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# Air Transport Economic Footprint in Remote Tourist Regions

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## Abstract

Air transport development is on the top of the agenda for governments, authorities and stakeholders especially for economies heavily depending on tourism, where air transport provides connectivity to national and international markets. Therefore, air transport is recognised as a key driver towards income generation, social stability, sustainable business development and economy enlargement. This chapter deals with the estimation of footprint of air transport sector to regional development. By reviewing the economic assessment methodologies, the pros and cons are highlighted, and the input-output computational modelling framework is presented. The analysis includes numerical applications and case studies in Mediterranean region, highlighting results that could be compared with other cases or business sectors. Conventional wisdom is to present the economic footprint definition methodology to estimate the wider economic effects and key results from applications in tourist destinations, providing the framework for similar applications and highlighting key messages to decision-makers.

**Keywords:** air transport, economic contribution, tourist destination development

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## 1. Introduction

The impact of air transport on the regional economy is of great importance, because it reflects to the economic profile of the region it serves and, in many cases, acts as a key driver of the socioeconomic development in regional or national scale. It is noteworthy that regions accessible to air transport services and connectivity to international markets, achieving essential economic benefits in terms of unemployment, business productivity and per capita income. Especially, for the tourism regions where the domestic income heavily depended on air transport and tourism performance, decisions on improving accessibility and the level of service are very crucial towards economic growth and social coherence.

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The tourism industry of extremely competitive and fragile business environment leads tourism industry and authorities continuously encourage air transports for lower prices, more capacity and additional connectivity, promoting those as key drivers towards higher tourist demand and financial sustainability for both, transport and tourism sectors. In addition, the market tendency for growing leisure travelling, especially in holiday periods, along with the fast-changing technology and the continuing booming of e-commerce, resulting strong air transport growth and this tendency is estimated to continue in next decade, according to estimations and forecast delivered by global organization, national institutes and air transport authorities. Therefore, key counterpart of the effective regional strategic planning includes plans and decisions for investments to improve efficiency and grow capacity in air transport infrastructures. In other words, the timely and financially efficient allocation of capitals to air transport infrastructure is a key success factor on strategic planning process, affecting not just air transport and tourism sectors but also the regional economy as a whole.

However, the complexities of today's global economy and the uncertainty in investments to infrastructure projects with long payback period and high volatility in patterns such aviation and tourism, rising business and financial risks leading to high complexity in decisions, i.e., the decision for a new runway may take some decades. In addition, the large range of stakeholders that involved in the decision process is also an essential issue that must deal with. Considering the limitations of the real-world life, the decision-making key question deals with economic benefits subject to operational, financial and competition restrictions. Agencies, authorities and stakeholders need accurate estimations about the overall impacts on the regional and national economy to support investment decisions and define policies towards improvement of connectivity networks and accessibility infrastructures. Therefore, the assessment of any business scenario has to be supported by short- and long-term economic impact assessment providing clear message to decision-makers about the existing and future socioeconomic benefits in regional economy.

Key objective of this chapter is to quantify the economic impact of air transport on regions that heavily depended on outbound tourism. By a top-down analysis, the key trends of tourism and aviation market are highlighted, providing the linkage between these two industries. According to a systemic approach, the methodology concept and the modelling are presented, providing the framework for relevant case studies. Conventional wisdom is to provide an easy-to-handle tool appropriate for relevant case studies and highlight key messages to decision-makers, stakeholders and aviation authorities in their strategic decisions regarding air transport market development. The case studies presented in this chapter are related to Mediterranean region and focused on Greece, which is a very attractive summer holiday tourist destination.

## **2. Air transport and tourism**

The relationship and the complexity between tourism and air transport have been an investigation area in many researches. As analysed in Refs. [1, 2], any changes in tourism business environment are closely linked to air transport industry fluctuations as well as socioeconomic development, and any restrictions on air transport development may lead to constraints in connectivity, accessibility and mobility. Tourism demand for air transport is strongly related with global economy,

trade and population, changes and innovation [3, 4]. Air transport is a demand-driven industry where the origin-destination pairs and mode choice are defined by the cost, time and level of service variables. The population distribution, the tourism choices and the trade and consumption patterns are key factors that determine the air transport market and mobility [1]. All these factors have significant effects for the economies especially in remote tourist destinations where the highest share of their income is generated by tourism delivered by air transport.

As highlighted in Ref. [5], the key drivers of the tourism growth in a specific destination deal with the macroeconomic economic environment of the origins and the destinations, the transport cost and the regulations as well as the supply chain and performance. The passenger's decision for choosing the most suitable holiday option depends on a variety of factors such as the consumer profile, the distance of the final destination, the transport options and the price of services [6]. In Refs. [7, 8], it is claimed that the complexity of the tourist consumer's decision process and the transportation accessibility level of service are correlated to tourism market trends.

Institutions, associations, authorities and governmental bodies, widely, recognise the need for monitoring tourism demand and adopt strategies to achieve the economic benefits of tourism. According to Ref. [9], many regions draw a considerable part of their income from the tourism industry, which in turn is heavily dependent on the aviation industry. Therefore, on a national scale, the relationship between aviation and tourism needs to be investigated not only to extrapolate the demand trends but also to adopt policies, defines strategies and supports decisions towards tourism market growth.

In principal, the concept of sustainable air transport faces the challenge that decision-makers of all functions of air transport, economic and social system could consider different perspectives. These different expectations may lead to conflicts in planning and implementation of strategic plans, making authorities defend to demand growth.

The sustainability of air transport sector is based on demand variables on the one hand and supply variables on the other [10]. These variables are affected by the transport business, the economy conditions and the social values of the region, as analytically described in **Figure 1**.

Special care should be given to environmental implications that may have a range of diverse impacts on transport and tourism sector and services especially for the remote tourist destinations. These implications may vary significantly by region and depend on the local or regional circumstances and vulnerabilities, including those associated with the natural environment, as well as many socioeconomic factors [1].

The related demand variables such as the transport cost, per capita income, social security, education and health and the related supply variables as transport asset portfolio, working force capital and non-tangible capitals affect the decision-making process in order to improve the air transport sector efficiency and lead to the equilibrium between air transport sustainability and economic development.

Air transport sector demand variables and economic system supply variables interact with each other as air transport makes significant direct and indirect contributions to the economy and increases the cycle of economic activity. In addition, air transport, as an indicator of a network's concentration and its ability to move passengers from their origin to their destination,

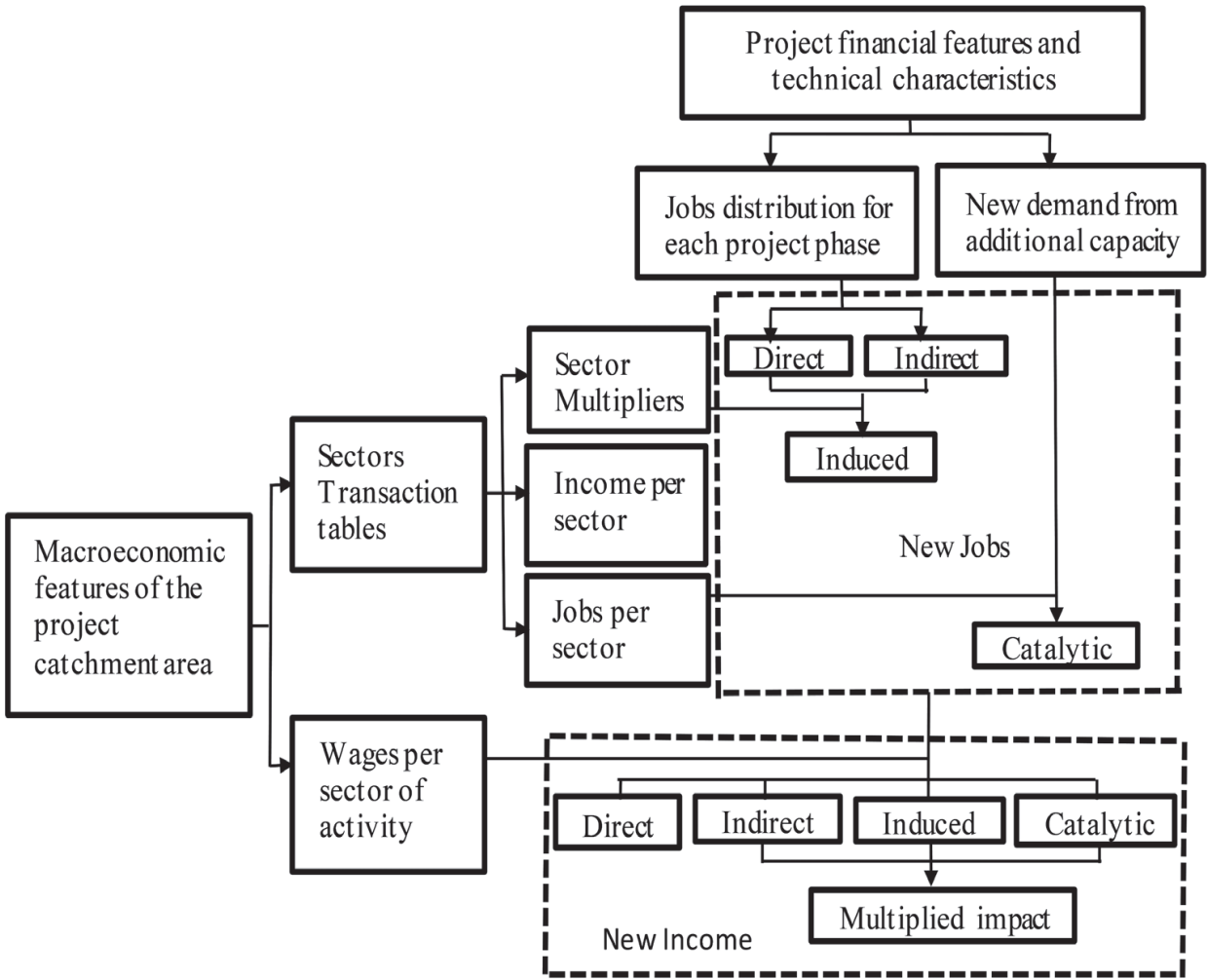


Figure 1. Demand-supply variable decision-making in air transport industry (source: [1]).

creates wider economic benefits of trade in services and goods, tourism, foreign direct investment, productivity and innovation.

### 3. Methodology for estimating air transport economic impact

In literature as regards the air transport interaction with economy, there are many empirical analyses and ex-post assessments that analyse the sector’s socioeconomic impact with different methodologies, with no unique approach to determine the interdependence of the two industries. Ref. [11] provides a guidance to estimate the economic effects of air transport, typically relying on the following approaches: the assessment of costs and benefits and the impact analysis methods (multipliers) [11].

#### 3.1. Cost-benefit analysis (CBA)

Cost-benefit analysis (CBA) may be a valuable tool for cases where a large number of investments in the air transport sector have to be ranked against each other and define a strategic

investment plan in order to influence decision-making process [12]. CBA is an analytical method that is frequently used in ex-ante analysis and is applied to investments into the transportation sectors in order to provide evidence so decision-makers can justify their decisions [12].

In Ref. [13], the role and position of CBA in the transport planning process are presented, partly based on a survey of a number of countries where CBA plays a formalised role in decision-making and is concerned with the appraisal situation in the overall decision-making process and if CBA appraisal results actually influence decisions. Elliasson and Lundberg [12] confirmed that since decision-makers are knowledgeable in regard of CBA appraisals, they take this into account when selecting public investments early in the decision-making process.

On the other hand, there are many researches that claim that CBA does not support decision-making process in a sufficient way. Odeck [14] claimed that most of the variables determining decisions are included in CBA evaluation, but the decision-maker takes account of them in nonmonetary units rather than in a composite benefit-cost ratio or net present value. Furthermore, as in Ref. [14], it is also supported that CBA does not matter in stakeholders decision making, but its components matter in a nonmonetised form [14].

In Ref. [15], 10 large transport projects in eight countries that had benefited from EU Cohesion and ISPA funding are examined, and the not extended contribution of all the relevant economic impact analysis tools, especially such as the CBA framework and multi-criteria analysis framework, was identified. Mouter and Annema [16] noted that the debate between many economists claim the fact that CBA is an overestimated framework not so extended and not so useful in the stakeholders decision making process and this is a major problem in multiagent decision making as it results in big debates between the different stakeholders and agents about the positive and negative effects of CBA results.

### 3.2. Air transport regional economic impact analysis

“The air transport industry has a substantial economic impact, both through its own activities and as an enabler of other industries [17].” Economic development can be influenced by air transport sector mainly through direct, indirect and induced cycles [12]:

- Direct air transport regional economic impact represents the flow of capitals (income) into a given economic system, generated from the airport activity (employees and airport company) located in under examination region.
- Indirect regional economic impact, respectively, representing the capital (income) generated from the suppliers of the airport such as airlines and all the supply chain services for passengers and goods due to the airport operation.
- Induced regional economic impacts, respectively, deal with the capital (income) generated by all the other sectors of the regional economy which are taking the benefits of air transport sector development [11].

Besides direct, indirect and induced effects that spur economic regional development as analysed in Refs. [17–19], there is also an additional impact, the catalytic that encourages further investigation to identify aviation economic sector outputs interacted with other sectors of the economy such as tourism, trade, real estate [20].



The quantification of benefits as part of the previous analysis of the types of impact caused by air transport is calculated through economic impact analysis. Economic impact analysis traces the effects of expenditures of the air transport sector through the economy. An initial expenditure circulates through the economy and creates a chain reaction of additional expenditures [21].

Economic impact analyses usually are based on two different methods for analysing economic impact. The one is the input-output analysis (IO analysis), based on interindustry transactions and business sectors in order to quantify the response of the change in one business sector to another. Based on these data, multipliers are calculated in order to be used to estimate economic impact. An alternative methodology for conducting economic impact analyses is the Computable General Equilibrium (CGE) models. The fundamental difference is that in addition to what IO analysis does, CGE attempts to forecast the impacts due to future economic, price, economic and population changes.

### *3.2.1. CGE method*

CGE analysis is being employed to explore the economic impacts of policy initiatives and frameworks and broader changes as environment-economy interactions, structural adjustment, technological change, labour market deregulation, financial market deregulation, taxation changes, macroeconomic reform and international capital interactions [19].

CGE methodology is based on interindustry transactions and business sectors and concept of multipliers but in addition attempts to forecast the impacts due to future economic conditions, prices, population variations [19]. CGE models can be described as a set of equations solved simultaneously to find prices at which quantity supplied equals quantity demanded (equilibrium) across all (general) markets. CGE models can broadly be distinguished according to their level of spatial detail (i.e., national, multiregional) or to time dimension (static versus dynamic) [21].

CGE models are valuable for analysing policies that affect different sectors in different ways. They can help capture the impacts of a policy on a factor (capital, labour and land), on commodity markets, on household types and on different regions. CGE models are also valuable for understanding the welfare and distributional impact of alternative policies. They are capable of capturing the indirect effects of a wide range of policy changes, and they represent a much more broad approach to estimating impacts, but the main disadvantage is that they predict consumer profiles and price fluctuation in the future with a high level of uncertainty [6].

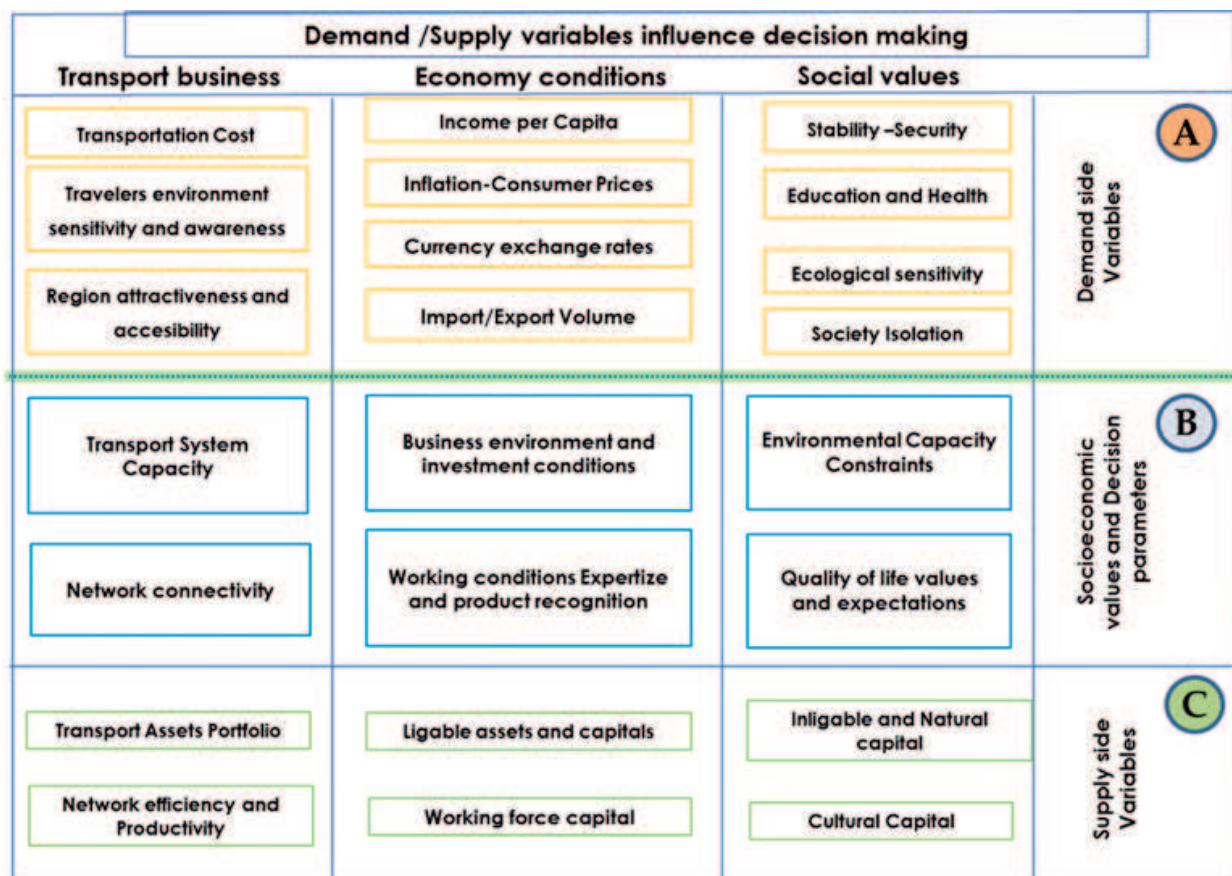
### *3.2.2. IO method*

IO analysis based on the concept of multipliers is an appropriate approach to evaluate how an economy may react to specific policies or external shocks or changes such an investment in a new transportation infrastructure project. Developed by Wassily Leontief in the 1930s, input-output method analyses the interdependence of industries within a given economy. Input-output analysis is based on a system of linear equations that describe the distribution of an industry's product throughout an economy [22].

More specific, IO method provides a complete picture of the flows of products and services in an economic system, illustrating the relationship between producers and consumers and the exchange of goods and services among economic sectors. In other words it illustrates all monetary market transactions between various businesses and also between businesses and final demand sectors as, for example, a new investment. Thus, they can be used to construct disaggregated multipliers in order to estimate apart from the direct impacts of a particular investment also its indirect impacts, induced impacts and catalytic impacts [23]. The conceptual framework of the IO method is depicted in **Figure 2**.

Mainly limitations of input-output analysis are lack of price effect, difficulties at the data collection or differences in defining and calculating each effect [24].

Applications of IO models have traditionally focused on the national level, but modifications to the method with specific local characteristics and regional economic development are also popular [25]. Rong and Yu Chang [26] investigated the role and influence of the transportation sector on the national economy of Taiwan using input-output analysis. In Ref. [22], an input-output inoperability model is used as a mechanism for analysing the induced effects caused by critical infrastructure dependencies and interdependencies.



**Figure 2.** IO model depiction (source: [14]).



## 4. IO modelling framework

### 4.1. Key definitions and assumptions

A regional or national economic system could be depicted by a capital flow table between all the sectors of the economy that is the base IO table. This table is the sum of all the business sectors that constitute the gross national product [27]. Even though some business sectors' total capital output may be lower to the overall value added; however, for simplification reasons, it is assumed that each business sectors' total income output represents the weight of this sector to a given economic system. In Ref. [27], it is noted that this is one kind of balance of the economic system, which can be called a balance between final output values and value added [27].

Mathematically, the IO table is depicted as a matrix where the rows and columns represent different business sectors. Each cell of the matrix provides the income (production and consumption) between different business sectors for a given time window, usually, annually. Construction business sector, for instance, would create income to the fabricated metal business sector. Obviously, it is too costly to collect and store all the transaction between all economic sectors; therefore, in the most of the developed world states, it happens periodically between 3 and 5 years. For the years with no actual data, the IO table figures are given by a time series regression analysis, based on the last available actual data.

Reviewing the economic impact of air transports in a region, the analysis framework provides results for three distinguished causalities, measuring the changes caused not just to air transport business but also to the maintenance and the new investments delivered to improve air transport infrastructures. As a result, even for the same demand level, the IO analysis may provide different results over time, resulting in high variations in income generated in various business sectors, depending on the capitals spent for construction, operation and maintenance of infrastructures, according to Ref. [28].

According to Ref. [29], it is assumed that the economy can be categorised into  $n$  sectors. If the total output is denoted by  $x_i$  and by  $f_i$  of the total final demand for sector  $i$ 's product, then the simple equation accounting for the way in which sector  $i$  distributes its product through sales to other sectors and to final demand is

$$X_i = z_{i1} + \dots + z_{ij} + \dots + z_{in} + f_i = \sum_{j=1}^n z_{ij} + f_i \quad (1)$$

In IO analysis, the fundamental assumption is that the flows of sector  $i$  to  $j$  depend on the total output of sector  $j$ . The  $z_{ij}$  terms represent interindustry sales by sector  $i$  (also known as intermediate sales) to all sectors  $j$  (including itself, when  $j = i$ ) [29].

### 4.2. Technological coefficients

The fundamental step of the IO analysis is to convert the interindustry transaction table into the direct purchase coefficient table. Based on the above-mentioned assumptions of the IO table that the flows of sector  $i$  to  $j$  depend on the total output of sector  $j$ , the technical

coefficient can be derived by dividing the flows between the business sector  $i$  to business sector  $j$  ( $z_{ij}$ ) with a overall output of business sector  $j$  ( $X_j$ ). The function that depicts the total technical coefficient table is [29].

$$c_{ij} = \frac{z_{ij}}{X_j} \quad (2)$$

where  $c_{ij}$  is the IO coefficient defined as direct input coefficient. The  $c_{ij}$  determines the flows between the business sector's output and its inputs and is defined as follows [29]:

$$z_{ij} = \frac{c_{ij}}{X_j} \quad (3)$$

IO table describes the national economy as a system that depicts the flows between  $m$  business sectors. The input output economic system equilibrium equation of this model can be written in matrix as Ref. [29] defines:

$$(I - A)^{-1} X = F \quad (4)$$

where  $I$  is the  $m \times m$  matrix,  $X$  is the nonnegative vector of the total output of the business sectors,  $F$  is the nonnegative vector of the final demand,  $A$  is the  $n \times n$  nonnegative matrix of technological coefficients or the input-output matrix and  $m$  is the number of business sectors in which  $(I-A)^{-1}$  is the multiplier or Leontief inverse matrix [29].

The matrix  $(I-A)^{-1}$  is the inverse of  $(I-A)$  and is defined as the Leontief matrix. The solution of Eq. (4) has a meaning if and only if  $(I-A)$  is a non-singular M-matrix. Indeed, the theory of M-matrices implies that a nonnegative solution  $x$  exists corresponding to each nonnegative  $m$ .

### 4.3. Modelling regionalisation

The approach of a regional IO modelling framework tries to adapt the national input-output tables with the use of location quotients derived from differences of regional and national employment and production patterns. A simple location quotient for each regional economic sector can be defined as:

$$SLQ_i^r = \frac{Q_i^r}{T^r} \frac{\frac{Q_i^r}{T^r}}{\frac{Q_i^N}{T^N}} \quad (5)$$

where  $Q_i^r$  is the total output of business sector  $i$  in region  $r$ ,  $Q_i^N$  is the total output of business sector  $i$  in nation  $N$ ,  $T^r$  is the sum of all business sectors in region  $r$  and  $T^N$  is the sum of all business sectors in nation  $N$ .

The SLQ depicts the region's capability in producing the output of a business sector. Referring to Eq. (5), an SLQ of less than 1.0 means that the output of regional business sector  $i$  represents a small proportion of the total gross output. Thus, if  $SLQ_i$  is less than 1.0, the region imports

some of the output of the sector  $i$  from elsewhere in the nation  $N$  as in Ref. [30] is analysed. Similarly, if  $SLQ_i$  is greater than 1, the region exports some of the output of its sector to the rest of the nation  $N$ .

## 5. Numerical examples: case studies

The case studies provided in this section are referred to the economic impact footprint analysis of air transport sector in Greece, highlighting the overall economic impact in national economy, setting estimations for the development of a new airport and providing comparisons with other tourist regions in Mediterranean. The analysis framework is based on IO modelling as given above.

### 5.1. Economic footprint of air transport in Greece

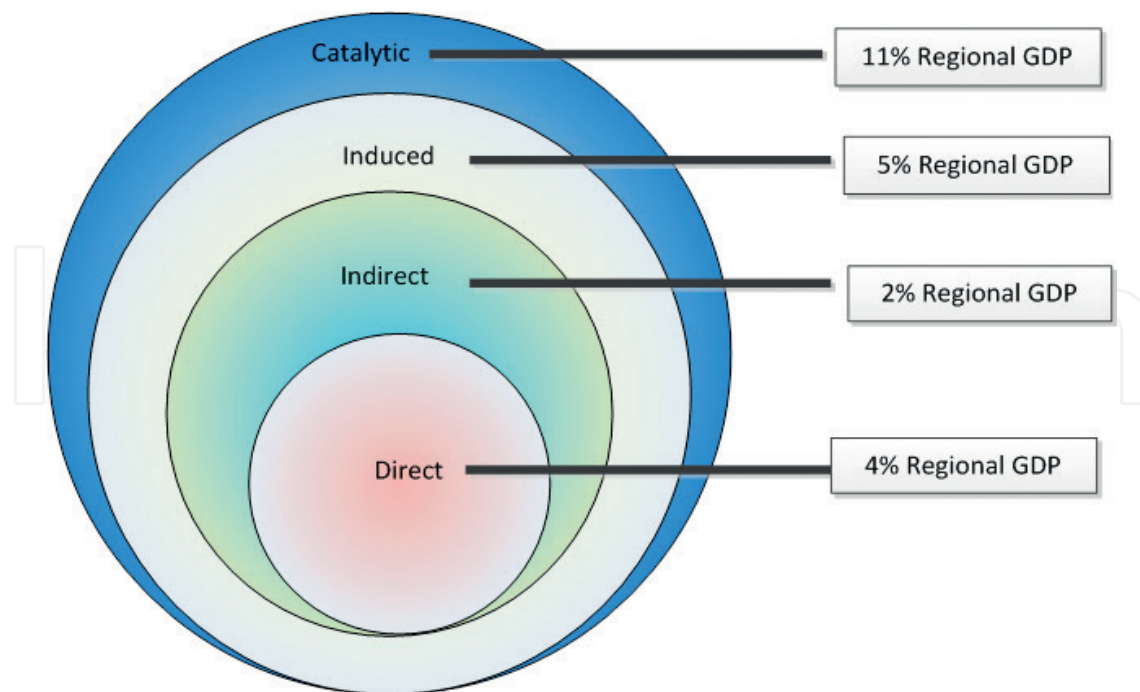
Greece attracts a high number of tourists because of the warm weather, the excellent climate, the 16,000 km of coast along the Mediterranean, the spatial allocation of Greek islands in Mediterranean (Aegean Sea) and the high number of archaeological and cultural places. Tourism in Greek economy production model has achieved a satisfactory performance, as according to Ref. [31], in 2012, Greece was in the 17th position as regards the number of international tourist arrivals and 23rd as regards international tourism receipts. Moreover, according to Ref. [9] in 2013, Greece was ranked in the 32nd position between 140 countries as the Travel and Tourism Competitiveness Index 2013 analysed, while Greece ranked in the 96th position in the Global Competitiveness Index 2013. This proves that tourism is one of the most competitive sectors of the Greek economy at a global scale. Since tourism destinations are a long distance from the tourist home residences (highest share in Germany, France, Holland, the UK), air transport becomes the most important transportation mode, and aviation industry fulfils the task for over 70% of the international tourist arrivals (ITA) in Greece [9].

In terms of air transport traffic, 38 million passengers arrived and departed from Greek airports in 2013 [32]. The five largest airports are Athens, Heraklion, Thessaloniki, Rhodes and Chania, which handle almost 28 million passengers in 2013. It is noteworthy that for Heraklion, Rhodes and Chania, almost 90% of the passengers are leisure travellers during the summer and almost 65% of the traffic in Athens and Thessaloniki accommodated during the summer season [32]. Applying the IO analysis framework, it appears that the total contribution of air transport sector to the national GDP amounted to 10.8% (**Figure 3**).

In conclusion, air transport sector in 2013 direct, indirect and induced contributed to 3.8% to the country's GDP, whereas its catalytic contribution was estimated at 7% confirming the large interaction between air transport and national economy [33].

### 5.2. Economic footprint of a new tourist airport

The decision-making process to invest in a new airport is complicated, mainly, due to the planning process restrictions, the amount of capital investment needs and the many stakeholders



**Figure 3.** Contribution of air transport to the national GDP (Greece, year 2013) (source: [33]).

involved in decision process. Especially in tourist seasonal airports, where the new airport development is strongly related to the regional competitiveness and medium-long-time sustainable development, the decision may take very long time.

This case study focuses on the establishment of a new regional airport with high seasonal traffic nature, like airports located in tourist destinations. The new airport is based on the island of Crete (approx. 30 kms for the centre of Heraklion city at Kasteli valley), which is one of the most attractive tourist destinations in south-east Mediterranean.

The construction cost of the new airport is estimated at € 800 million comprised mainly of the construction of runways, terminal, roads, parking lots and control tower. The construction period is 5 years. The project financing and management scheme will follow the public-private partnerships (PPP). The new airport will be developed on a design-build-finance-operate-and-transfer (DBFOT) basis for a period of 35 years.

Applying the IO modelling is estimated that approximately the 4% of GDP in the island of Crete is generated directly due to the existing Heraklion airport. The circulation of direct and indirect impacts through the regional economy contributes additionally 7% to the GDP [25]. Finally, it is estimated that 11% of the regional GDP is created due to catalytic impact (**Figure 4**).

The construction of the new airport will create an additional 10% contribution to the regional GDP during the construction period through the direct employees, the indirect referring to the suppliers of the construction works and the induced employees, thus recycling to the regional economy due to direct and indirect impact. Furthermore, the operation of the new airport will create an additional 8% contribution to the regional GDP during the first 5 years of operation period through the catalytic impact.

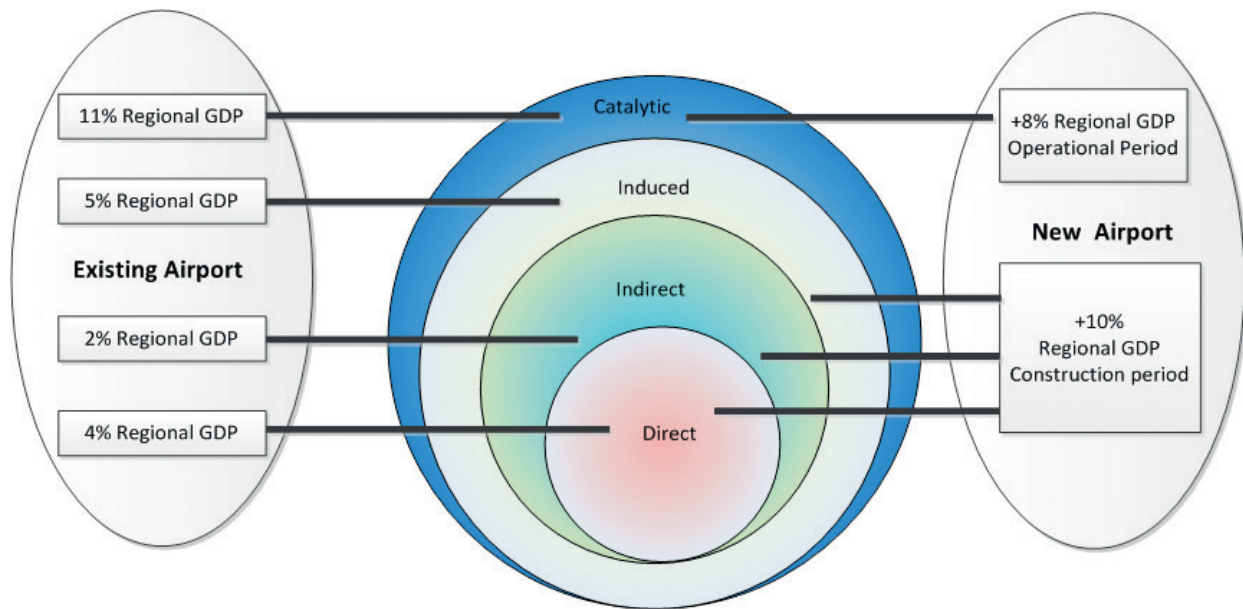


Figure 4. Contribution of existing and new airport to regional GDP (2010 prices) (source: [21]).

The results provide the evidence that the development of a new airport will spur economic growth by generating additional income through the construction period and through the operation through increased tourism demand.

5.3. Economic footprint in Mediterranean tourist destinations

The Mediterranean region is one of the most attractive tourism destinations in the world, accounting for approximately one third of the world ITA (423.7 million ITA in 2013) according to Ref. [31]. For decades, the Mediterranean destinations have provided, along with other

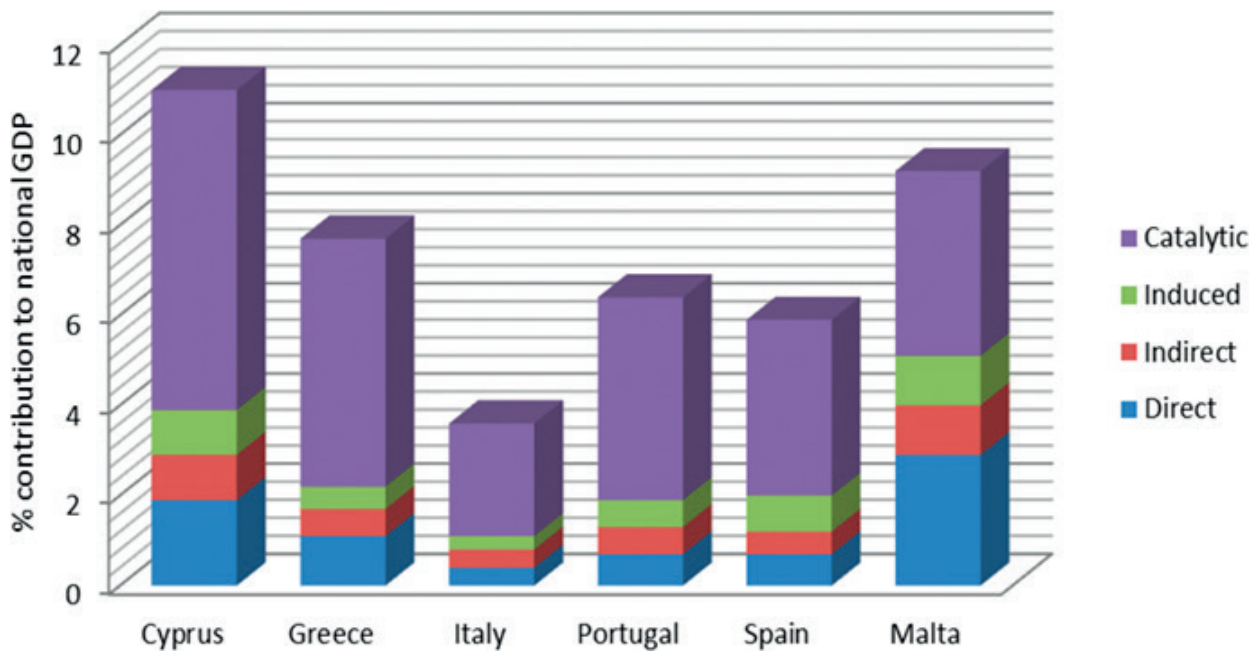


Figure 5. % Contribution of airports in North Mediterranean countries to GDP (2013) (source: [34]).



attractions, the traditional sun, sand and sea product, essentially for the North European markets. Spain, Portugal, Greece, Cyprus, Malta and Italy are the leaders in attracting tourists in the region of North Mediterranean. Tourism in these countries is one of the major sources of national income [31].

According to Ref. [34], for 2013, the contribution of the airports for six main Mediterranean countries to the national GDP ranges from 3.5% of to 11% (**Figure 5**).

Especially for destinations with high percentage of air transport ITAs like the islands of Cyprus and Malta, the contribution of air transport to national GDP extends to 11 and 9.2%, respectively. It is also highlighted that Greece due to the dispersion of tourist destinations, the intense seasonality and a large number of airports, has the highest share of airport contribution to the national GDP (7.6%) in comparison with other Mediterranean countries [34].

## 6. Conclusions

Tourism industry performance is determined from the demand it generates for products and services and plays significant role in the regional development of tourist destinations, contributing to income growth and sustainable socioeconomic development. Due to the high interaction of air transport and tourism industry, the air transport sector is considered to be extremely a crucial driver of socioeconomic development for these tourist destinations.

The competitive environment and globalisation of tourism and air transport business sectors result in the essential manner that strategic and business planning settles regional targets in order to achieve higher outputs. A key success factor is to define a clear, compact and coherent strategy appropriate to support decisions based on the commercialisation of the necessary improvements in tourism and air transport industry. Therefore, the quantification of the economic effects caused by air transport sector is an essential task to support decision and policies.

Key benefit of this chapter is that it presents the methodological framework to quantify the wider economic outputs of air transport in tourist destinations, appropriate for planners, managers and decision-makers to apply in relevant cases. The case studies' findings improve understanding of the close interactions of air transport and economy and which are the determinants that affect the contribution of air transport economic development of tourist destinations and especially remote tourist destinations. The application results provide a strong evidence of the existence of this long run cointegrating relationship among economic development and air transport sector.

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