the estimates reflect the mix of international/national traffic, the assessment method used, consideration of regional versus national effects and the importance of hubbing.

These data can serve as a first approximation to the comparison of the economic impact of airports. However, the main problem for the comparison are the differences in methodology adopted by the different studies that are aggregated under the categories of high, medium and low impact. As we will show in the rest of this section the numbers for low impact airports correspond better to the methodological proposal of this article. Therefore, a million of passenger generate around 750 direct jobs and 2.500 total jobs (including direct, indirect and induced jobs). With respect to the economic impact, one millions passenger produce a 30 million dollars (of 1990) direct effect on the economy of the area under consideration. The total economic impact reaches the 120 million dollars per million of passengers.

The purpose of the rest of this section is to consider economic impact studies that have similar methodology. There are several aspects easy to compare because there is a high degree of consensus on them. One of those is the direct impact of the airport on income and employment. For this calculation the main source of information is the balance sheet and income statement of the airport operator. The fact that the activities directly related to the airport take place on site helps in the definition of what to consider as direct impact. It also eases the calculation of the economic effect. Table 4 contains the direct employment generated by million of passengers at different airports.

Table 4: Direct labor impact

Airport	workers	wpm
Vienna***	8,200	1345
Orly (FRA)**	28,000	1272
LAX** (CA)	34,669	837
Manchester**	8,390	830
Denver (CO)	23,000	694
Dallas-Ft. Worth*(TX)	14,253	649
Chicago-O'Hare*	24,727	633
Valencia (Spain)	940	607
San José (CA)	4,277	512
Barcelona (Spain)	4,903	463
Norfolk (VA)	1,521	445

* Data refer to year 1981.

** Data refer to year 1988.

*** Data refer to year 1990.

wpm: workers per million of passengers.

Most of the studies in this table were elaborated with 1994 data. As it can be seen the direct employment generated per million of passenger is closer to the low impact case consider by the ATAG.

With respect to the direct production impact table 5 shows results for several airports

Table 5: Direct production impact ($M)

Airport	production	ppm	ppw *
Charles de Gaulle **	2,190	121.7	66.3
Orly (FRA)**	2,147	97.6	76.7
LAX** (CA)	2,490	60.1	71.8
Barcelona (Spain)	332	31.4	67.9
Valencia (Spain)	44	28.6	47.2

where data are comparable or, at least, use similar methodology.

* In thousand of dollars

** Data refer to 1988.

ppm: production per million of passengers.

ppw: production per direct worker.

In the above table is interesting to notice the large divergence in direct production per million of passengers but the similar productivity of the direct workers of all the airports. The Spanish airports considered would belong to what the ATAG calls low impact while the other three airports are part of the medium impact category.

The comparison of the total economic impact is more complicated than the direct impact because it depends on the methodological approach adopted and the size of the geographical area considered. For instance, while the studies of Valencia and LAX use type II multiplier the study of Barcelona uses type I. In addition, while the study of the Valencia airport calculates induced impacts using the regional input-output table, the LAX study works with county level input-output tables. Having this words of precaution into account we can see that LAX generates 690 million dollar per million of passengers while the Barcelona airport generates 245 and the Valencia airport around 240. Finally, with respect to total employment LAX implies around 9,013 workers per million of passengers while Barcelona supports 6,591 per millions of passengers and Valencia 5,138.

5. Conclusions.

This article presents the basic principles and the alternative methodologies available for the estimation of the economic impact of airports. The basic questions in the choice of the methodology are related to the issues of additionality and transferability. Obviously, the amount of resources that is allocated to studies of this kind imposes a trade off between practical considerations and scientific bases. Moreover, the modelling of additionality and tranferability will lead, in general, to the use of many complementary assumptions and, therefore, will always be subject to controversy.

Several aviation organizations (FAA and ACI) have made methodological proposals for the estimation of the economic impact of airports. The main classification of impacts divide them in direct, indirect and induced effects. The induced effects are usually calculated using the input-output methodology. These proposals are not free of controversy either. Some authors criticize the inclusion of indirect and induced impacts as part of the economic impact arguing that these impacts are difficult to define and quantify. However, this fact should not be a determinant in the methodological decision because indirect and induced impacts are basic in the

characterization of the economic effect of the main activity of airports: the production of air services.

Finally, we emphasize that it is difficult the comparison of different economic impact studies because usually there are methodological differences. The last section of the article presents the comparative results of several airports. While there is similarity in the results for direct effects the total impact shows a large variability.

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