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COMPUTATIONAL MODELING FOR EVALUATING THE ECONOMIC IMPACT OF AIRPORTS ON REGIONAL ECONOMIES

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ABSTRACT

Airports, as fundamental nodes of the air transport network, reflect the economic status of the region they serve and act as major engines of economic development, as was stated in ACI 2004. The impact of regional tourist airports on their region is more important due to the fact that there is a high interrelation between airports and tourism. A growing literature on this subject highlights the methods used to calculate the total effect of an airport on regional economy, and the difficulties entailed in such calculations.

The key objectives of this research are to develop an econometric assessment model based on a computational modelling concept that will estimate the economic impact of Regional Tourist Airports on Regional economy. The modelling framework is based on the Input Output Analysis concept and is in accordance with the theoretical principles of regional and national Economics, as well as all the reviewed models which have been developed globally, in order to assess the regional economic significance of airports and transportation projects. The case study of the research is the new airport in the Island of Crete in Greece, one of the most attractive tourist destinations in southeast Mediterranean.

Conventional wisdom dictates the presentation of a Computational Input Output Model, appropriate for this purpose, in order to quantify the total value of the new airport operation in terms of jobs and income, at a regional and national level. The Economic impact that the Model will estimate includes four categories of impact: direct, indirect, induced and catalytic. The model outputs will measure these impacts in terms of Jobs, total Income and Total growth of GDP.

The goal is to create a Model, which will be appropriate for application in relevant tourism regional airports, giving an essential tool in order to support decisions at the level of strategic planning, providing essential results about the impact of tourist airports developing a new airport and estimating the economic development.

ACKNOWLEDGMENTS

This thesis is the result of an effort that actually began three years ago; an effort to improve my skills and my personality. I do not really know if I have managed to improve my personality but undoubtedly with this research I have really learned many things not only about the economic impact but also about the way an economic growth through an airport development in the next decade is encouraged.

It is a pleasure to thank those who made this thesis possible. First of all, I would like to thank my supervisor Dr. Dimitrios Dimitriou; without his help, guidance, motivation and support I could not have finished this thesis. During all these years unpleasant events made me lose my willingness and the courage to continue what I have started. Dr. Dimitriou was always there to encourage me; he always knew what to say to keep me on track and to enhance my efforts.

I would like to acknowledge and express my gratitude to the personnel of the Department of Aerospace Science; their help and support throughout the years of my research made this thesis possible.

On the personal side, I would like to thank my parents, Sofia and Fragiskos Sartzetakis, for their continuous (psychological and financial)support all these years.

Sartzetaki Maria

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ABBREVIATIONS

ACI	Airport Council International
ICAO	International Civil Aviation Organization
I-O	Input Output model
CAA	Civil Aviation Authority
CGE	Computable General Equilibrium
DOT	US Department of Transportation
FAA	Federal Aviation Administration
FTE	Full Time Equivalent
GAV	Gross Added Value
GDP	Gross Domestic Product
IATA	International Air Transport Association
LQS	Location Quotient
OECD	Organization for Economic Cooperation and Development
PAX	Passengers
WTO	World Tourism Organization
WLU	Work Load Unit
ATAG	Air Transport Action Group
AOA	Airport Operators Association
IMPLAN	A micro-computer-based input output modelling system
MPAX	Million Passengers

BASIC ECONOMIC IMPACT TERMS

Region	The Geographic area for the Economic Impact
NAICS	North American Industry Classification System
Sector	A group of industries
Final Demand	Sales to final consumers
Intermediate sales	Sales between industries
Endogenous Variable	Variable in an economic/econometric model that is explained, or predicted, by that model
Exogenous Variable	Designates variables that appear in an economic model, but are not explained by that model
GDP	Gross domestic product is the value-added produced in the domestic economy regardless of the origin of the production factors.
National Accounts	Consistent macroeconomic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications
Final Demand	Transactions that involve purchases of produced goods and services for final uses are presented in final demand table
Final consumption	Final consumption consists of goods and services used up by individual households or the community to satisfy their individual or collective needs or wants.
Imports	Imports are payments for goods and services originating from abroad or from other provinces or territories
Industry	An industry is a group of establishments engaged in the same or a similar kind of economic activity
North American Industry Classification System	The North American Industry Classification System (NAICS) is an industrial classification system used to group producers into industries on the basis of similarities in their production processes
Output	Output consists of the goods and services that are produced within an establishment that become available for use outside that establishment

Value added	Value added is the value that a producer adds to its intermediate inputs
Exports	Exports are receipts from other provinces and territories or from abroad for sales of merchandise or services.
Tourism	The activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes."
Tourism Industry	Tourism Industry is an industry that would cease to exist or would continue to exist only at significantly reduced levels of activity in the absence of tourism
Base year	A reference period in the past that provides prices for valuing current production of goods and services
Sector i	a grouping of industries that produce similar products or services. Most economic reporting and models in the U.S. are based on the Standard Industrial Classification system (SIC code). Tourism is more an activity or type of customer than an industrial sector.
Multipliers	capture the size of the secondary effects in a given region, generally as a ratio of the total change in economic activity in the region relative to the direct change
Income	is the money earned within the region from production and sales. Total income includes Wage and salary income, and Proprietor's income, rents and profits
Jobs or employment .	a measure of the number of jobs required to produce a given volume of sales/production. Jobs are usually not expressed as full time equivalents, but include part time and seasonal positions

1 INTRODUCTION

The significant role of tourism in local economy has been well recognised in many researches, such those presented by Davies and Downward (2006), Tretheway and Mark (2006), and Hoti et. al. (2007). The relationship and the complexity between tourism and air transport have been an area of investigation in many researches, such as the research presented by Cooper et al. (2005) which concludes that tourism remains dependent on the aviation industry and any changes in its efficiency is a significant counterpart for tourism development. Dimitriou et al. (2008) and (2009) highlights the historical relationship between tourism and air transportation, and it is concluded that changes in tourism business environment are closely linked to air transport industry innovations.

According to decision making theory, the process of the passenger's for choosing the most suitable option for holidays depends on a variety of factors such as consumer profile, distance of final destination, transport options and services, etc. The complexity of this process is well recognised on relevant researches and a variety of alternative frameworks have been applied in many cases, to provide explanations of market trends (Davies and Downward 2006). Based on World Tourism Organization (UNWTO 2009) and EUROSTAT 2008, many islands in the Mediterranean draw a considerable part of their income from the tourism industry which, in turn, is heavily dependent on the aviation industry. In addition, the new trends in aviation lead to significant changes in airport business and operation. Especially for markets relying heavily upon aviation, the relationship between aviation and tourism trends needs to be investigated to provide conclusions about future demand.

Therefore, the impact of the tourist airport on the regional economy is of great importance, due to the fact that it reflects the economic status of the region it serves and acts as an

economic development engine. European regions with airports and sufficient air services have a better social and economic development with lower unemployment, higher productivity and higher income per-capita, than regions without airports(ATAG 2008).The significant role of airports on regional economy have been well documented in many researches, such those presented by *ACI 2004*.

The local authorities in tourism regions press airport authorities to offer capacity and low cost services to meet the tourism demand needs on one hand; and provide new business opportunities to carriers to establish schedule air transport services on the other. Also, the extremely competitive environment of the tourism industry leads the tourism sector to press for more investments in airports as part of the regional and national investment planning process.(WTTC 2006)

On the other hand, the complexities of today's global economy and the uncertainty in achieving essential economic benefits in domestic or international levels, make decisions regarding investments and development of new large scale infrastructure projects, such as airports, difficult. Norojono et.al 2010 indicates that global market interactions are so pervasive in determining economic outcomes that more sophisticated empirical research tools are needed to improve visibility for investments.

Government agencies, authorities and stakeholders need accurate estimates about the impacts on the regional/national economy. The key question for all parties involved in the decision process, is whether a new airport can cause measurable economic impacts to other activities of the regional and the national economy. Therefore, an essential component for any decision is to estimate the expected impacts because of the airport development, as well as the impact to other activities of economy.

The key objective of this research is to estimate the regional economic impact caused by regional tourist airports. The methodology approach is developed to facilitate the use of an easy to handle econometric assessment modelling framework, providing essential information about the level of total economic impacts in the regional economy by tourist airports. The application focuses on the economic impact assessment of a new regional tourist airport with high seasonal traffic characteristics, such as in airports located in tourist destinations, in the island of Crete in Greece (at Kasteli valley), which is one of the most attractive tourist destinations in South-east Mediterranean. The model will provide useful results about the expected economic impacts.

This model could be used in other relevant tourism regional airports, providing an essential tool to support decisions at the level of strategic planning and forecasting the economic impact when a new airport is going to be developed.

The thesis is organised in six sections:

- In the first, the introduction describes the purpose of this research;

- The second, third and fourth section analyse the methodology framework, providing the background bibliography;
- In the fifth section the application is presented; these sections outline the key issues of the analysis that has been carried out and the key messages for the selected airport case;
- In the sixth section, the research conclusions and recommendations for further future research are presented;
- Finally, the references can be found at the end of the thesis;

2 RESEARCH METHODOLOGY

This section introduces the methodological approach adopted for the current research; the research background is based on the concept of Input Output analysis, while taking into consideration the importance stakeholders attach to different impacts. The key points of the methodological framework are given in the following chapters.

According to Saunders et al. (2009), the research strategy should enable the researcher to answer research questions and meet research objectives. In order to decide on the research strategy, the researcher identified the research objectives and research questions and reviewed the literature to come to a decision regarding which research strategies were the most appropriate, how they could be combined in this research and therefore, how the research would be conducted (Creswell, 2009).

2.1 RESEARCH AIM & OBJECTIVES

This study has the following research aim, which is then supported by the following research objectives:

Aim:
To measure the economic impact of a new airport to the regional and national economy prior to decision making.

Objectives:

The main research objectives are to:

- ✈ *develop a* computational model that will measure the contribution that a new airport will have on regional and national economy
- ✈ *assess* the macroeconomic impact of an investment on a new regional tourist airports to the regional economy in terms of employment and output(GDP).
- ✈ *quantify* the effects of the an investment on the different sectors of the economy
- ✈ *use* the model to carry out a case study of a proposed airport development in Crete

2.2 RESEARCH CONTRIBUTION

Airports play an important facilitating role as well as being a generator of national wealth and welfare on their own(ACI 2004). The research highlights the potential contribution of tourist airports to tourism development and overall regional economic development.

The research contribution is to:

- ✈ *support* decision makers to measure the gains from an investment in a new airport and understand the consequences that a new airport will have on other sectors of the economy.
- ✈ *enhance and inform* the decision making process in the region on airport development at the level of strategic planning
- ✈ *act* as a decision support tool for the government and local authorities
- ✈ *support* tourism industry to understand the consequences that a new airport will have on the tourism industry

2.3 DATA RESOURCES

The necessary data was obtained from books, journal papers, conference proceedings, official reports, airport operators' sustainability reports, airport environmental plans, airport operators' official web-sites and workshop presentations. Information regarding the key data sources is given below.

Publications, papers, journals and official reports regarding Airport economic impact studies, Methods, Models and Input Output frameworks, were examined in detail in order to review the current state from literature, regarding the analysis of economic impact of airports on the Region. The literature is revised in the references.

2.4 RESEARCH LIMITATIONS

The first limitation is that the input output tables are generally at least a few years out-of-date: therefore this is not usually a problem unless the region's economy has changed significantly because of unexpected events. So the stability of the transactions in the regional economy over time is a limitation.

The economy of the case study area (Greece) is characterized by inconstant output growth. Last 3 years suffers from recession and high and instable inflation.(rise in the general level of prices of goods and services in an economy over a period of time). So Greece's government in the part of a barrage of austerity measures in order to secure new debt agreements and rescue funds from international lenders cut state jobs and reduce wages both in public and private sector.

It is worth noting that the data used in this study were collected prior to the current economic crisis. Although the forecasts for economic and aviation growth may now be wrong, the principles that underpin the research remain invalid.

Nevertheless, based on available data, the researcher managed to meet research objectives. Consequently, the mentioned limitations affect neither the analysis nor the application and therefore they cannot reduce the importance of this research.

2.5 METHODOLOGY FRAMEWORK

The current research aims to develop a modelling framework to evaluate economic impact of airports and to support decision making in regards to a new tourist airport that is going to be developed. The research background is based on the concept of Input Output analysis. The methodological framework of the research is shown in the following figure 1.

In the following pages, the research methodological framework is going to be analysed, providing, at the same time, the background bibliography. The first two main steps ('*analyse*' and '*identify*') provide the literature review and the methodological approach to the research questions, while the next step ('*develop*') illustrates the modelling framework (detailed analysis is provided in the relevant chapter). The following step ('*apply*') refers to the application of the framework to the case study of Kastelli airport; the key issues and the results of the analysis are going to be presented. The last step ('*conclude*') provides the conclusions of the research, discussion of the key findings and recommendations for further future research.

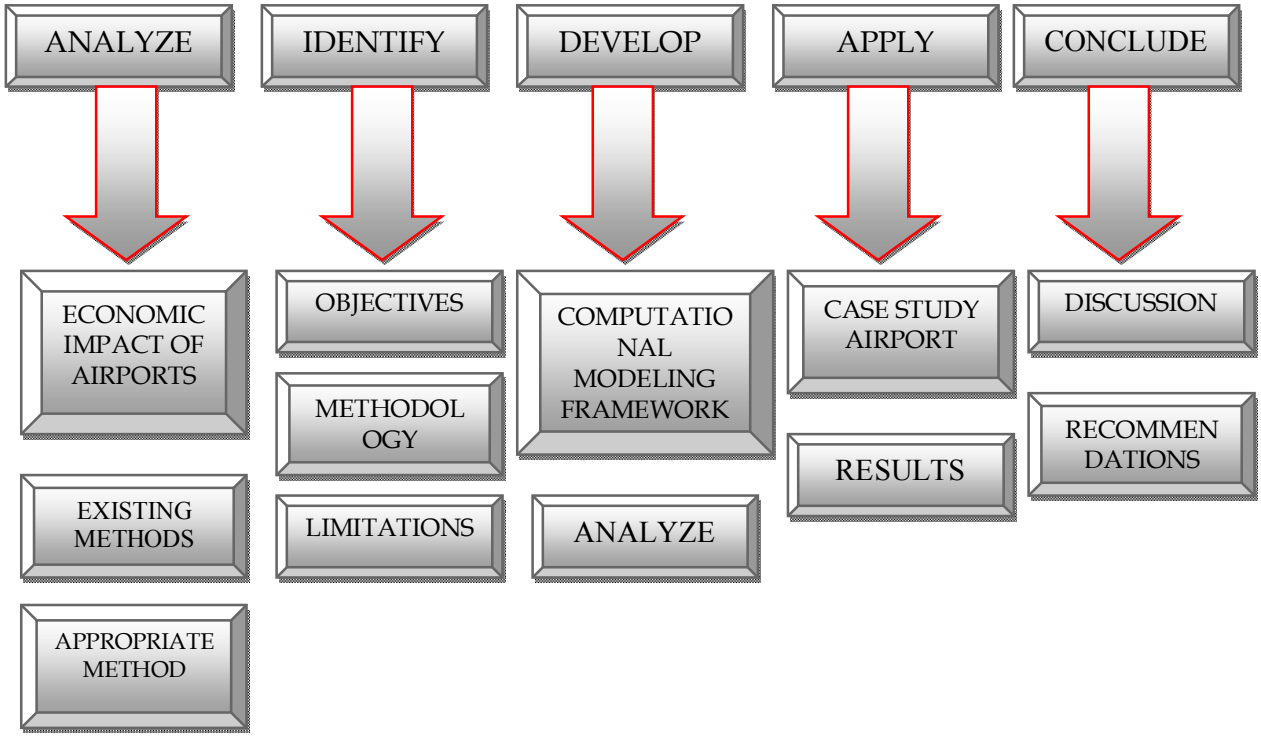


Figure 1 : The methodological framework(Source:author)

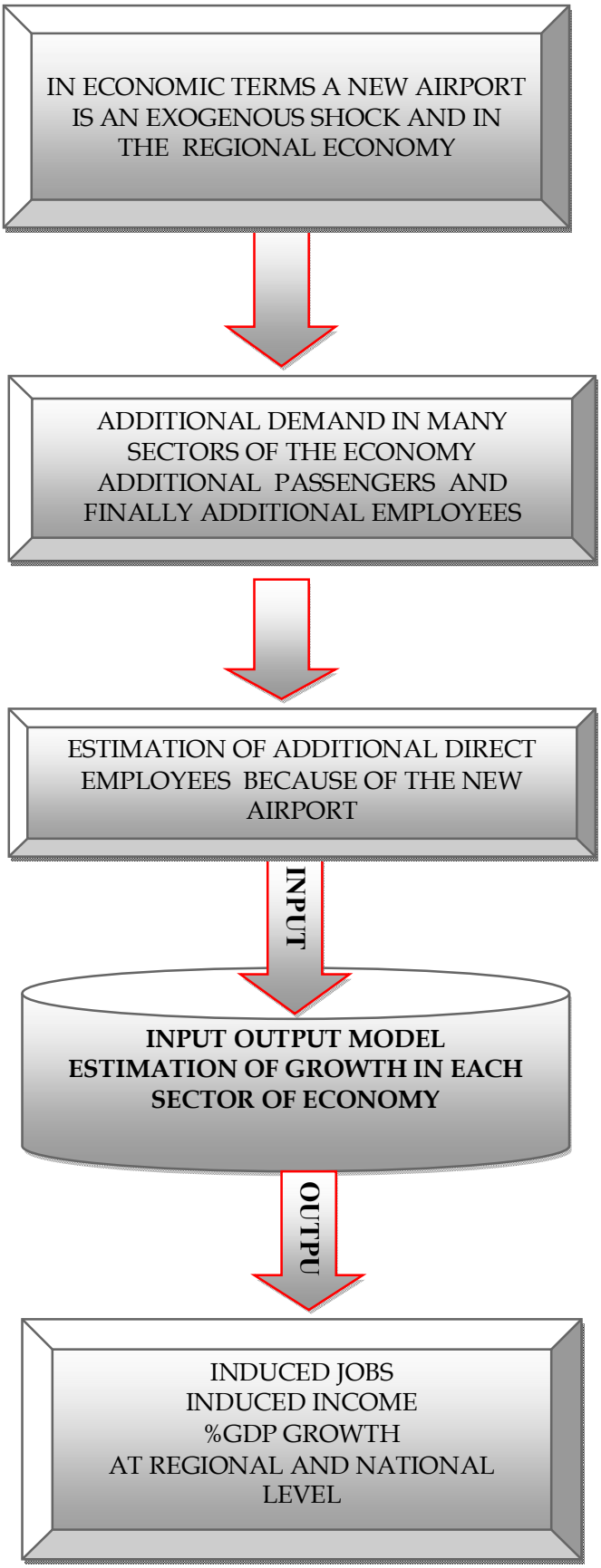


Figure 2: Concept chart of the Modeling framework (Source:author)

3 AIRPORT ECONOMIC IMPACT

3.1 NATURE OF ECONOMIC IMPACT OF AN AIRPORT ON THE REGION

In general economic terms, the Economic impact , is the Impact that a project or an activity or an event or an industry causes on the economy of a specified area.

The total economic impact of an industry is equal with the sum of direct, indirect, induced and catalytic impact of spending on that industry. This definition was offered by FAA 2009 and is standard for economic impact studies and is used to assess the aviation's unique economic contribution to the regional economy. The first level of the impact caused by an airport is the direct impact, the second is the indirect and the third is the induced.(Figure 3)

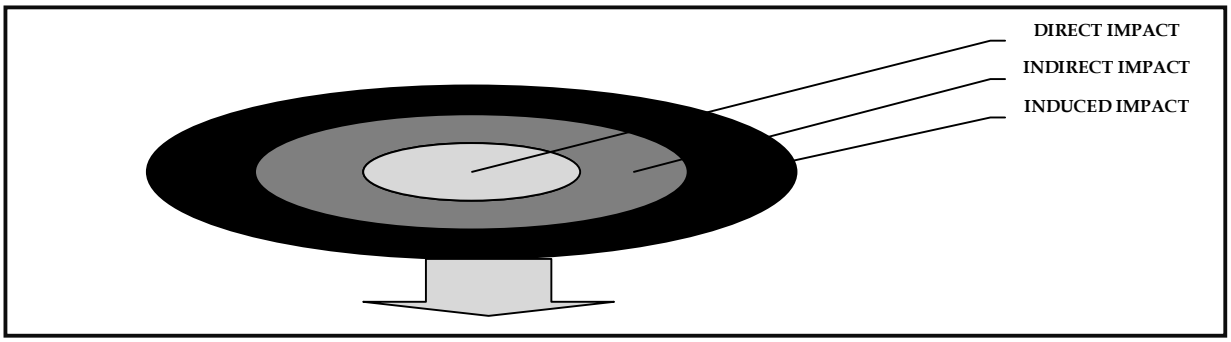


Figure 3: The cycles of the Economic Impact (source: Jacobs Consultancy,2005)

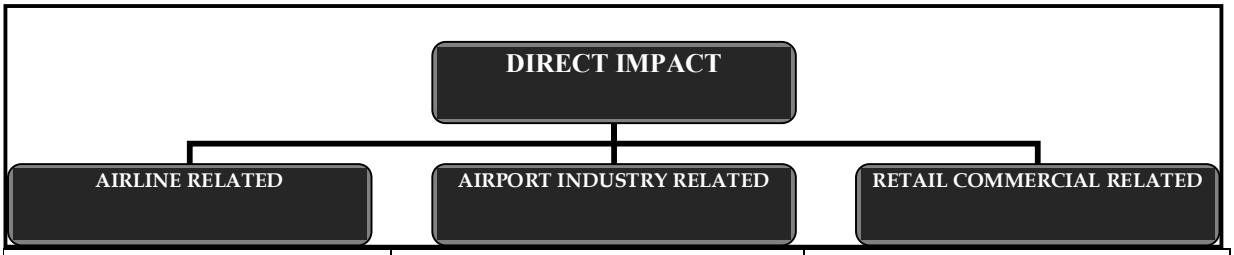
Graham 2003 suggests that airports are classified according to their economic impact characteristics in six categories:

- International gateway airports
- National hub airports
- Regional airports
- Tourist generator airports
- Tourist Receiver airports
- Transit and interline airports.

3.1.1 THE DIRECT IMPACT

The direct impact is the employment and income generated by the direct operation of the airport. Graham 2008 defines this as the most obvious economic impact and the most easily measured and quantified.
The direct employment is depended on the volume of passenger traffic and is estimated based on observable and historical relationships between airport activity generated inside the airport and air passengers volumes. There are three areas regarding employment

generated inside the airport according to ACI 1998. Figure 4 shows in diagrammatic form the areas for employment generated inside the airport.



Airline agents	Fuel storage	Restaurants
Handling agents	Warehousing	Shops
Airport operators	Control authorities	Parking facilities
Airport managers		Car rental
Flight catering		Hotels
Aircraft maintenance		Ground transportation

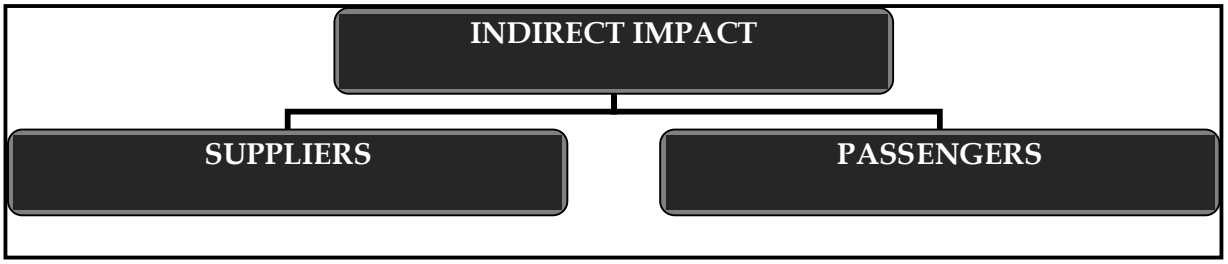
Figure 4 : The areas of the Direct Impact (source: Graham ,2008)

Klophaus Richard 2005 defines that the employment density is the total number of jobs located on the premises of an airport connected with air traffic measured in terms of handled passengers.ACI 2004 suggested the factors that determine the employment density inside the airport as follows:

- The structure of passenger traffic
- The nature of flights (scheduled/charter traffic, business/leisure passengers)
- The role of the airport (major hubs have higher employment densities)
- The number of airlines
- The nature of passengers (inbound or outbound)
- The capacity **(**due to the fixed staffing levels)
- The development opportunities (such as office development)

3.1.2 THE INDIRECT IMPACT

The indirect impact is the employment and income generated from the chain of suppliers outside the airport and from the visitors spending in proximity to the airport. The indirect Impact is estimated as the flow of Euros generated from the supply, goods, and services that are attributable to the airport by industries that are dependent on the airport and will not exist if the airport will close as Graham 2003 incorporates. Figure 5 below , shows in diagrammatic form the areas for employment generated around the airport.



Food suppliers	Transportation
Fuel suppliers	Lodging
Utilities	Entertainment
Construction	Establishment
Retail purchase	Shopping facilities

Figure 5: The areas of the Indirect Impact (source: Graham , 2005)

3.1.3 THE INDUCED IMPACT

Airport Operators Association 2005 defined Induced impact as the income spending that is generated by the direct and indirect employees on local goods and services, such as housing, transport, food, and retail. The Spending that results from direct and indirect incomes is spent again by the employees. Employees use their salaries and wages to produce services from other industries. These industries make their own produces and create employees, who also spend their salaries and wages throughout the local, regional, and state economies (AOA 2005)

The induced impact results from the spending of direct and indirect employees (FAA 2009). Induced impact is an estimation of the recycling of Euros through the economy, and is calculated using impact multipliers. Figure 6 below shows in diagrammatic form the chain of spending that generates the induced impact (FAA 2009).

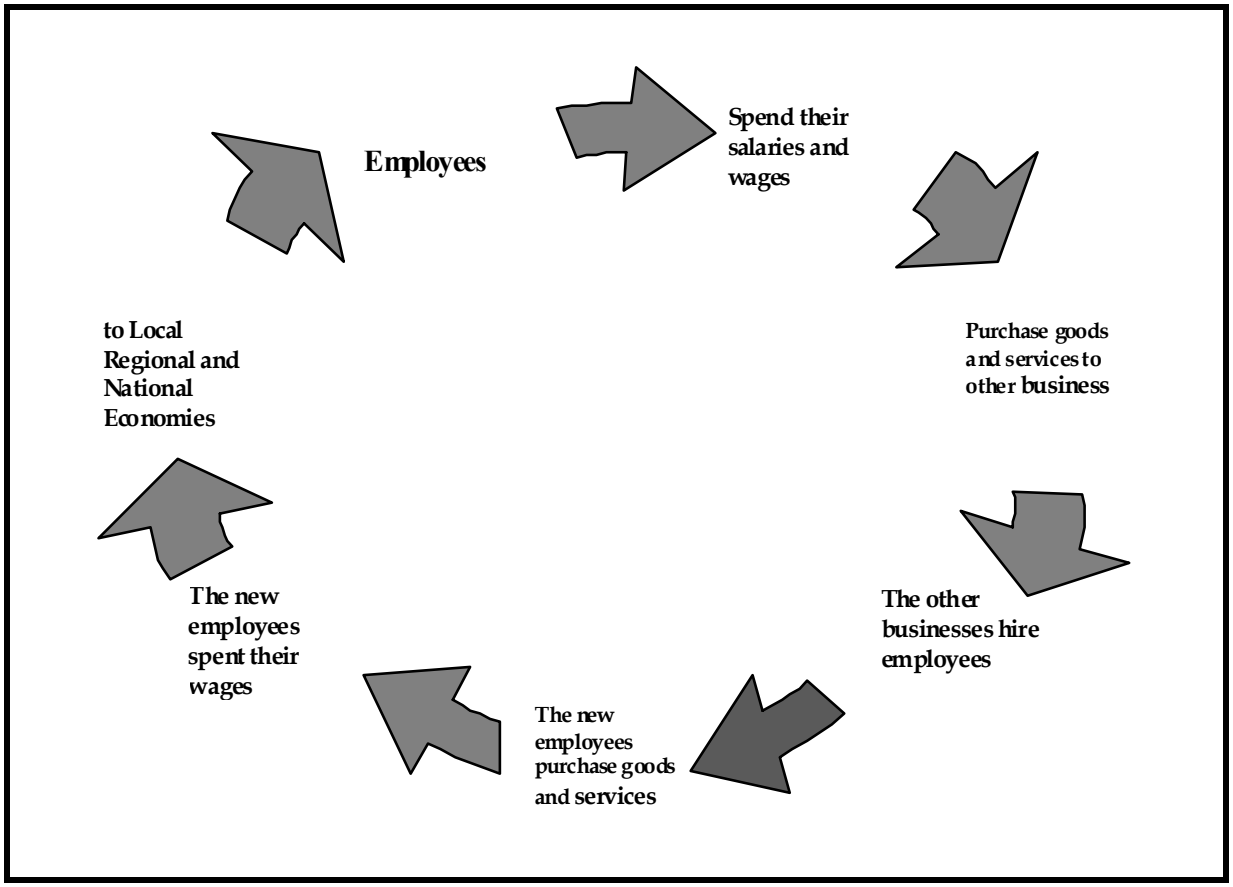


Figure 6 : Induced impact as a chain of Spending (Source: Airport Operators Association 2005)

3.1.4 THE CATALYTIC IMPACT

The airport acts as a magnet for a wide range of economic activities, and is referred to as catalytic effect (Petr Cech 2002). Graham 2008 argues that in addition to the previous types of economic impact that are generated by the economic activity generated by the airport itself, there are wider benefits, such as investment or tourism development because of the existence of the airport. These effects are the catalytic effects, and they capture the extent to which the growth in aviation transport drives the performance of other industries through tourism, trade, investment and productivity (Britton et all 2005).

Oxford Economic Forecasting 2006 states that the economic catalytic contribution of air transport to GDP is bigger than its combined direct, indirect and induced impact as it results from the contribution of air transport to tourism and trade and the contribution of growth in air transport usage to GDP.

According to OECD Report (2009) in OECD countries the sector of tourism accounts from 2% up to 11% of nation GDP . As shown in following figure Greece's the contribution of tourism sector to the nation economy is the fourth highest in OECD countries.

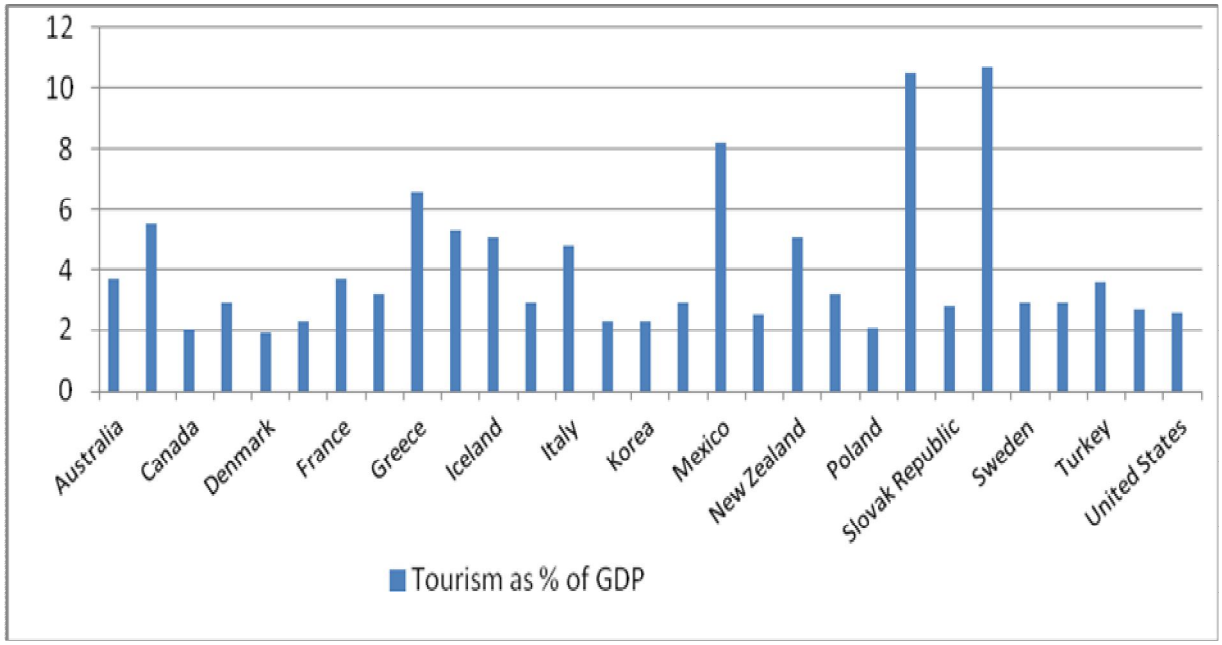


Figure 7: Tourism as % of GDP in OECD countries (Source: OECD 2008)

3.1.5 MEASURES OF ECONOMIC IMPACT

Weisbrod 1997 defines that the various measures of economic impacts are :

1. Total employment : reflects the number of additional jobs created by economic growth. This is the most popular measure of economic impact because it is easier to comprehend than large, abstract dollar figures. However, job counts have two major limitations:
   (1) they don't necessarily reflect the quality of employment opportunities, and
   (2) they cannot be easily compared to the public costs of attracting those jobs (through subsidies, tax breaks or public investments).

2. Aggregate personal income: rises as pay levels rise and/or additional workers are hired. Either or both of these conditions can occur as a result of business revenue growth. As long as nearly all of the affected workers live in the study area, this is a reasonable measure of the personal income benefit of a project or program. However, it is still an under-estimate of the true income impact, insofar as there is also some net business income (profit) generated that may be paid out as dividends to local business owners or else reinvested locally in buildings, equipment or labor training-- thus further improving the economic base of the area.

3. Value Added: (which is normally equivalent to Gross Domestic Product or Gross Regional Product) is a broader measure of the full income effect. This measure essentially reflects the sum of wage income and corporate profit generated in the study area. However, in today's increasingly global economy, value added can be an over-

estimate of the true income impact on a local area, insofar as it includes all business profit generated there -- including that paid out as dividends to owners of the business who do not reside in the study area, and that which is reinvested in corporate facilities outside of the study area. Thus, while value added is the most appropriate measure of impact on overall economic activity in a geographic area the personal income (wage) measure is often preferred as a more conservative measure of income benefit to residents of the area.

4. Business Output:(also referred to as revenue or sales volume) is the broadest measure of economic activity, as it generates the largest numbers. It includes the full (gross) level of business revenue, which pays for costs of materials and costs of labor, as well as generating net business income (profits). This can be a misleading measure of economic development benefit, since it does not distinguish between a high value added activity (generating substantial local profit and income) and a low value added activity (generating relatively little local profit or income from the same level of sales).

5. Property Values are also a reflection of generated income and wealth. However, it would be double counting to add property value impacts to income or value added impacts. After all, when property values rise in a community as a result of increasing demand for property, that may be a direct consequence of increasing aggregate personal income or investment of business profits. It is also important to note that when property values go up in one neighbourhood and down in another neighbourhood, there may be a redistribution of wealth but no net change in the overall level of local wealth or income.

Overall, these various measures of economic impact are overlapping. A portion of business output (revenue) goes to pay worker incomes and generate profits, which are also the components of value added. Property values also reflect investment of personal income and corporate profits. For these reasons, the different measures of economic impact (income, value added and output) cannot be added together.

3.1.6 SELECTION OF APPROPRIATE MEASURES

The selection of the most appropriate measures of economic impact depends on the purpose of the analysis. A public information study is aimed at representing the impacts of an existing activity or planned project. It may be used to help guide economic development policy, or it may be used for public relations purposes. For this kind of study, the number of additional jobs created is the most popular benefit measure, as it is most widely understood and appreciated. Other common measures of benefit are aggregate dollar measures of business sales and wage income created as a result of the project. Other measures of benefit, such as value added or gross domestic product are also legitimate indicators of economic impact, but are less well understood by the public and political decision-makers.

The airport, in the framework of an Economic Impact Analysis of this research, is considered as an industry that causes economic growth. The measure that are selected to depict this growth are: employmentt, income and %GDP as shown in Figure 2

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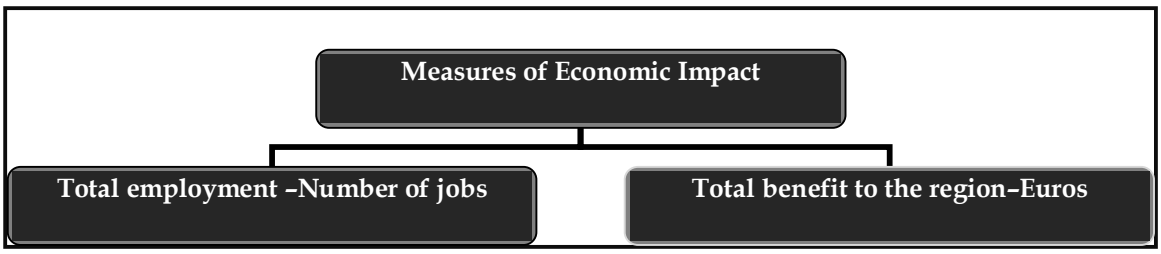


Figure 8: Measures of Economic impact (source:author)

3.2 ECONOMIC IMPACT OF AIRPORTS ON REGIONAL ECONOMIES

Oxford Economic Forecasting 1999, provides updated data regarding benefits and tourism development for Africa, Europe, Middle East, Latin America and North America, and stating that 32 million jobs totally are generated from the aviation industry (equal with 3,560 billion USD, and equivalent to 7.5% of world Gross Domestic Product (GDP). Of the 32 million jobs totally, the 5,5 million are generated directly at the airport, 6.3 million are supported through the purchase of goods and services by companies in the air transport industry, 2.9 million are supported through employees in the air transport industry using their income to purchase goods and services for their own consumption (induced impact) and the biggest portion equal with 17.1 million jobs are supported from tourism- catalytic impact (ATAG 2008).

Regarding USA Economy, ATAG 2009 estimates the civil aviation's contribution to the U.S. and estimates the total economic impact of civil aviation on the U.S. economy. Using all the data available from government and private sources ATO captures all of the economic activity generated by direct and indirect air transport of passengers and cargo, according to which the civil aviation represented the 5.6 percent of the U.S. economy in 2007. In addition the total output amounted to $1.3 trillion in 2007 and generated nearly 12 million jobs, with earnings of $401 billion (ATO 2009).

At European level, Airports Council International (ACI 2004) highlights the key role that European airports play in boosting regional accessibility and social expansion, driving tourism development and suggests that the average direct impact of an airport in Europe can amount to 950 jobs per million passengers. The indirect/induced jobs supported nationally on average can amount to 2950 jobs, the indirect/induced jobs supported regionally can amount to 2000, and finally the indirect/induced jobs supported sub-regionally to 1425jobs, (Figure 7)

Figure 9: Average Jobs created per million passengers in European Airports (Source: ACI 2004)

ACI 2004 also defines that Airports can make a substantial contribution to the overall economy of the areas that they serve, as the contribution of the GDP, excluding tourism impacts, can vary from 1.4 to 2.5% and failure to provide increases in airport capacity could cost between 2.5% and 3% of national or regional GDP(ACI 2004).

Finally ACI 2004 suggests that the total impact of an airport is estimated through the generation of multipliers that multiply the direct impacts and distribute them to the region. The scale of the multiplier is a reflection of the relatively size of the economy of the nation or the region and depicts the size of the study area. So low multipliers reflect small size of the Nations Economy. Generally, the larger the size of the study area, the greater the multiplier is. In table 1 are summarized some multipliers across a range of European airports according to their size of economy at regional, national or local level(York Consulting 1998).

Table 1 : Income Multipliers across European Airports

Airport	Direct	Indirect	Induced	Total	Indirect/induced income multiplier	Study area
Brussels	1.079	410	92	1.581	0.47	National
Cardiff	35	3	11	49	0.40	Local
Düsseldorf	383	204	326	913	1.38	Local
Exeter	16	3	3	22	0.38	Local
Gatwick	357	131	121	609	0.71	Regional
Glasgow	165	311		476	1.88	Regional
Canarian Islands	83	7		90	0.08	Regional

Source: York Consulting: The Economic Impact of Airports (May 1998)

Taking into account 59 airports with different passenger traffic volume, ACI 2004 demonstrates that there is a considerable variation in the density of on-site employment at European airports. A recent study refers to the impact of additional passengers on airport employment examining the case of German airports and analyzes the relationship between air traffic and on-site employment for 17 German airports categorized as international airports. The empirical analysis was based on several regressions using data on passenger numbers and workload units handled as well as employment data. (Klophaus 2007)

ACI 2004 describes that European airports with less than five million passengers have a higher average employment density (= direct jobs per million passengers) than airports with more than five million (ACI 2004). The relationship between direct employment and air traffic depends among others on the airport size as Richard Klophauson states. The arithmetic average employment on site for six categories of airport passenger volume densities is shown in table 2.

Table 2: Average direct employment density at European airports per million passengers

Direct Jobs per million passengers	
>50 million	985
20-49 million	867
10-19 million	934
5-9 million	793
1-4 million	1.034
<million	1.724
Total	925

Source: ACI 2004

The case study airport at Heraklion today is able to accommodate 5 million passengers. According to the scenarios developed by HMEPW (2009) and are analyzed in section 5.3 the new airport is expected to accommodate from 5 to 10 million passengers.

At the level of UK Oxford Economic Forecasting, 2006 examines the size and importance of the aviation industry in the UK, defining that the aviation industry generated £11.4 billion value-added in 2004, 1.1% of the overall economy, employing 186,000 people and supporting over 520,000 jobs in total including those employed in its supply chain and the jobs dependent on the spending of its employees.

Oxford Economic Forecasting 2006 states that :

- The direct contribution of Travel &Tourism to GDP is expected to be US$1,850.0bn (2.8% of total GDP) in 2011, rising by 4.2% pa to US$2,860.5bn (2.9%) in 2021 (in constant 2011 prices).
- The total contribution of Travel &Tourism to GDP, including its wider economic impacts, is forecast to rise by 4.2% pa from US$5,991.9bn (9.1% of GDP) in 2011 to US$9,226.9bn (9.6%) by 2021.
- The total contribution of Travel & Tourism to employment, including jobs indirectly supported by the industry, is forecast to rise by 2.3% pa from 258,592,000 jobs (8.8% of total employment) in 2011 to 323,826,000 jobs (9.7%) by 2021

Revising the previous studies it is shown that at:

- globally level aviation contributes 7.5% to the GDP(FAA 2009)
- USA level (ATAG 2008**)** aviation contributes 5.6% to the GDP(ATAG 2008**)**
- European level aviation contributes from 1.4 to 2.5 % to the GDP(ACI 2004)
- UK level aviation is equal with the 1.1% to the national GDP

4 MODELLING FRAMEWORK

4.1 REVIEW OF SELECTED METHODS FOR ESTIMATION OF ECONOMIC IMPACT OF AIRPORTS

Lynch T. 2000 notes that there is a variety of methods that can used to estimate Regional Economic Impact of Transportation Projects. Several studies(eg. TRB 2008) have suggested different methods that are used in order to evaluate the Economic impacts of Airports. From the wide variety of methods that are available for estimating Economic Impacts, each one has its advantages and disadvantages. The most commonly used method to estimate the total impact is based on creation of multipliers that express the transactions of all sectors of the region. These multipliers show the relation between an initial increase in final demand and the effect in the employment and GDP of the Region. *Transportation Research Board 2008* focuses on how economic impact studies are conducted today and proposes five basic types of methods as described below (*TRB 2008*)

4.1.1 THE INPUT OUTPUT METHOD

The Input-Output analysis has been developed by the economist Wassily Leontief and shows how the parts of a system are affected by a change in one part of that system. David Mulkey et.all 2009 describes that Input-output analysis specifically shows how industries are linked together through supplying inputs for the output of an economy, quantifying the interactions between firms, industries, and social institutions in the local economy.

The Input-Output method is based on the framework of the relationship between industries of a region. As TRB 2008 claims the Input-output method is based on a matrix representation of a region's economy showing the inter-industry relations of the economy. The method is based on how the output of one sector is an input to another sector and creates a multiplier for each sector of the economy. Each multiplier of each sector then is used to estimate the economic impact of a change in total demand for each sector. (TRB 2008)

4.1.2 THE COLLECTION METHOD

The collection method is based on qualitative measures of costs and benefits that are caused by an airport. These measures are very difficult to be quantified and as TRB 2008 describes these are:

- The time and the costs that are saved by using the air transportation
- The stimulation of business, recreation, commercial activities, and
- The general benefits of the community (TRB 2008)

4.1.3 THE COST BENEFIT ANALYSIS

Benefit Cost analysis addresses the benefits from economic efficiency in contrast with Input Output analysis that focuses on the regional distribution of economic activity. *As Daniel, J. Stynes 2001* describes B/C analysis includes both market and non-market values, while economic impact analysis is restricted to actual flows of money from market transactions.

4.1.4 THE CATALYTIC METHOD

This method is based on the Measurement of the airport benefits performance in the supply-side of the economy including all the impacts on investment, trade, and tourism and productivity of the economy. The difference from the collection of benefits methods is that catalytic impacts can be quantified. (*TRB 2008)*

4.1.5 THE ECONOMETRIC REGRESSION ANALYSIS

This method is based in the concept of applying regression analysis to the results of previous economic impact studies. This method is used in many countries to estimate the economic impact of airports, as for example across Canadian Airports. In the Economic Impact Study of St Thomas Municipal Airport highlights, that the results of a regression analysis produce reasonable estimates of the Canadian Airports on regional Economy (*Purcell 2007)*.

4.2 SELECTION OF METHOD

The method of Input Output analysis has the following advantages in comparison with the alternative methods:

1. it is the most transparent and persuasive method;
2. is a non Survey Method (non survey is best suited for purposes of projecting future economic impacts from non-existing facilities such a new airport and while financial resources are restricted, estimating economic impacts through analysis of secondary data is more useful as Daniel J.Stynes 2001 defines ;
3. depicts the Macroeconomic Activity that takes place in a specified Region;
4. the concept of the method is based in the input-output tables that provide a comprehensive picture of the interindustry structure of the regional economy;
5. -points up the strategic importance of various industries and sectors -highlight possible opportunities for strengthening regional income and employment multiplication." (Bendavid-Val, p.113)

Concerning the disadvantages of the method the Input Output Method (I-O) method has the following disadvantages:

1. high cost of constructing the input-output tables
2. time/Data issues: Usually a single year's data are used to develop the Total Requirements Table. But 1) purchases may actually reflect a longer term investment and 2) short term trends may impact the data.

The central advantage of Input-Output analysis is that *it tries to estimate these inter-industry transactions and use those figures to estimate the economic impacts of any changes to the economy*.

Also very important and valuable is the fact that Instead of assuming a change in a basic sector industry having a generalized multiplier effect, the IO approach estimates how many goods and services from other sectors are needed (*inputs*) to produce each dollar of *output* for the sector in question. Therefore it is possible to do a much more precise calculation of the economic impacts of a given change to the economy. (Daniel J.Stynes 2001)

4.3 REVIEW OF SELECTED INPUT OUTPUT MODELS CURRENTLY USED

There are many available I-O models in US based on the concept of Input Output Analysis that can be used in order to evaluate the Economic impact of an airport. *U.S. Department of Transportation 2000* describes these basic models in USA and explaines the theoretical and technical application of them. A comparison of these models has been conducted by Bonn and Harrington 2008, examining the differences between the most often used economic impact models using the example of Florida due to the fact that tourism is the number one industry. The basic two and most commonly used IO models are the RIMS II and the IMPLAN as described below.

The I-O models do not cover dynamic impacts over the time. They assume that there are no impacts on wage levels, property values, prices or costs of other product inputs or outputs, no change in labour or capital productivity (the ratio of output per unit of input), and no change in population or business in/out migration patterns. Input-output models are based in the concept of changes in final consumption (final demand) as David Mulkey et.al 2009 notes.

There are two types of modelling framework: the Input Output Models and the Dynamic Economic Stimulation Models. Cambridge Systematics 2006 identifies that both of the models estimate how each change in the flow of income and cost among industries lead to broader impacts on economic growth. The difference is that Input-Output Models trace the flow of income among industries and calculate how changes in one industry affect growth in the rest of the economy, while Simulation Models (including Computable General Equilibrium) calculate the effects of changes in industry cost competitiveness on economic growth. Both types of models can be regional, multiregional, or national (*Forsyth 2006).*

4.3.1 THE REGIONAL INPUT-OUTPUT MODEL - RIMS-II

In 1980, the Bureau of Economic Analysis (BEA) on the U.S. Department of Commerce developed a method for estimating Regional I-O multipliers known as RIMS II (Regional Input Output Model). RIMS II is based on an Input Output table. For each industry, the table shows the industrial transaction of inputs and outputs, as the Bureau of Economic Analysis defined, while describing the Input-Output Structure of the U.S. Economy. The typical I-O table in RIMS II is derived from the BEA's national I-O table which shows the input and output structure of 500 U.S. industries, and the BEA's regional economic accounts, which are used to adjust the national I-O table into a regional input output table. et al. Bureau of Economic Analysis.

Weisbord (1997) argues that RIMS II can estimate the economic impact for any region composed of one or more counties and for any industry, or group of industries, in the national I-O table with relatively low cost, without expensive surveys, reflecting recent data.

4.3.2 THE MINNESOTA- IMPLAN MODEL

The IMPLAN's Social Accounting System describes transactions that occur between producers and final consumers through a social accounting matrix. The simplest case study can be founded through a simple application that estimates the total impacts of a new firm location in a rural area of Florida as Mulkey et.al 2009 describe.

IMPLAN is a database system available from Minnesota IMPLAN Group that estimates local economic impacts. The IMPLAN software and database have the ability to estimate the interindustry transaction table for specific local areas and unique multipliers that

capture the direct and indirect effects of changes in a particular sector. The IMPLAN software also allows modification of the model so that, in addition to direct and indirect effects, multiplier will capture the effects of increased consumer spending resulting from direct and indirect income changes or induced effects as Mulkey et.al 2009 defines.

4.3.3 DYNAMIC ECONOMIC STIMULATION MODELS

Weisbrod 1997, identifies that the Economic Stimulation Models are "econometric" and "general equilibrium" models. These models consider the change of the economic conditions in the study area and forecast effects of future changes in business costs, prices, wages, taxes, productivity and other aspects of business competitiveness, as well as shifts in population, employment and housing values.

CGE models give more importance to the prices and let the level of the wages to affect an industry demand in contrast with the Input Output model that assumes a fixed amount of an industry required to produce a ton of another industry. The literature concerning General Equilibrium Models is limited, even though examples can be found in some areas concerning international trade or planning (eg. Sohn Ira 1986, Chumacero et.all 2005). The Center for Global Change Science (CGCS) in MIT describes in detail the general framework of a CGE model making an effort to cover the gap in literature and explain the CGE models and to increase their accessibility to a wider group of economists and policy analysts as Ian Sue Wing, 2004 argues.

Duchin et.all 2007 state, that the consistent estimation of all the necessary consumers' and producers' substitution elasticity is problematic, because of the inadequate data and the lack of a tradition of estimating such elasticity's at the regional level. In addition the stimulation is problematic too, especially because of the highly non-linear character of the behavioral equations. In CGE models the amount of price differentiation usually applied takes into account the differentiation between domestic flows of goods and goods in international trade according to Kurt Kratena et.all , 2008.

General Equilibrium is reached when supply and demand are balanced. This tends to occur in the long run, as prices, production, consumption, imports, exports, and other changes occur to stabilize the economic system. The general equilibrium properties are necessary to evaluate changes such as tax policies that may have an effect on regional prices and competitiveness.

4.3.4 ECONOMETRIC CGE MODEL- REGIONAL ECONOMIC MODELING (REMI)

Lynch T.2000 describes that the REMI simulation model uses hundreds of equations and thousands of variables to forecast the impact that an economic or a policy change has upon an economy. The REMI model is an eclectic model that links an input-output model to an

econometric model. If the econometric responses are suppressed, the model collapses to an input-output model *as Gartner 2005 defines.*

The REMI model is a dynamic forecasting and policy analysis tool that can be variously referred to as an econometric model, an input-output model, or even a computable general equilibrium model. The result is a comprehensive model that answers "what if…?" questions about the economy. The model consists of thousands of simultaneous equations and demonstrates how firms, individuals, and the economy at large respond to changes in taxes.

Regional Economic Models, Inc. (REMI), produce economic modeling software that enables users to "answer what if questions" about their respective economies. Each REMI model is tailored for specific geographic regions by using data, including employment, demographic, and industry data, unique to the modeled region. The Center for Economic & Business Development uses the Oklahoma REMI model, which is a six region, 53 sector REMI model, to forecast how a given economic activity or policy change occurring in one region would affect that region, a group of regions, and/or the state.

The REMI simulation model uses hundreds of equations and thousands of variables to forecast the impact that a economic/policy change has upon an economy. For example when a new industry hires an additional 100 new employees, then the model measures how this increase would ultimately affect the total output, the population, the migration, the wage rates, etc. (TRB 2008)

4.4 DESCRIPTION OF THE MODEL

4.4.1 GENETIC FUNCTION OF THE MODEL

The Input Output model describes an economic system in which n industries (each producing a single commodity) interact with each other using, as inputs, the outputs of the n industries. In its basic formulation the equilibrium equation of this model can be written in matrix form as Miller and Blair 1985 define :

$$(I-A)^{-1}\,X=Y \qquad [1]$$

Where
I = n × n unit matrix
X = nonnegative vector of gross output of each production sector
Y = nonnegative vector of final demand
A = n × n nonnegative matrix of technological coefficients or the input- output matrix
n = number of production sectors in which $((I-A)^{-1}$ is referred to as the multiplier, or Leontief inverse matrix (Miller and Blair 1985)

The solution of equation [1] has an economic meaning if and only if (I-A) is a nonsingular M-matrix. Indeed, the theory of M-matrices implies that a nonnegative solution x exists corresponding to each nonnegative n. In economic terms, the model is called "productive" according to Abaffy et.all 1998.

The I-O model is based in a matrix, where each row and column represents a different industry or industrial segment. The cells of the matrix describe, mathematically, the production and consumption relationships between the various industries and segments. I-O models use regression equations to associate purchases of goods or services in one industry with similar purchases in other sectors. Transit facility construction, for example, would create increased production, consumption, and employment in the fabricated metals and stone/glass/clay industries, two industries that are suppliers to the construction industry. Inputs into the model include the dollar amount spent in different industries to construct, operate, and maintain a new transit system. The model estimates the dollar value of direct and indirect, production by industry resulting from the spending according to Cervero 2003.

Spörria, et.all notices that, for this model in order to be valid, it is assumed that the structure of the economy —the set of production functions — does not change and that for the considered changes in final demand, the economy can be described with linear production functions.

The following steps describe the implementation of the input-output tool from its initial construction, to effective simulations in the context of the evaluation.

The ultimate goal of the Input-Output Analysis technique is to generate a Total Requirements Table that shows the flows of euros between industries in the production of output for a given sector. To arrive at this final result, IO Analysis requires three steps:

4.4.2 STEP 1: CONSTRUCTION OF THE INPUT OUTPUT TABLE

An economic system is expressed by a monetary input output table. Augusztinovics 1995 recognizes that in this table the sum of every sectoral final output value equals the sum of every sectoral value-added, which is called the gross national product. In general, some sectoral final output value may be unequal to this sectoral value-added. However, theoretically it is possible that all sectoral final output values equal their respective sectoral values-added. Lisheng 2010 notes that this is one kind of balance of the economic system, which can be called a balance between final output values and values-added.
Essentially, a most typically national input-output table can be divided into four sections:
The basic layout is of suppliers (rows) and users (columns):

1. The first section is the intermediate goods matrix that provides data on the interactions between domestic suppliers and domestic users of domestically produced industrial components and services.

2. The second section (below the intermediate transactions matrix) consists of rows showing the adjustments required to derive total intermediate inputs used in production at purchasers prices.
3. The third section comprises of the rows that make up value added (at basic prices) such as wages and salaries
4. The fourth section, to the right of the intermediate goods matrix, accounts for the supplies of goods that are not consumed by domestic industries. The columns therefore include such categories as final consumption (both by households and general government) and exports.

Miller and Blair, 1985, therefore note that if the economy is divided into n sectors, and if we denote by Xi the total output of sector i and by Yi the total final demand for sector i's product, the equation that describes the transactions in the input output table is:

$$Xi = zi1 + zi2 + \ldots\ldots zij + \ldots\ldots zin + Yi \quad [2]$$

where
Xi = the total output of sector i,
zij = the flow of input from sector i to sector j, and
Yi = the total final demand for sector i's product

Regarding regional input output tables a weakness exists, due to the big cost collection of essential statistical elements. In order to construct regional I-O tables simple location quotients (SLQ's) can by provided (RIMS II 1981, McCann and Dewhurst 1988, Flegg et al 1995, Thomo 2004).

4.4.3 STEP 2: CONSTRUCTION OF DIRECT REQUIREMENTS(TECHNOLOGICAL COEFFICIENTS) TABLE

Second step is to convert the inter-industry transaction table into the Direct purchase coefficients table. In IO analysis, the fundamental assumption of the IO model is that the flows of sector i to j depend on the total output of sector j, so we can derive the technical coefficient by dividing the inter-sectoral flows from i to j(zij) with total output of j (Xj). This will be done by dividing each inter-industry transaction in the Input Output table I-O by each industry's total Input. The Equation that derivate the Technical Coefficient Table is :

$$aij = zij / Xj \quad [3]$$

where, aij is also often termed as IO coefficient and (direct) input coefficient.
The aij is regarded as determining fixed relationships between a sector's output and its inputs so can be expressed as follows:

$$xij = aijXj \quad [4]$$

The fundamental assumption of the model is the flow of sector of agriculture to the sector of manufacture depends on the total output of the sector of manufacture . So the technical

or direct requirement coefficient is derived by dividing the interidustry transaction from the sector agriculture to the sector of manufacture by the total input of the sector of manufacture as presented analytically in figure 10.

The Transactions Table
(in thousands of units)

	Intermediate Purchasers		Final Purchasers	Total
	--Agriculture	*--Manufacturing*	*--Households*	*Sales (outputs)*
Intermediate Suppliers				
--Agriculture	10	30	60	100
--Manufacturing	5	10	35	50
Primary Suppliers				
--Households	85	10	15	110
Total Purchases (inputs)	100	50	110	260

Direct Requirements Table
(in thousands of units)

	Purchasers		
	--Agriculture	*--Manufacturing*	
Intermediate Suppliers			**Every unit of output**
--Agriculture	0,10	0,60	**requires inputs of a certain**
--Manufacturing	0,05	0,20	**amount from other areas**
Primary Suppliers			**of the economy.**
--Households	0,85	0,20	
Total Purchases (inputs)	1,00	1,00	

Figure 10 : Framework matrix analysis background (convention into direct requirements table)

A simple location quotient for each regional economic sector can be defined by the following equation:

$$SLQ_i^r = Qi^r / T^r / Qi^N / T^N \quad [5]$$

Where:
Qi^r =a measure of the output of sector i in region r,
Qi^N =a measure of the output of sector i in Nation N,
T^r =a measure of the aggregate economic activity in region r,
T^N =a measure of the aggregate economic activity in Nation.

Simple LQ's are one measure of the region's self-sufficiency in producing the output of a given economic sector. Referring to equation [5] an LQ of less than 1.0 means that the output of regional sector i represents a smaller share of regional economic activity than the output of national sector i represents of total national economic activity. Accordingly, LQ's are often used to identify regional sectors that are net importers and exporters. The region's SLQ's are often used to regionalize the national I-O table in the estimation of the regional direct-purchase coefficients. This can be expressed by the:

$$aij^r = SLQi^r \, aij^N \quad [6]$$

Where:
aij^r = The proportion of the total output of the regional sector j that accounted for by the purchases of inputs from the regional industry i.
aij^N= The national direct requirements coefficient.

4.4.4 STEP 3 : CONSTRUCTION OF TOTAL REQUIREMENTS TABLE (INVERSE MATRIX)

The object of the model is to create the inverse (I-A) matrix. Chiang et al. notices that after the Inverse I-O matrix is derived, the total impact of any proposed project or activity on the region economy can be estimated by multiplying this matrix by changes in the final demand caused by the project/activity. The multipliers of the matrix summarize the total impact that can be expected from any change in a given economic activity. Based on the multipliers per industry category the total impact of the proposed airport on the region economy will be estimated by multiplying the matrix by the changes in the final demand caused by the new airport.The matrix (I-A)-1 which is the inverse of (I-A) in the case of n sectors is the Leontief matrix and is the key ingredient of the model. It is a representation of the nation's (or the region's) economy and helps to predict the effect of changes in one industry on others and shows all the connections between the different branches of the economy. According to equation [1], A is the technical coefficient matrix, X is the vector of output, Y is the vector of final demand. (Tang 2011). So, the basic IO model can be expressed as follows:

$$\mathbf{AX + Y = X} \qquad \mathbf{[7]}$$

And Eq. [7] can be written as follows:

$$\mathbf{(I - A)^{-1}\ X = Y} \qquad \mathbf{[8]}$$

If we multiply the total final output of the agriculture sector by the direct coefficient of this sector we have the input of this sector If we add this with the input of the manufacture and all the input of the sectors we have the total input of the sector agriculture When the total input and the total output are equal then the system is in balance as analytically is presented in figure 11.

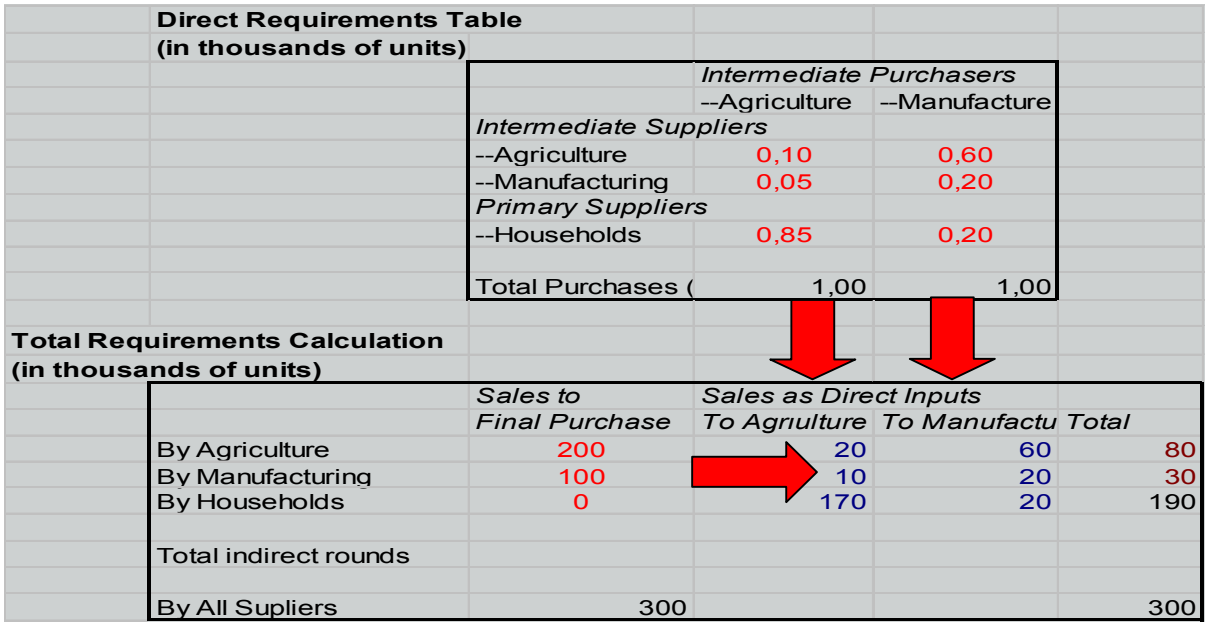


Figure 11 : Framework matrix analysis background (convention into total requirements table)

5 ECONOMIC ASSESSMENT MODELLING APPLICATION

This chapter will present the application of the methodological framework, which was presented in previous chapters.

5.1 FIGURES OF THE CASE STUDY AREA

5.1.1 CRETE ISLAND KEY FIGURES

Crete is the largest island in Greece, the fifth largest in the Mediterranean, and the second largest (after Cyprus) in the eastern Mediterranean as depicted in figure 1. Crete straddles two climatic zones, the Mediterranean and the North African, and the Cretan summer season starts from early May to late October, with the average temperatures reaching the high 20s-low 30s Celsius. Maximum temperatures can reach the upper 30s to mid 40s. Due to the island's location and landscape formation, Crete enjoys significantly more sunny days and high temperatures throughout the year than other destinations in the Mediterranean. Because of its microclimate, most of the urban areas are spatially located on the north coastline of the island. The island's total population was estimated to be 650,000 in the year 2005.

The mainland of Crete covers an area of more than 8,000 square kilometres, with a 1,000 kilometre-long coastline dotted with numerous coves, bays and peninsulas which offer the visitor a multitude of sandy beaches looking out over the Mediterranean Sea. Most of the major European tourist operators' web sites promote holidays in Crete, recognising it as one of the most famous and attractive summer holiday destinations.

Figure 12 : The island of Crete in southeastern Mediterranean

5.1.2 ECONOMY OF CRETE

Greece adopted the euro (€) as its currency in January 2002. The adoption of the euro provided Greece with access to competitive loan rates and. This led to an increase in consumer spending, which gave a significant boost to economic growth. Between 1997 and 2007, Greece averaged 4% GDP growth, almost twice the European Union (EU) average.(OECD 2008). As with other European countries, the financial crisis and resulting slowdown of the real economy have taken their toll, Greece's rate of growth started slowing in 2007 as shown in tables 3 and 4. (ELSTAT 2009)

The economy of Crete, which was mainly based on farming, began to change visibly during the 1970s. While an emphasis remains on farming and stock breeding, due to the climate and landscape of the island, there has been a drop in manufacturing and an observable expansion in its service industries (mainly tourism-related). All three sectors of the Cretan economy (agriculture, processing-packaging, tourist services) are directly connected and interdependent. The island has a per capita income close to Greek national average, while unemployment is fall behind of that of the country overall. The gross added value by industry and the total employment of the area in comparison with the whole nation after 2007 are presented in tables 3 and 4. The GDP of Crete is on average 5% of the total GDP of Greece.(ELSTAT 2009)

Table 3 : Actual national and regional income αt the price levels year 2009 (million Euros)

Year	Greece	Crete
2007	231.8 million Euro	12.75 million Euro
2008	231.0 million Euro	11.55 million Euro
2009	222.5 million Euro	12.24 million Euro
2010	206.9 million Euro	10.35 million Euro

(Source: ELSTAT 2009)

Table 4 : Total number of jobs at national and regional level

Year	Greece	Crete
2007	4.701.792 jobs	270.939 jobs
2008	4.402.900 jobs	242.160 jobs
2009	4.299.000 jobs	236.445 jobs
2010	4.194.400 jobs	230.692 jobs

(Source: ELSTAT 2009)

5.1.3 TOURISM IN CRETE

The Greek economy is heavily dependent on the tourism sector. It attracts a high number of tourists because:
(1) of the climate;
(2) the 16.000-km of coast along the Mediterranean;
(3) the spatial allocation of Greek islands; and
(4) the high number of archaeological sites and cultural events.
According to the OECD 2008, tourism accounted for 18.2% of Greek GDP in 2007. Tourism has also contributed between 1 and 2% economic growth between 1998 and 2004 (Ivanov and Webster, 2006).

Greek GDP is very dependent on tourism but it is less dependent on foreign tourism than other EU countries (see Figure 2). Tourism receipts in 2005 were more than four times higher than they were in 2000 (Eurostat, 2008) equivalent to a positive balance of €8 591 million in 2005 (Eurostat, 2008). International tourism receipts in 2005 totalled €11 billion generating approximately €1,200 for each resident, placing Greece 5th in the world by this measure (OE CD 2008). Eurostat (2008) notes that international tourism receipts account for 5.2% of GDP; while 93.5% of Greeks vacationed domestically making a total of 15.9 million trips (Eurostat, 2008).

Crete, the biggest island of Greece, attracts a high number of tourists because of the climate, the coast along the Mediterranean, the spatial allocation of islands as well as the high number of archaeological places. Crete is a faraway European destination (over 3.000 kilometres) from the countries that represent the main sources of tourist market. Thus, the transport participation in the total holiday package is high and depends on the time window the origin, and the final destination. Analyzing the volumes of Crete tourist market, the higher share is from European regions, representing more than 90% of total International Tourist Arrivals, diachronically.

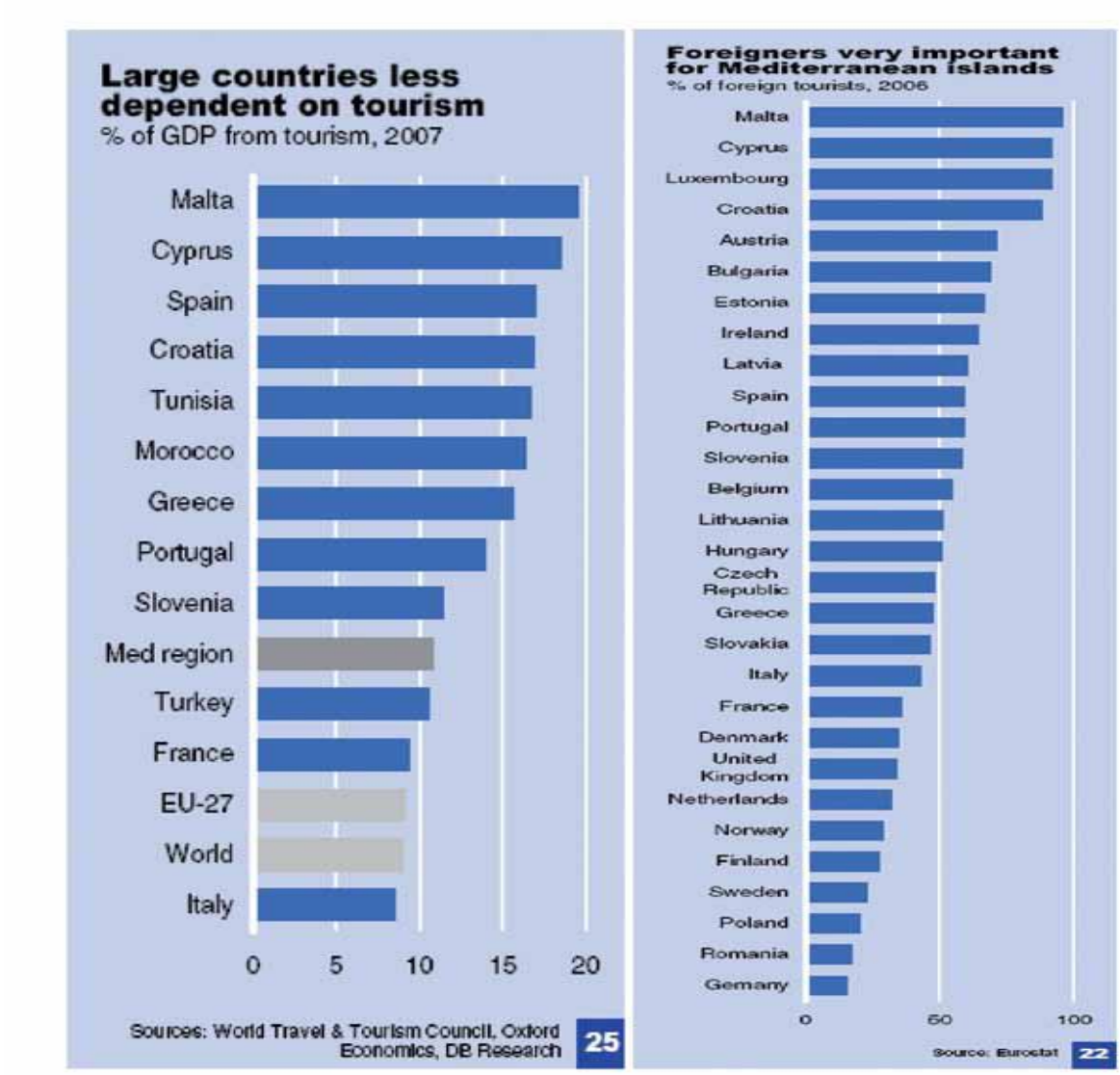


Figure 13 : EU country economic dependence on foreign tourism - *Source: Deutsche Bank (2008)*

The tourism in Crete is the most dynamically developing business sector. The tourist season lasts from April to October; the peak tourist months are July and August. Despite the economic downturn the long-term forecasts by National Tourism Organization UNWTO (2008) refer an average annual growth around 3% due to 2020. The tourist business is based on partnerships of resorts with global tourist operators, promoting tourist services for summer holidays vacations. Last decades, widely applied business practice is developed based on policy named "all inclusive" where tour operators and resorts promote tourist packages including the whole chain of transport and accommodation services for the duration of holidays.(ELSTAT 2009)

5.2 DESCRIPTION OF THE CASE STUDY AIRPORT IN CRETE

5.2.1 AIRPORTS IN GREECE

The Greek airports serve both business and leisure traffic, providing accessibility to most big cities and islands in Greece. There are 38 airports in Greece serve a wide Catchment area in the Greek region (11 in mainland and 27 in islands).15 of them are International, 13 serve domestic and international flights and 10 serve only domestic flights. They offer air transport services to 40.869.919 total passengers, 12.995.448 domestic residents and 27841071 international tourists(not residentsxyear 2007).(HCCA 2008)

The main international Airport EL.VENIZELOS shares the 40% of total international PAX. The second and third busiest airports Heraklion and Thessaloniki share the rest 23% percentage , and the airports at the tourist islands share the rest 37%.

The greater amount of international passengers is non scheduled. Charter flights to Greece have become more commonplace in recent years as budget airlines have opened up many routes to some of the major islands tourist destinations.
The low cost carriers provide many direct charter flights per week from Greek tourist airports to European countries. The nature of tourism and aviation business along with the seasonal nature of demand leads to growth of charter and seasonal flights to/from Greek tourism seasonal airports.

Given the importance of Crete to the regional economy and the potential constraints on future growth associated with its facility limitations, there are focused planning efforts to ensure that the future aviation needs will be met. Crete is an important tourist destination not just in Greece but in the whole of Europe. There will be reallocation of aviation activities from the existing airport to new airport. Key objectives of the development of the new airport are focused on three strategic issues:

a) meet the Crete growing needs for air transport services
b) provide accessibility to new tourist market and
c) improve Heraklion airport's role in European network providing opportunities in order to be a hub in an eastern Mediterranean region, in future.

5.2.2 FEATURES OF THE EXISTING AIRPORT

The existing airport is situated near an urban area, where many tourist facilities are located. According to national statistics, Heraklion city is the 4th most populated city in Greece (about 200.000 residents). Also, the Crete tourism facilities promote around 64,000 beds to serve tourism during the tourist season. Therefore, the Heraklion airport serves both business and leisure traffic, providing accessibility most big cities in Greece and airports accommodate charter airlines in Europe.

The existing international airport at Heraklion (named Nikos Kazantzakis) is the second busiest airport in Greece after Athens International Airport.(HCCA 2008) There were 3,927,292 international air transport passengers in 2007 and the airport has reached capacity during the peak holiday season. Heraklion airport receives more international charter flights during peak season than any other Greek hub. The demand for air travel in Greece is expected to double by the year 2025. Therefore airport capacity around the country needs to increase as failure to increase capacity will have a negative impact on regional and national economic growth and international competitiveness.

Today 15 airlines currently operate from Heraklion City Airport, flying to 31 different destinations. The international passengers of Crete are travelling mainly during the summer period with charter flights that impose high peaks in various subsystems of the airport terminal. However, the major part of aviation market is reached by charter industry providing seasonal connections to Germany, United Kingdom, Italy, France, Russia, Scandinavia and Central Europe, which are the main areas of origin for the 90% of international tourist arrivals.

The 80% of total passenger traffic concerns the tourism season (May – October) and around 47% concerns the peak season extend from July to September each year as described in figure 14.

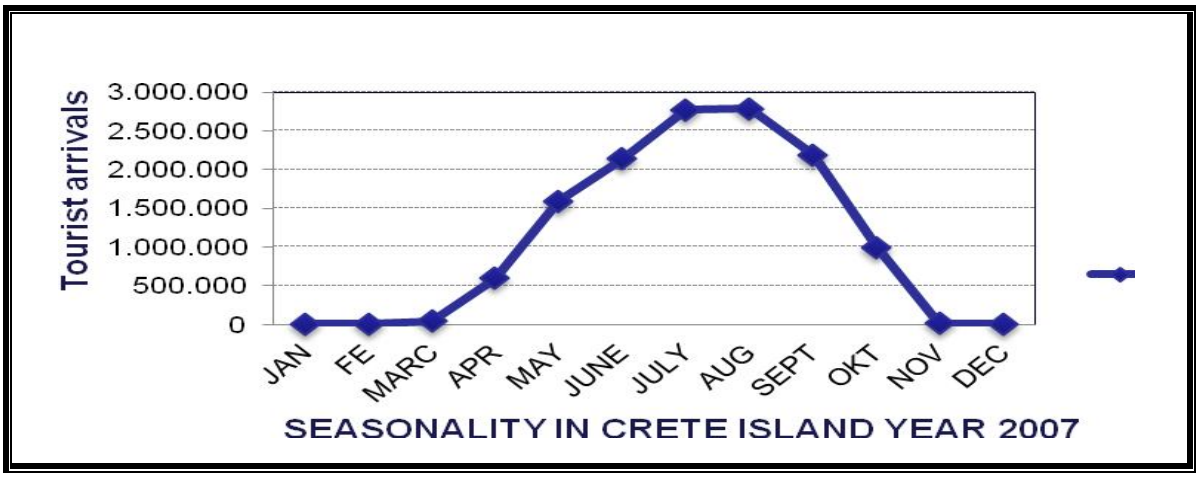


Figure 14 : Seasonality of the tourist arrivals in Crete in 2007 (HCCA 2008)

The nature of tourism and aviation business along with the seasonal nature of demand leads to growth of charter and seasonal flights to/from Heraklion airport, where more than 2 million passengers travelled on charter flights in 2007 (Greek National Statistics, 2009). The pattern of traffic at Heraklion Airport is shown in the figures 15 an 16, illustrating how the nature of the aviation business has developed over the past 20 years.

The most passengers travelled in 1998-2000. From 2001 due to the destruction of the twin towers the air craft movement were significantly reduced. From 2004 to 2007 there was air passenger significant traffic growth.

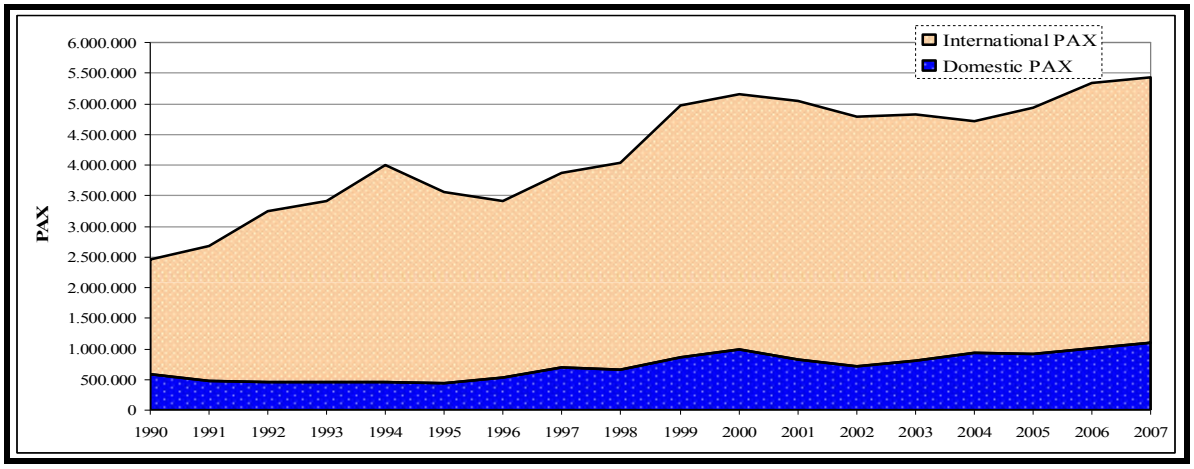


Figure 15: Total Passengers at Heraklion International Airport in 1990-2007
(Source: HCAA 2008)

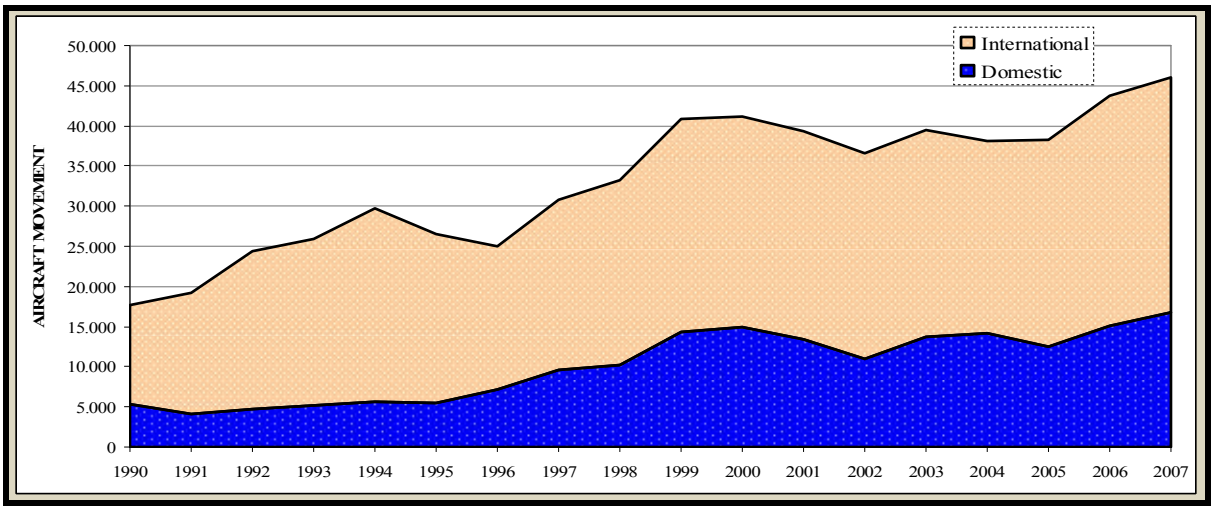


Figure 16: Annual aircraft movements at Heraklion International Airport in 1990-2007
(Source: HCAA 2008)

5.2.3 FEATURES OF THE NEW AIRPORT

Given the importance of Crete to the regional economy and the potential constraints on future growth associated with its facility limitations, the Government of Greece is moving forward with focused planning efforts to ensure that the future aviation needs of the region will be met.

According to new Heraklion airport master plan, it will be almost twice as large as existing once and will be able to accommodate more than 5.000 holiday travelers per day as shown in table 6. . It will be located in north-west part of Heraklion prefecture, close to town of Kasteli and will be the primary commercial airport serving the air transportation needs of people and businesses in and around the island of Crete. The airport, auxiliary facilities and infrastructure will cover an area of 600 hectares with a Runway length 3.800m which will

be capable of handling aircrafts up to the size of A380 and two full parallel taxiways (4F Category). An additional area of 22 hectares (54 acres) will be reserved for commercial activity south-west of the new airport. In addition, the airfield will have a Passenger terminal that will include approximately 70.000 m2 and a Freight terminal that will include approximately 15.000m2. The apron area will accommodate up to 44 airplanes.

Based on 2007 traffic of the existing airport, 3 scenarios for future traffic were developed. For long term planning the high scenario forecasts 1.5 times more traffic than in 2007 while the low scenario forecasts a doubling of 2007 traffic. The scenarios of the traffic figures for the anticipated future demand according to HMEPW (2009) are given analytically in table 5

Table 5: Traffic key figures for the existing and the new airport (HMEPW, 2009)

	Total PAX in thousands[3]	PAX in 30th design hour[4]	Aircraft Movements[4]	Scenario[2]
Existing Airport[1]	5.369	3,000	200	Real Value
New Airport in 2015[2]	6.000	3.500	302	Low Scenario
	6.400	3.750	322	Basic Scenario
	6.900	4.000	338	High Scenario
New Airport in 2025[2]	7.900	4.250	354	Low Scenario
	8.600	5.000	388	Basic Scenario
	10.200	5.500	426	High Scenario

[1] source: HCAA in 2007
[2] source: HCAA in 2007
[3] Arrivals and departures
[4] Typical day in high season

These airport infrastructures and the capacity of the new airport will provide many opportunities for growth of the aviation business growth. Key figures relating to the current and new airport are presented in the table 6.

Table 6: Airport facilities for the existing and the new airport in Crete (HMEPW, 2009)

Airport infrastructure	Existing Airport	New Airport in 2025
Terminal area (sq. meters)	41.800	70.000
Number of runways for civil aviation	1	1
Length of runway (meters)	2,680	3,800
Aircraft parking places on apron	19	44
Airport territory (hectares)	278	600
Distance from Heraklion city (kms)	3	35

The construction cost of the new airport is estimated between 1,200 and 1,500 million Euros and the additional cost for the road connection with the existing motorway and the local services roads is estimated between 50 and 60 millions Euro. The project financing and management scheme will follow the Public-Private Partnerships (PPP).(HMEPW, 2009)

It is noteworthy that at the moment in the area of new airport exists an active military airport. The master plan highlights that the military airport will be on action when the new civil airport starts its operation. Also, the existing airport in Heraklion will be closed at the

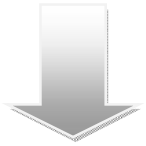
time of new airport operation, and the area of 278 hectares (687 acres) will be returned to local communities for a large regeneration plan of this area.

5.3 APPLICATION IN CASE STUDY AIRPORT

The steps of the procedure for the application of the model are described as following:

1. ***Develop 3 scenarios of total number of passengers***

Traffic (Thousand PAX)	Low Scenario	Basic Scenario	High Scenario
New Airport in 2015	6.000	6.400	6.900
New Airport in 2025	7.900	8.600	10.200



2. ***Define how many jobs are created per million passenger according to ACI 2004***

Direct Jobs per million passengers	
10-19 million	**934**
5-9 million	**793**

3. ***Develop 3 different scenarios for seasonality***

Non resident tourist arrivals	Low Scenario	Basic Scenario	High Scenario
Seasonality	7 months	10 months	Whole year

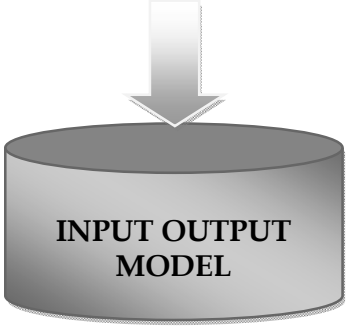
4. ***Define how many employees are created for the different scenarios of seasonality***

Seasonality of Employees	Low Scenario	Basic Scenario	High Scenario
Number of average employees per million passengers per month	7 months	9 months	12 months
	700employees	700 employees	700 employees
	5 months	3 months	12 months
	400 employees	400 employees	700 employees
Average number of employees per million passenger	**575**	**625**	**700**

5. ***Multiply total number of passenger x average number of employees per million passenger and get the total number of direct employees***

	Low Scenario	Basic Scenario	High Scenario
New Airport in 2015	**3500**	**4000**	**5000**
New Airport in 2025	**5500**	**6000**	**7000**
Construction period		**1000**	

6. ***Enter the total number of direct employees as Input to the Model***



7. ***Collect the appropriate and most recently Input Output transaction tables for the region***

Symmetric input-output tables are industry-by-industry matrices combining both supply and use into a single table with identical classification of products or industries, applied to both rows and columns.

These I-O tables show:

- The structure of the costs of production and the value added, which is generated in the production process
- The inter-dependencies of industries
- The flows of goods and services produced within the national economy
- The flows of goods and services with the rest of the world

The European System of Accounts (ESA95) has established a compulsory transmission of Five-yearly symmetric input-output tables by the European Member States. Supply, use and input-output tables are available in national currency (NAC) and the are compiled every 10 years(Eurostat 2008) .

8. *Define the classification of industries in the transaction tables*

The tables are harmonised by Eurostat's standardised questionnaire, which distinguishes 60 products (classification CPA P60) and 60 industries (NACE A60) for the data up to 2007 based on NACE rev 1.1. From reference year 2008 onwards, the products and industry classifications will be based on NACE Rev 2 (64 products and 64 industries).

9. ***Follow the steps of the development of the model from section 4.4.1 to 4.4.3 and calculate the matrixes for 59 sevtors of economy,***

The computations are implemented in the impact spreadsheets in the Appendix A.

The first step is to convert the inter-industry transactions into "direct purchase coefficients." This is done by dividing each inter-industry transaction in the Input Output table (Matrix 1 in the Appendix) by the respective industry's total input (i.e. value of the element in the last cell of the industry column).

Matrix 2 contains the resulting industries' direct purchase coefficients. For example, in the manufacturing/construction industry column, the value in the first cell shows the ratio of the purchases of natural resource/utilities industry inputs by manufacturing/construction industry to total manufacturing/construction input.

Matrix 3 and 4 are the I and A that are multiplied (I-A)-1 in order to give the Matrix 5 that is the inverse matrix (I-A)-1 (generally referred to as the "Leontief Inverse" in input-output modeling). Matrix 5 shows the inverse matrix for the 2005 59 sectors of the economy. The elements in this matrix are "total requirement coefficients." For example, the first value in the second data column(sector 2) of the table show that, for a one euro increase in final demand for the state's agriculture,hunting and related services sector the trade services (sector 35) raise their output by 0.007euro .

Matrix 6 gives the total multipliers per sector of economy that are depicted analytically in Table 7.

Table 7: Multipliers per sectors of Economy for the Region of Crete

MULTIPLIERS PER SECTOR OF ECONOMY FOR THE REGION OF CRETE		
	Sectors of the Economy	**Multipliers**
1	Products of agriculture, hunting and related services	**3,3141**
2	Products of forestry, logging and related services	**2,4534**
3	Fish and other fishing products; services incidental of fishing	**2,4341**
4	Coal and lignite; Peat	**2,8234**
5	Crude petroleum and natural gas; services oil and gas extraction	**3,3283**
6	Uranium and thorium ores	**2,0000**
7	Metal ores	**2,5297**
8	Other mining and quarrying products	**2,7689**
9	Food products and beverages	**3,1915**
10	Tobacco products	**2,5112**
11	Textiles	**2,7541**
12	Wearing apparel; Furs	**2,4408**
13	Leather and leather products	**2,3784**
14	Wood and products of wood plaiting materials	**3,1603**
15	Pulp, paper and paper products	**3,0987**
16	Printed matter and recorded media	**2,8668**
17	Coke, refined petroleum products and nuclear fuels	**4,1051**
18	Chemicals, chemical products and man-made fibres	**3,4977**
19	Rubber and plastic products	**2,7864**
20	Other non-metallic mineral products	**3,0611**
21	Basic metals	**5,1043**
22	Fabricated metal products, except machinery and equipment	**3,2193**
23	Machinery and equipment n.e.c.	**2,6850**
24	Office machinery and computers	**2,0436**
25	Electrical machinery and apparatus n.e.c.	**2,7819**
26	Radio, television and communication equipment and apparatus	**2,2567**
27	Medical, precision and optical instruments, watches and clocks	**2,2568**
28	Motor vehicles, trailers and semi-trailers	**2,2292**
29	Other transport equipment	**2,3903**
30	Furniture; other manufactured goods n.e.c.	**2,4824**
31	Secondary raw materials	**3,2650**
32	Electrical energy, gas, steam and hot water	**3,9441**
33	Collected and purified water, distribution services of water	**2,4764**
34	Construction work	**3,4779**
35	Trade, maintenance, repair services of motor vehicles sale of fuel	**2,9341**
36	Wholesale trade, commission trade services, vehicles, motorcycles	**4,1221**
37	Retail trade services, repair services of personal and household goods	**3,5888**
38	Hotel and restaurant services	**2,9882**
39	Land transport; transport via pipeline services	**3,1039**
40	Water transport services	**2,8374**
41	Air transport services	**2,5117**
42	Supporting and auxiliary transport services; travel agency services	**2,9105**

43	Post and telecommunication services	**3,1150**
44	Financial intermediation services, and pension funding services	**3,6400**
45	Insurance and pension funding services, except social security services	**2,7716**
46	Services auxiliary to financial intermediation	**2,7293**
47	**Real estate services**	**3,6322**
48	Renting services of machinery equipment and household goods	**2,8084**
49	Computer and related services	**2,8583**
50	Research and development services	**2,6221**
51	Other business services	**5,0387**
52	Public administration, defence services; social security services	**2,4112**
53	Education services	**2,1570**
54	Health and social work services	**2,4920**
55	Sewage and refuse disposal services, sanitation and similar services	**2,3597**
56	Membership organisation services n.e.c.	**2,8699**
57	Recreational, cultural and sporting services	**2,7604**
58	Other services	**2,2960**
59	Private households with employed persons	**2,0000**
60	Total	

10. Multiply the inverse matrix by the total number of direct employees

Once the Inverse I-O matrix is derived, the total impact of the new airport on the state economy can be estimated by multiplying these multipliers that are given in Table 7 by changes in the increased final demand(additional direct employees) caused by the new airport that are given in the fifth step of the procedure.

Table 8: Total Multiplied jobs for the operational period for the Low scenario

Direct, Indirect and Induced Impact per sector of economy (low scenario) in terms of jobs								
	2015		2025		2015		2025	
	Direct	Induced	Indirect	Induced	Direct	Induced	Indirect	Induced
1	**131**	**433**	**49**	**161**	**206**	**681**	**64**	**211**
2	**1**	**-**	**1**	**-**	**2**	**-**	**1**	**-**
3	**11**	**-**	**4**	**-**	**17**	**-**	**5**	**-**
4	**7**	**-**	**3**	**-**	**12**	**-**	**4**	**-**
5	**65**	**217**	**24**	**81**	**102**	**341**	**32**	**105**
6	**0**	**-**	**0**	**-**	**0**	**-**	**0**	**-**
7	**1**	**-**	**0**	**-**	**2**	**-**	**1**	**-**
8	**6**	**-**	**2**	**-**	**10**	**-**	**3**	**-**
9	**177**	**564**	**66**	**209**	**277**	**886**	**86**	**274**
10	**8**	**-**	**3**	**-**	**13**	**-**	**4**	**-**
11	**33**	**90**	**12**	**33**	**51**	**141**	**16**	**43**
12	**34**	**82**	**12**	**30**	**53**	**129**	**16**	**40**
13	**10**	**-**	**4**	**-**	**16**	**-**	**5**	**-**
14	**14**	**44**	**5**	**16**	**22**	**70**	**7**	**22**
15	**20**	**63**	**8**	**23**	**32**	**99**	**10**	**31**
16	**23**	**66**	**9**	**25**	**36**	**104**	**11**	**32**

17	94	388	35	144	148	609	46	188
18	99	346	37	129	155	544	48	168
19	26	73	10	27	41	114	13	35
20	40	124	15	46	63	194	20	60
21	68	345	25	128	106	542	33	168
22	42	135	16	50	66	212	20	65
23	67	180	25	67	105	283	33	87
24	9	-	3	-	14	-	4	-
25	19	54	7	20	30	84	9	26
26	21	47	8	17	33	74	10	23
27	14	31	5	11	21	48	7	15
28	54	121	20	45	85	189	26	59
29	38	91	14	34	60	143	19	44
30	36	88	13	33	56	139	17	43
31	1	-	0	-	1	-	0	-
32	59	234	22	87	93	367	29	113
33	13	32	5	12	20	50	6	15
34	257	894	95	332	404	1 405	125	434
35	61	180	23	67	96	282	30	87
36	211	871	78	323	332	1 368	103	423
37	160	573	59	213	251	900	78	278
38	198	593	74	220	312	932	96	288
39	47	145	17	54	74	228	23	71
40	141	399	52	148	221	627	68	194
41	12	-	5	11	19	-	6	15
42	76	221	28	82	119	347	37	107
43	56	176	21	65	89	276	27	85
44	96	350	36	130	151	551	47	170
45	17	47	6	18	27	74	8	23
46	8	-	3	-	12	-	4	-
47	222	805	82	299	348	1 266	108	391
48	11	-	4	-	17	-	5	-
49	19	54	7	20	30	85	9	26
50	5	-	2	-	8	-	3	-
51	103	517	38	192	161	812	50	251
52	206	496	76	184	323	780	100	241
53	109	236	41	88	172	371	53	115
54	116	290	43	108	183	455	56	141
55	12	-	4	-	19	-	6	-
56	17	48	6	18	26	76	8	23
57	53	147	20	55	84	232	26	72
58	32	74	12	27	50	116	16	36
59	13	26	5	9	20	40	6	12
60	3500	10 987	1300	4 092	5500	17 265	1700	5 351

Table 9: Total multiplied jobs for the operational period for the Basic scenario

Direct, Indirect and Induced Impact per sector of economy (basic scenario) in terms of jobs								
	2015		2015		2015		2025	
	Direct	Induced	Indirect	Induced	Direct	Induced	Indirect	Induced
1	149	495	56	186	224	743	71	235
2	2	-	1	-	2	-	1	-
3	13	-	5	-	19	-	6	-
4	8	-	3	-	13	-	4	-
5	74	248	28	93	112	372	35	118
6	0	-	0	-	0	-	0	-
7	1	-	1	-	2	-	1	-
8	7	-	3	-	11	-	3	-
9	202	644	76	242	303	966	96	306
10	9	-	4	-	14	-	4	-
11	37	102	14	38	56	153	18	49
12	38	94	14	35	58	140	18	44
13	12	-	4	-	18	-	6	-
14	16	51	6	19	24	76	8	24
15	23	72	9	27	35	108	11	34
16	26	76	10	28	40	113	13	36
17	108	443	40	166	162	665	51	211
18	113	396	42	148	170	593	54	188
19	30	83	11	31	45	125	14	39
20	46	141	17	53	69	212	22	67
21	77	394	29	148	116	591	37	187
22	48	154	18	58	72	231	23	73
23	77	206	29	77	115	308	36	98
24	10	-	4	-	16	-	5	-
25	22	61	8	23	33	92	10	29
26	24	53	9	20	36	80	11	25
27	16	35	6	13	23	53	7	17
28	62	138	23	52	93	207	29	65
29	44	104	16	39	65	156	21	49
30	41	101	15	38	61	151	19	48
31	1	-	0	-	1	-	0	-
32	68	267	25	100	102	400	32	127
33	15	36	5	14	22	54	7	17
34	294	1 022	110	383	441	1 533	140	485
35	70	205	26	77	105	308	33	97
36	241	995	91	373	362	1 493	115	473
37	182	655	68	245	274	982	87	311
38	227	678	85	254	340	1 016	108	322
39	54	166	20	62	80	249	25	79
40	161	456	60	171	241	684	76	217
41	14	-	5	13	21	-	7	17
42	87	252	33	95	130	379	41	120
43	65	201	24	75	97	302	31	96

44	110	401	41	150	165	601	52	190
45	20	54	7	20	29	81	9	26
46	9	-	3	-	13	-	4	-
47	253	921	95	345	380	1 381	120	437
48	12	-	5	-	19	-	6	-
49	22	62	8	23	33	93	10	29
50	6	-	2	-	9	-	3	-
51	117	590	44	221	176	886	56	280
52	235	567	88	213	353	851	112	269
53	125	270	47	101	187	404	59	128
54	133	331	50	124	199	496	63	157
55	14	-	5	-	21	-	7	-
56	19	55	7	21	29	82	9	26
57	61	169	23	63	92	253	29	80
58	37	84	14	32	55	126	17	40
59	15	29	5	11	22	44	7	14
60	4000	12 556	1500	4 722	6000	18 834	1900	5 981

Table 10: Total multiplied jobs for the operational period for the High scenario

Direct, Indirect and Induced Impact per sector of economy (high scenario) in terms of jobs								
	2015		2015		2015		2025	
	Direct	Induced	Indirect	Induced	Direct	Induced	Indirect	Induced
1	187	619	64	211	262	867	82	272
2	2	-	1	-	3	-	1	-
3	16	-	5	-	22	-	7	-
4	11	-	4	-	15	-	5	-
5	93	310	32	105	130	434	41	136
6	0	-	0	-	0	-	0	-
7	2	-	1	-	3	-	1	-
8	9	-	3	-	13	-	4	-
9	252	805	86	274	353	1 127	111	354
10	12	-	4	-	16	-	5	-
11	46	128	16	43	65	179	20	56
12	48	117	16	40	67	164	21	51
13	15	-	5	-	21	-	7	-
14	20	63	7	22	28	89	9	28
15	29	90	10	31	41	126	13	40
16	33	95	11	32	46	132	15	42
17	135	554	46	188	189	776	59	244
18	141	494	48	168	198	692	62	218
19	37	104	13	35	52	145	16	46
20	58	176	20	60	81	247	25	78
21	97	493	33	168	135	690	42	217
22	60	193	20	65	84	270	26	85
23	96	257	33	87	134	360	42	113
24	13	-	4	-	18	-	6	-

25	28	77	9	26	39	108	12	34
26	30	67	10	23	41	94	13	29
27	19	44	7	15	27	62	9	19
28	77	172	26	59	108	241	34	76
29	54	130	19	44	76	182	24	57
30	51	126	17	43	71	176	22	55
31	1	-	0	-	1	-	0	-
32	85	334	29	113	118	467	37	147
33	18	45	6	15	26	64	8	20
34	367	1 277	125	434	514	1 788	162	562
35	87	256	30	87	122	359	38	113
36	302	1 244	103	423	423	1 742	133	547
37	228	818	78	278	319	1 145	100	360
38	283	847	96	288	397	1 186	125	373
39	67	208	23	71	94	291	29	91
40	201	570	68	194	281	798	88	251
41	17	-	6	15	24	-	8	19
42	108	315	37	107	152	442	48	139
43	81	251	27	85	113	352	36	111
44	138	501	47	170	193	701	61	220
45	24	68	8	23	34	95	11	30
46	11	-	4	-	15	-	5	-
47	317	1 151	108	391	444	1 611	139	506
48	15	-	5	-	22	-	7	-
49	27	78	9	26	38	109	12	34
50	7	-	3	-	10	-	3	-
51	146	738	50	251	205	1 033	64	325
52	294	709	100	241	412	993	129	312
53	156	337	53	115	219	472	69	148
54	166	414	56	141	232	579	73	182
55	17	-	6	-	24	-	8	-
56	24	69	8	23	34	96	11	30
57	76	211	26	72	107	295	34	93
58	46	105	16	36	64	147	20	46
59	18	36	6	12	26	51	8	16
60	5000	15 695	1700	5 351	7000	21 973	2200	6 925

Table 11: Total multiplied jobs for the construction period

Direct and Induced jobs per sector of economy for the construction period				
	Jobs		Income	
	Direct	Induced	Direct	Induced
1	37	124	1.494.891,83 €	4.954.202,59 €
2	0	-	16.413,98 €	40.270,69 €
3	3	8	125.563,57 €	305.638,36 €
4	2	6	84.232,95 €	237.823,42 €
5	19	62	744.653,69 €	2.478.440,12 €
6	0	-	0,00 €	0,00 €
7	0	1	14.561,77 €	36.836,33 €
8	2	5	73.611,55 €	203.823,08 €
9	50	161	2.018.144,04 €	6.440.872,45 €
10	2	6	93.722,86 €	235.353,04 €
11	9	26	371.483,62 €	1.023.119,47 €
12	10	23	383.535,03 €	936.150,19 €
13	3	7	119.683,20 €	284.660,48 €
14	4	13	160.433,95 €	507.014,42 €
15	6	18	231.827,44 €	718.353,55 €
16	7	19	263.826,78 €	756.329,95 €
17	27	111	1.079.567,32 €	4.431.779,25 €
18	28	99	1.130.826,49 €	3.955.256,73 €
19	7	21	297.998,40 €	830.328,91 €
20	12	35	461.179,20 €	1.411.696,11 €
21	19	99	772.150,68 €	3.941.316,58 €
22	12	39	478.475,21 €	1.540.354,50 €
23	19	51	765.913,63 €	2.056.458,13 €
24	3	5	104.912,55 €	214.394,05 €
25	6	15	220.835,59 €	614.347,41 €
26	6	13	237.010,67 €	534.865,46 €
27	4	9	155.903,33 €	351.841,62 €
28	15	34	618.064,05 €	1.377.814,65 €
29	11	26	435.366,24 €	1.040.651,86 €
30	10	25	406.061,68 €	1.008.017,74 €
31	0	1	8.357,72 €	27.288,03 €
32	17	67	676.911,30 €	2.669.820,90 €
33	4	9	146.561,91 €	362.950,11 €
34	73	255	2.938.058,80 €	10.218.259,24 €
35	17	51	699.190,02 €	2.051.467,77 €
36	60	249	2.414.376,19 €	9.952.326,71 €
37	46	164	1.823.810,25 €	6.545.341,88 €
38	57	169	2.267.713,61 €	6.776.364,34 €
39	13	42	535.319,09 €	1.661.588,67 €
40	40	114	1.606.459,26 €	4.558.137,42 €
41	3	9	138.492,21 €	347.851,80 €
42	22	63	867.065,01 €	2.523.613,40 €
43	16	50	645.489,39 €	2.010.707,76 €

44	28	100	1.100.425,21 €	4.005.573,17 €
45	5	14	195.180,33 €	540.962,80 €
46	2	6	87.400,52 €	238.541,62 €
47	63	230	2.534.314,28 €	9.205.071,58 €
48	3	9	123.876,74 €	347.891,50 €
49	5	16	216.937,42 €	620.082,70 €
50	1	4	58.953,04 €	154.578,60 €
51	29	148	1.171.746,03 €	5.904.047,38 €
52	59	142	2.352.513,66 €	5.672.371,71 €
53	31	67	1.249.728,48 €	2.695.724,98 €
54	33	83	1.327.919,28 €	3.309.167,69 €
55	3	8	138.220,33 €	326.158,82 €
56	5	14	191.597,08 €	549.873,22 €
57	15	42	610.538,89 €	1.685.325,65 €
58	9	21	366.157,07 €	840.700,06 €
59	4	7	145.888,38 €	291.776,75 €
60	1000	3213	40.000.052,80 €	128.561.577,44 €

11. Calculate the total direct income caused by the new airport

Assuming an average of 40000 per employee for the 2015 (source ELSTAT 2009) and an average of 50000 euro for 2025 based on the scenarios of economic growth, for the different scenarios of traffic (number of passengers) the new airport will accumulate from 140-200 million Euro for 2015 and 220-350 million Euro for 2025 as shown in the following table. These million Euros will be distributed to the region and will create the induced economic effects in the region.

Table 12 : Total direct income for the different scenarios

	Total PAX in thousands	Scenario	Total direct income
Existing Airport(1)	5.369	Actual Value	**80 million**
New Airport in 2015(2)	6.000	**Low scenario**	**140 million**
	6.400	**basic scenario**	**160 million**
	6.900	High scenario	**200 million**
New Airport in 2025(2)	7.900	**Low scenario**	**220 million**
	8.600	**basic scenario**	**340 million**
	10.200	High scenario	**350 million**

12. *Calculate the contribution of direct impact to GDP and Develop different scenarios of economic growth of Greece*

In order to calculate the contribution of the direct impact to GDP we have to divide the total income caused by the airport by the total GDP.(Miller and Bler,1985). For the future scanarios we have to develope different scenarios of economic growth.

At current period the economy of Greece is suffering a serious recession in the context of the sizeable, but vital, fiscal retrenchment. The GDP moves to negative rates from 2007 and a return to sustained positive growth is projected for 2011-2012(as shown in the following figure) as external demand strengthens, competitiveness improves and the far-reaching structural reforms implemented in response to the fiscal crisis will start to take hold. Substantial economic slack and rising unemployment will keep inflation pressures subdued. The outlook is subject to important, mostly downside risks.

Nowadays there is a fiscal and structural adjustment programme, that was agreed in May 2010 with the European Union (EU) and the International Monetary Fund (IMF), and that is indispensible for restoring credibility and market confidence, long-term public debt sustainability and competitiveness. Success depends crucially on rigorous expenditure control and further progress in fighting tax evasion, combined with comprehensive reforms to address chronic rigidities in fiscal management, and in labour and product markets.

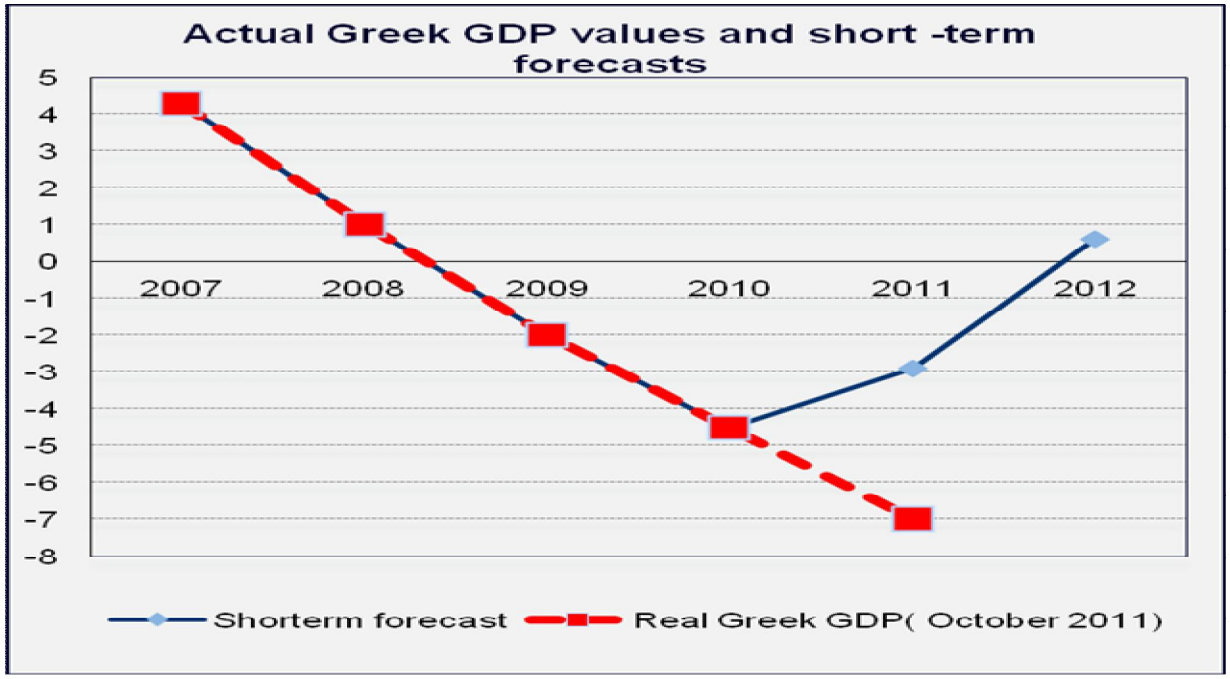


Figure 17: Actual GDP and Short-term forecast
(Source: OECD 2010-ELSTAT 2012)

Under conservative assumptions regarding growth and interest rates, and if fiscal and structural reforms are fully implemented, the debt-GDP ratio could peak in 2013 and fall

below 60% of GDP in the next two decades. There is a package announced on 21 July 2011 that should ensure reasonable interest rates on Greek debt, containing measures to enhance investment and growth, and will give Greece the time needed to implement reforms which will boost competitiveness and export performance. Despite the short term costs, the reforms that have been implemented or planned will benefit Greece for many years to come, as they will raise growth, living standards and equity. A key prerequisite of success is that the burden and benefits of reform be, and be seen to be, broadly and fairly shared.

The reforms carried out over the past year are impressive. The cuts in the public deficit are unprecedented. Deep-rooted fiscal reforms have been launched to strengthen the management of the public finances and to revamp the pension system. The statistical system is being improved significantly. Labour market reforms will increase employment and help to restore international competitiveness. Red tape and barriers to competition are being cut, which will boost investment and FDI.

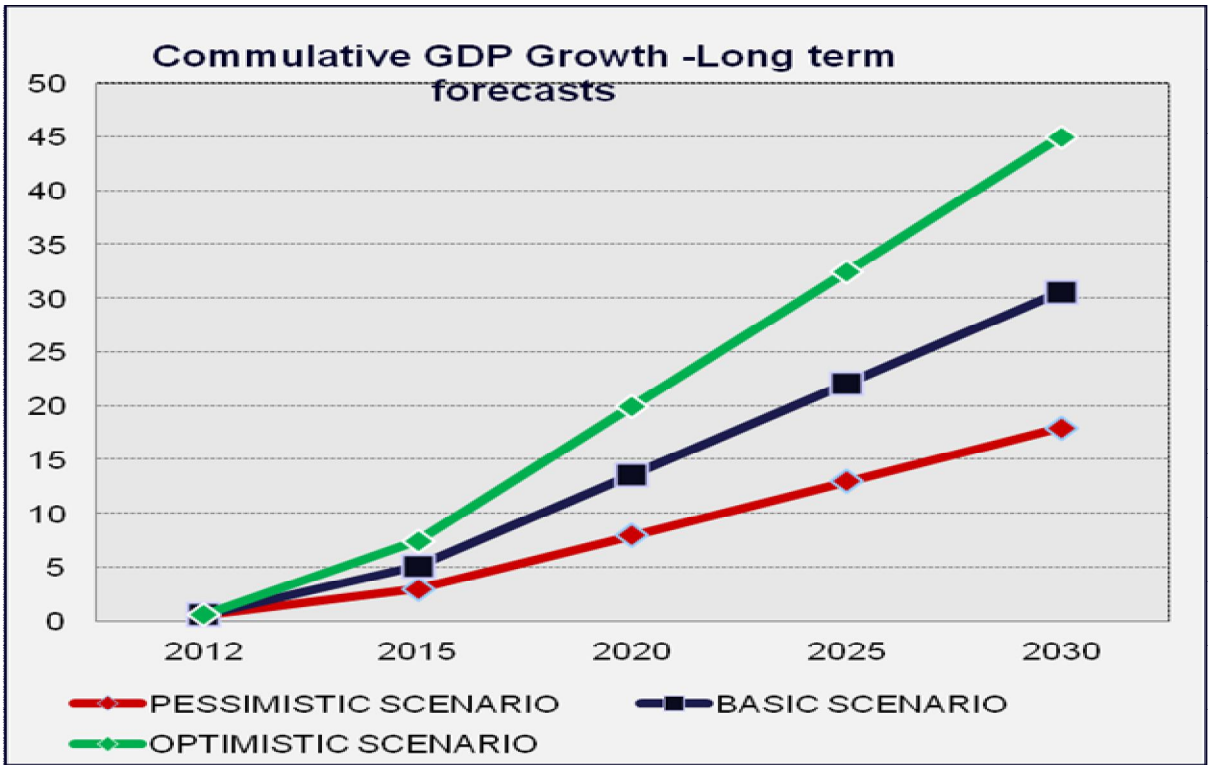


Figure 18: Long-term forecasts: alternative scenarios of development
(Source: *OECD calculations 2010)*

It is assumed that nominal GDP in Greece will grow in accordance with the IMF forecast between 2011 and 2015. From 2016 until 2030, which is the end of our projection period, we assumed that GDP would grow per annum according to OECD calculations as following:
Low scenario: Long-term potential growth 1.0% average
Basic scenario: Long-term potential growth 1.5% average
High scenario: Long-term potential growth 2.5% average

From 1999 to 2007, nominal GDP in the "core" Eurozone countries grew at an average annual rate of approximately 3.5 percent.3 During the same period, Greece averaged a nominal GDP growth rate of 7.5 percent per annum, but we expect that this exceptionally high rate of growth will be difficult for Greece to achieve, at least for the foreseeable future. Therefore, an average 3.5 percent growth rate as occurred in the "core" Eurozone during "normal" times, would be used as a longrun growth rate for Greece.(OECD 2008).

Under our base-case scenario of 1.5 percent long-run nominal GDP growth, the GDP ratio of the Greece will stabilize to around 20% percent of GDP in 2020 and 45% in 2030. The scenarios for the different growth in terms of GDP% and in million Euros output are depicted in the following table. It is assumed that the GDP of Crete equals constant the 5% of GDP of Greece.

Table 13: Potential growth of GDP(long term forecasts)

Year	Potential growth	Greece	Crete
2007	+4.30%	231.800 million Euro	11.590 million Euro
2008	+1.00%	231.000 million Euro	11.550 million Euro
2009	-2.00%	222.500 million Euro	11.125 million Euro
2010	-4.50%	206.900 million Euro	10.345million Euro
2011	-2.90%	210.000million Euro	10.500 million Euro
2012	+0.60%	220.000million Euro	11.000 million Euro
		2015	
Low Scenario	3,00%	226.600 million Euro	11.330 million Euro
Basic Scenario	4,50%	229.900 million Euro	11.495 million Euro
High Scenario	7,50%	236.500 million Euro	11.825 million Euro
		2020	
Low Scenario	8,00%	237.600 million Euro	11.880 million Euro
Basic Scenario	12,00%	246.400 million Euro	12.320 million Euro
High Scenario	20,00%	264.000 million Euro	13.200 million Euro
		2025	
Low Scenario	13,00%	248.600 million Euro	12.430 million Euro
Basic Scenario	19,50%	262.900 million Euro	13.145 million Euro
High Scenario	33,00%	292.600 million Euro	14.630 million Euro
		2030	
Low Scenario	18,00%	259.600 million Euro	12.980 million Euro
Basic Scenario	27.00%	279.400 million Euro	13.970 million Euro
High Scenario	45,00%	319.000 million Euro	15.950million Euro

13. *Develop scenarios of number of tourist arrivals in order to estimate the catalytic impact*

Thousands of visitors arrive daily during the months from July to October at the tourist destination of Crete. These visitors stay and spend money on hotels, shopping, entertainment, ground transportation and food. The direct total amount spent by air

visitors is derived from the number of visitors that are attracted annually and the average expenditure they spend per night multiplied by days (EL.STAT, 2008). There is a high seasonality in these arrivals that is depicted in figure 14. Analytically:

Table 14: Total air passenger visitors spending

Non residents tourist arrivals	2,13 million
Average spent per day	109 euro
Average days spent in Crete	15 days
Air passenger visitor spending	Air passengers x average spent per day x days
Air passenger visitor spending	3,4823 million Euros

(Source: EL.STAT, 2008)

Table 15: Total tourist spending for the different scenarios

	Non residents Tourists	Scenario	Total spent directly
Existing Airport(1)	**2.130.000**	Actual Value	**3.483 million**
New Airport in 2015	2.500.000	Low scenario	**4.088 million**
	2.700.000	basic scenario	**4.415 million**
	2.900.000	High scenario	**4.742 million**
New Airport in 2025	3.200.000	Low scenario	**5.232 million**
	3.700.000	basic scenario	**6.050 million**
	4.400.000	High scenario	**7.195 million**

(Source: EL.STAT, 2008)

For the different scenarios the new airport will accumulate from 4088-4742 million Euros in new sales from the tourists that will arrive in 2015 and 5232-7195 in 2025. The amount of million Euros will be distributed to lodging, restaurant, amusement and retail trade sectors in proportion to how each visitor spends their 109 Euros. Tourism industries are labour and income intensive, so a high proportion of sales will be translated into income and jobs. The tourism industry then buys goods and services from other local businesses, and pays out most of the amount of Euros in income as wages and salaries to employees. This creates the catalytic economic effects in the region.

6 RESULTS

The results of the study demonstrated that for the basic scenario the airport will substantially contribute to the regional economy with an annual total added value of 978 million euros, corresponding to 8.27% of Crete's GDP in 2015 and an annual total value of 1181 million euros corresponding to 10.05 % in 2025. At a national level, the airport s annual contribution will amount to 0.41 % of Greece GDP (billion euros), in 2015 and to 0.50% in 2025.

In addition, for the basic scenario, the airport will create 5000 direct jobs, 1700 indirect jobs and 21046 induced jobs in 2015 and 7000 direct, 2200 indirect and 28898 induced jobs in 2025.

Finally, the results of the catalytic impact show that the incremental tourism that will be realized by the new airport will contribute to the regional economy with an annual total added value of 605 million euros, corresponding to 3 % of Crete's GDP and to 0.22% of Greece GDP for the low scenario in 2015 and 1549 million euros corresponding to 6.2% of Crete's GDP and to 0.51 % of Greece GDP of in 2025.

For the basic scenario, the incremental tourism will be realized by the new airport will contribute to the regional economy with an annual total added value of 931 million euros, corresponding to 4.5 % of Crete's GDP and to 0.40% of Greece GDP for the low end scenario in 2015 and 2567 million euros, corresponding to 7.4 of Crete's GDP and to 0.65 % of Greece GDP of in 2025.

For the basic scenario, the incremental tourism will be realized by the new airport will contribute to the regional economy with an annual total added value of 1259 million euros, corresponding to 6 % of Crete's GDP and to 0.51% of Greece GDP for the low scenario in 2015 and 3517 million euros corresponding to 8.2% of Crete's GDP and to 0.80 % of Greece's GDP of in 2025.

For the construction period the new airport will create 1000 direct jobs and 3213 induced jobs as shown in figure 19.

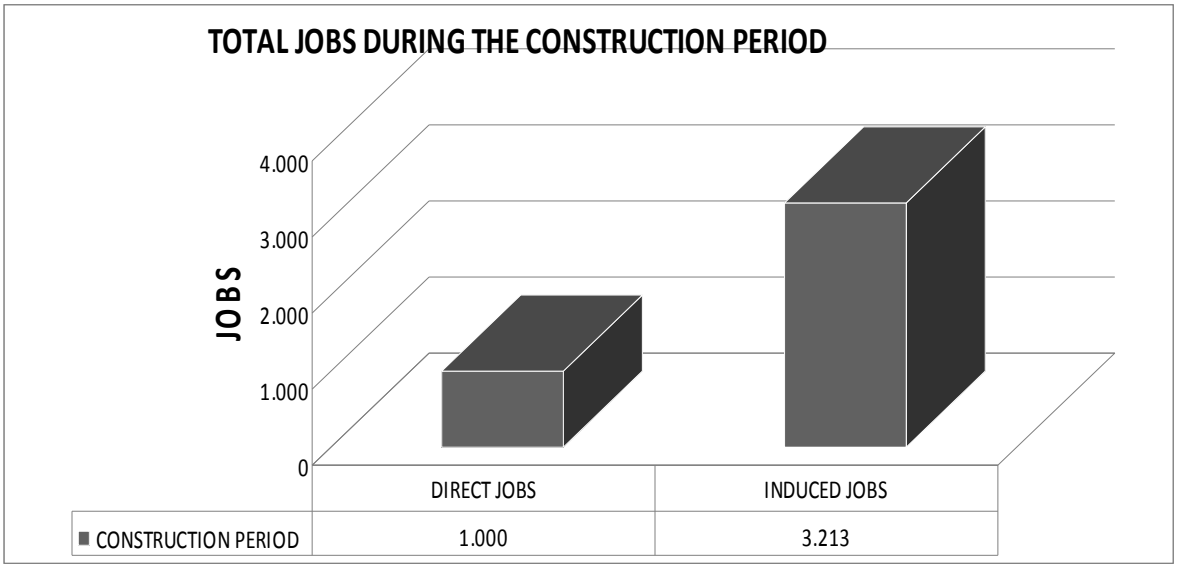


Figure 19:Total jobs for the construction period

For the low end scenario, the airport will create 3500 direct jobs, 1300 indirect jobs and 15079 induced jobs in 2015 and 5500 direct, 1700 indirect and 22616 induced jobs in 2025. In addition, for the basic scenario, the airport will create from 5000 direct jobs, 1700 indirect jobs and 21046 induced jobs in 2015 and 7000 direct, 2200 indirect and 28898 induced jobs in 2025 as shown in following figure. The

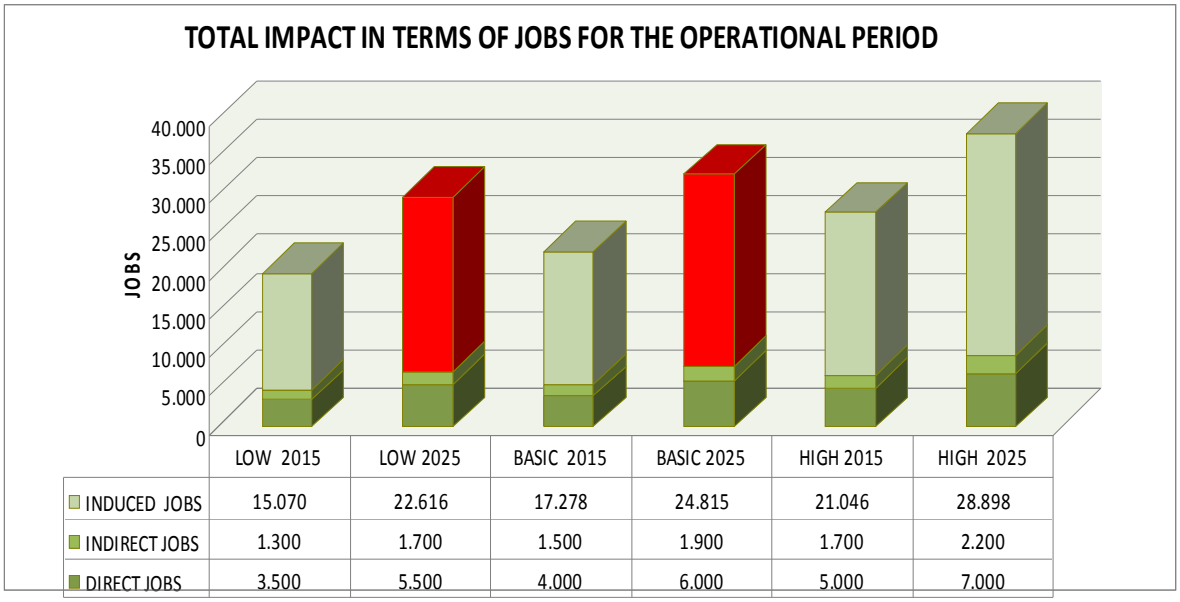


Figure 20:Total jobs for the operational period

The results of the study demonstrate that the new airport will substantially contribute to the regional economy with an annual total added value from 617 million euros, corresponding to 7.11% of Crete's GDP in 2015 for the low scenario, to an annual total value of 1191 corresponding to 9.67% in 2025 for the high scenario as shown in figure 21.

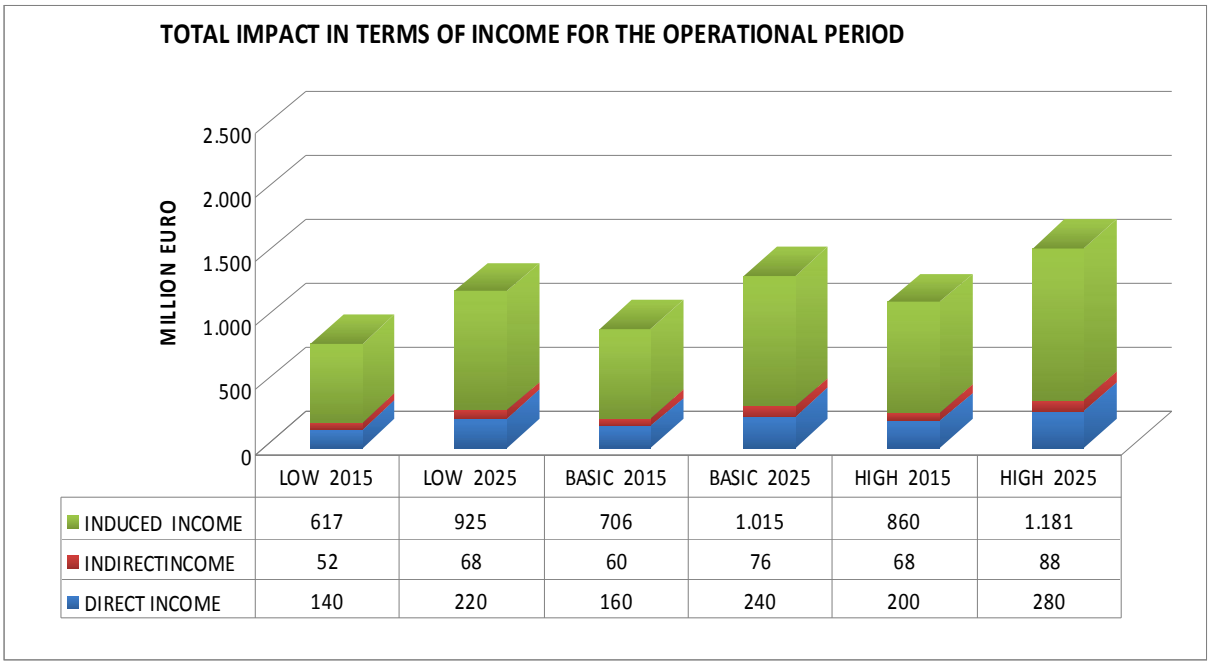


Figure 21: Total income for the operational period

In addition for the construction period the airport will contribute to the regionally economy with an annual total value for the two years of construction period 169 million Euro as shown in following figure.

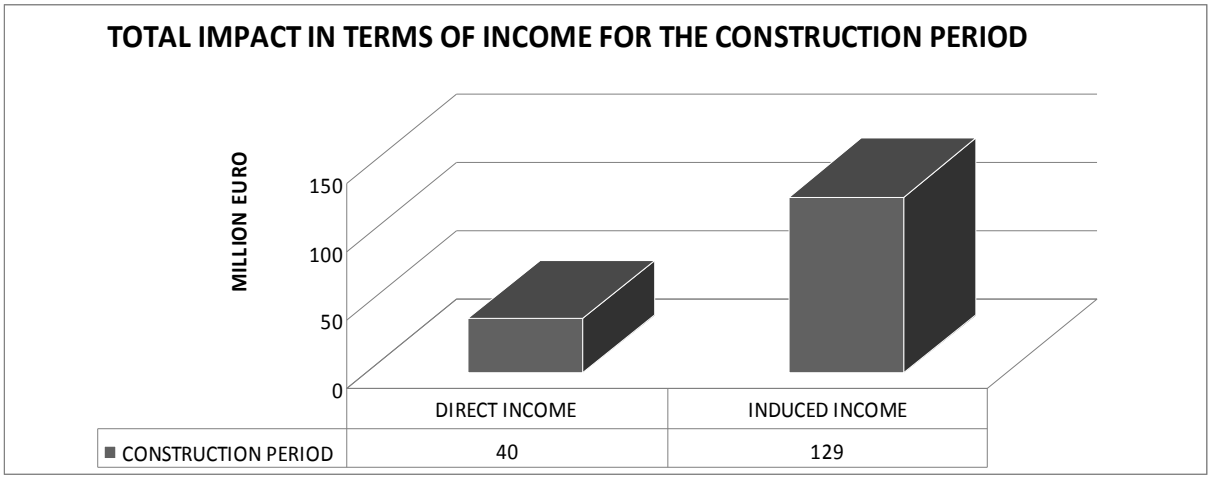


Figure 22: Total income for the construction period

The outputs of the model showed that the new airport will contribute a mean average from 7% to 8.27 % towards real GDP of Crete in 2015 and an average from 9.67% to 10.05% in 2025 as shown in figure 23.

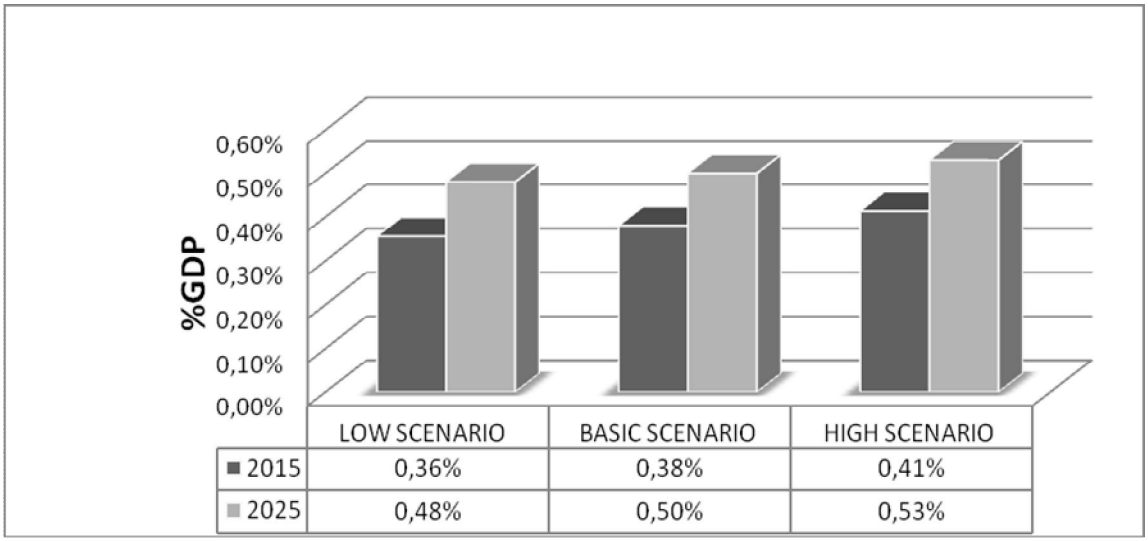


Figure 23: Contribution of the new airport to GDP of Greece

At a national level, the airport s annual contribution will amount from 0.36 to 0.41 % of Greece GDP (billion euros) in 2015 and from 0.48% to 0.53 % of Greece GDP in 2025 as shown in figure 24.

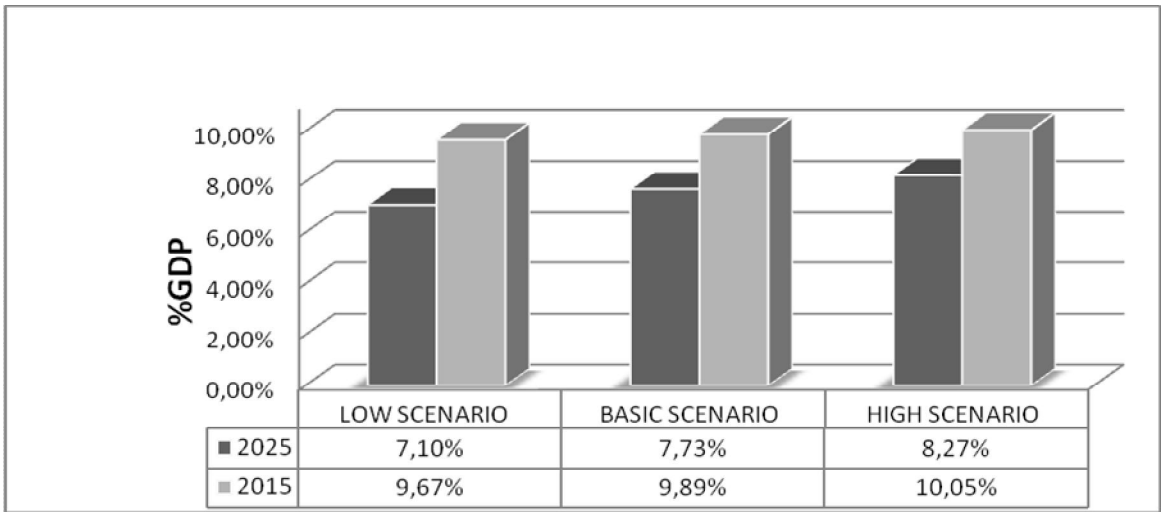
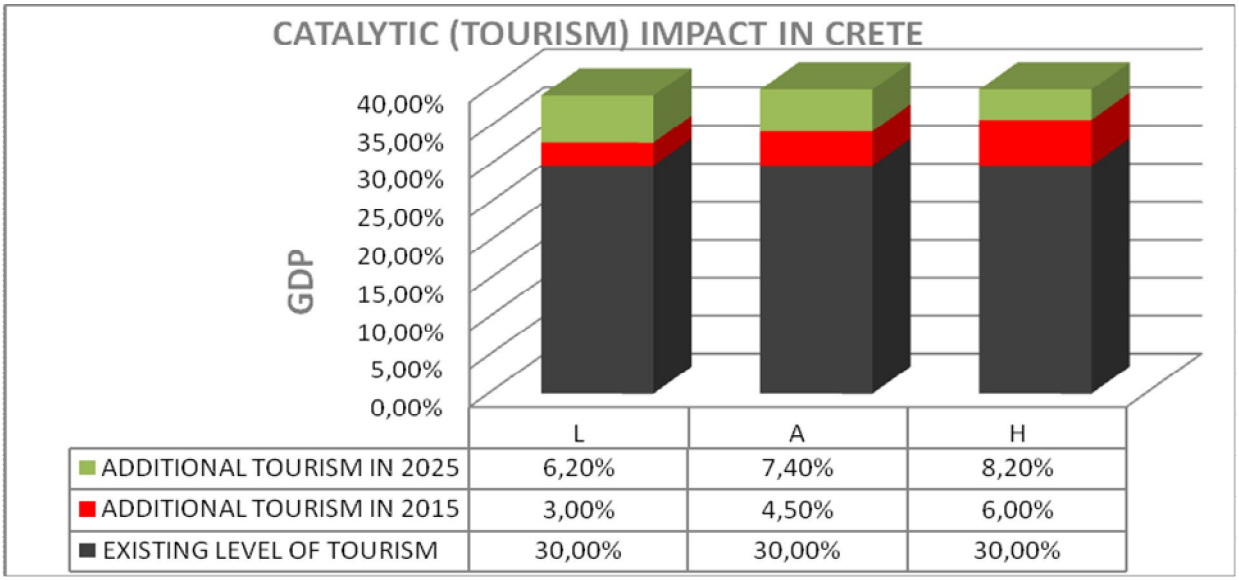


Figure 24: Contribution of the new airport to GDP of Crete

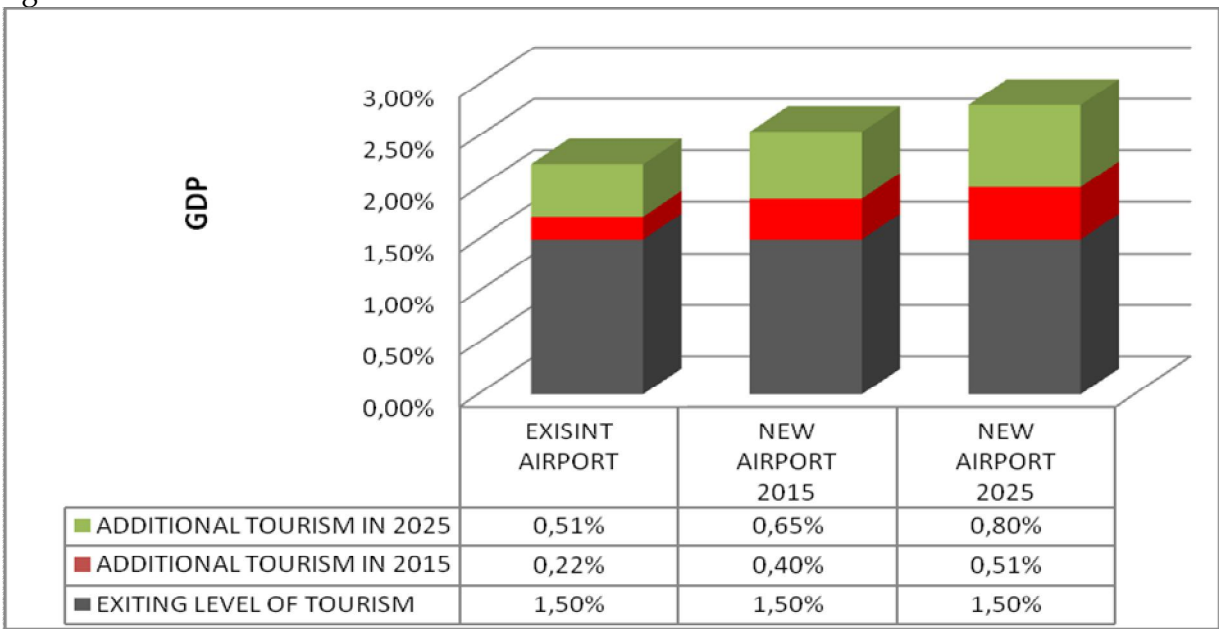
Incremental tourism (catalytic impact) at the region of Crete will contribute a mean average of 6% towards the real GDP of Crete, while the existing tourism sector now contributes an average of 30% of real GDP of Crete .



	L	A	H
ADDITIONAL TOURISM IN 2025	6,20%	7,40%	8,20%
ADDITIONAL TOURISM IN 2015	3,00%	4,50%	6,00%
EXISTING LEVEL OF TOURISM	30,00%	30,00%	30,00%

Figure 25: Total tourism impact of the new airport to the GDP of Crete

Incremental tourism (catalytic impact) at the nation of Greece will contribute a mean average from 0.22% to 0.51 % towards the real GDP of Greece in 2015, while the existing tourism sector now contributes an average of 1.5 % of real GDP of Crete as shownh in figure



	EXISINT AIRPORT	NEW AIRPORT 2015	NEW AIRPORT 2025
ADDITIONAL TOURISM IN 2025	0,51%	0,65%	0,80%
ADDITIONAL TOURISM IN 2015	0,22%	0,40%	0,51%
EXITING LEVEL OF TOURISM	1,50%	1,50%	1,50%

Figure 26: Total tourism impact of the new airport to the GDP OF Greece

7 DISCUSSION

The key questions in an investment appraisal decision concerning the development of a new airport are "what is the contribution of a new airport ?"and" how a new airport is able to lead to an increase in economic growth?". A computational model that will be able to measure the contribution that a new airport will have on regional and national economy was developed in order to :

- *assess* the macroeconomic impact of an investment on a new regional tourist airport to the regional economy in terms of employment and output(GDP) and
- *quantify* the effects of the investment on the different sectors of the economy.

The model was *used* to carry out a case study of a proposed airport development in Crete

The aim of the research was to estimate the short and longer term economic impact caused to local and regional economies by a new airport. Moreover the question what is the tourism impacts and the wider impacts from such an investment is answered by the findings of the research.

The broad findings of the modeling in this research would be applicable to many other parts of the Mediterranean and other tourist locations with the same characteristics. Considering the results and given the significance of tourism to the GDP of many countries in Southern Europe such as Greece, stakeholders could be based in these results and would promote decisions about airports based on tourism.

As the transaction tables used for this study were constructed to one year (2006), it was difficult to estimate change in baseline employment, expenditure and business investment values. The transaction tables that are published periodically by national and regional statistical bodies and airport survey data detailing employment, income and expenditure

items do not encompass important information about prices and traveler behavior. In fact, the production function in the modeling framework assumed a fixed input requirement, in order to meet a static amount of final demand or consumption. Further research would create wage and price elasticities in addition to the transactional data.

Moreover, the model addressed dynamic output effects (including catalytic effects), that are influenced by changing traveller attitudes and prices. The analysis could further focus more intensively on the demand side, by analysing the expenditures and attitudes of the airport users in more detail making questions regarding length of stay, type of accommodation, number of people travelling, principle purpose of air travel and travel expenditures, so as to produce more accurate inferences.

Estimates of the wider economic impact of the airport development are particularly sensitive to underlying assumptions regarding the additional passengers that will be attracted, as was acknowledged in the research. This is especially significant, given that passenger growth assumptions deviate substantially from WNTO forecasts. Given the sensitivity of the prediction of wider benefits to this particular assumption, regarding future use of aviation, it is unfortunate that it would be conducted a sensitivity run in the future..

The findings of the research support decision makers to measure the gains from an investment in a new airport and to understand the consequences that a new airport will have on other sectors of the economy. The findings enhance and inform the decision making at the level of strategic planning concerning an airport development
Finally the results of the research would act as a decision support tool for the government authorities. Moreover they would support tourism industry to understand the consequences that a new airport will have on the tourism industry.

According to the findings of the research, the new airport will contribute substantially to the regional economy with an annual total added corresponding to 7% - 8.27 % towards real GDP of Crete in 2015 and an average from 9.67% to 10.05% in 2025 and 0.36 to 0.35 % of Greece's GDP at national level. At the same time, the airport will be a powerful employment engine, able to create more than 20,000 jobs in Crete in 2015 and 35000 in 2025 ,inside and outside its fence. These figures illustrate the great contribution of a tourist airport on a tourist region comparing with European level, as in international European airports the respective impacts vary from 1.4% to 2.5% of the GDP. (ACI 2004)

Finally the findings of the research showed that the total economic impact of the airport is of great significance on regional level, indicating the important role of the new airport and tourism as an employment driver. Of great importance is the fact that the economic contribution of expanded tourism during the whole year (high scenario in 2025) may boost employment in the new airport and contribute up to 10% of Crete's GDP and 1% of Greece 's GDP in 2025.

Finally the results of the research showed the reliance of Greek and Cretan Economy on tourism. The tourism is the main function of the economy and is depended upon aviation. The research confirmed the significant contribution of Kastelli airport and the potential of this single development project to safeguard future jobs and economic development even at a time of economic recession.

8 CONCLUSIONS

The employment opportunities associated with the short term construction period and the following operational phase have the potential to make a great positive impact on total income in the area. The jobs associated with the construction and the operational phase are likely to be able to provide significant benefits to total employment in the area.

The results of the research also demonstrated the size and structure of the tourism industry in a given region and how tourism affects the other sectors of the economy. Such findings will be helpful in identifying potential partners for the tourism industry, as well as in targeting tourist industries as part of regional economic development strategies.

A challenge for Greece is to become stronger after an economic crisis through sustainable investments in infrastructures like an airport in a tourist region, in order to secure competitiveness and new foundation for economic growth in the future. As part of strategic response to the economic crisis, decision makers will have to focus on investments like the case study airport in order to restore long-term economic growth. This research should also help setting priorities and uncovering good practices, including in the area of evaluation and co-ordination of planned efforts in order to attract the investors interest.

Regarding an investment in a new airport, the greatest challenge that decision makers face is to incorporate that can achieve a sustainable investment . The complexities of today's global economy make the decision about developing a new airport very difficult.

The research answered the key questions "What is the contribution of a new airport to the economy of the region "and "how such an investment may contribute to the economic growth of the region". Direct impact values were typically low compared to catalytic impact values. The results depict the added value of developing a new airport as extra growth on top of that from the existing airport.

Recommendations

The tables used in this research were constructed in 2006. Therefore any change in the period from 2006 to 2010 is not taken into account. In this research, until 2010 the changes were not significant, so they did not influence the research results. However last 2 years when Greek economy suffers a serious recession in the context of sizeable, and fiscal retrenchment. The GDP moves to negative rates, so the input output tables have to be reconstructed in order to be used in the model and give accurate results. Therefore more research in transactions between the sectors of the economy is recommended.

Also the model is based on airtransport traffic forecasts. Then the accurancy of the outputs is related in these short and long term forecasts. Therefore the assesment about the future effects has to be related with additional assessment about changes in future demand. In order to improve the accuracy of the number of tourists, that was estimated (according to domestic and foreign tourists in key southern European tourism destinations) a higher resolution historical analyses to quantify more accurate number could be implemented.

Moreover the economic uncertainties approve that a dynamic modeling approach may provide accurate and safe estimations. Especially for the outputs for airports serving airports with no economic stability.

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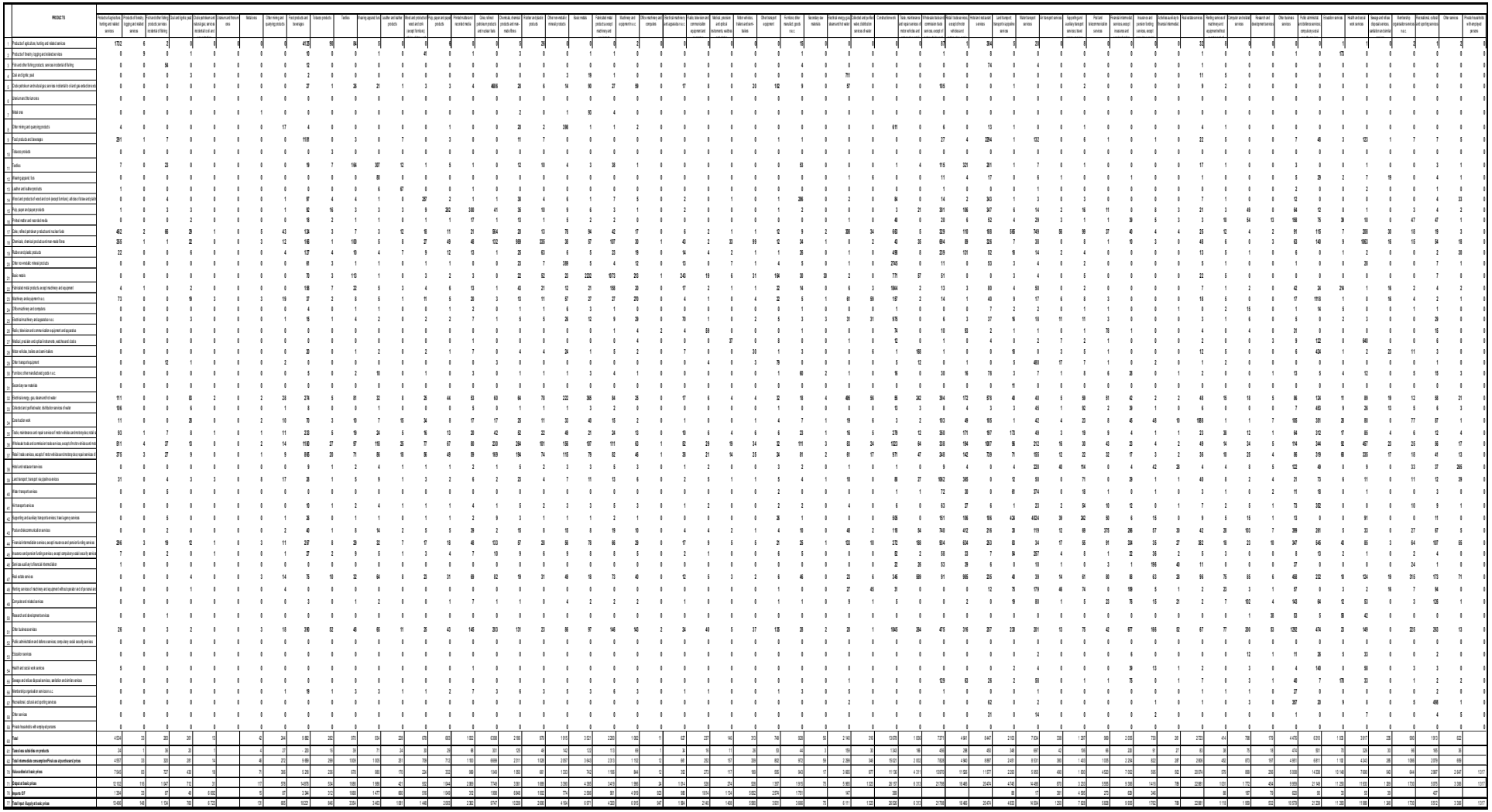
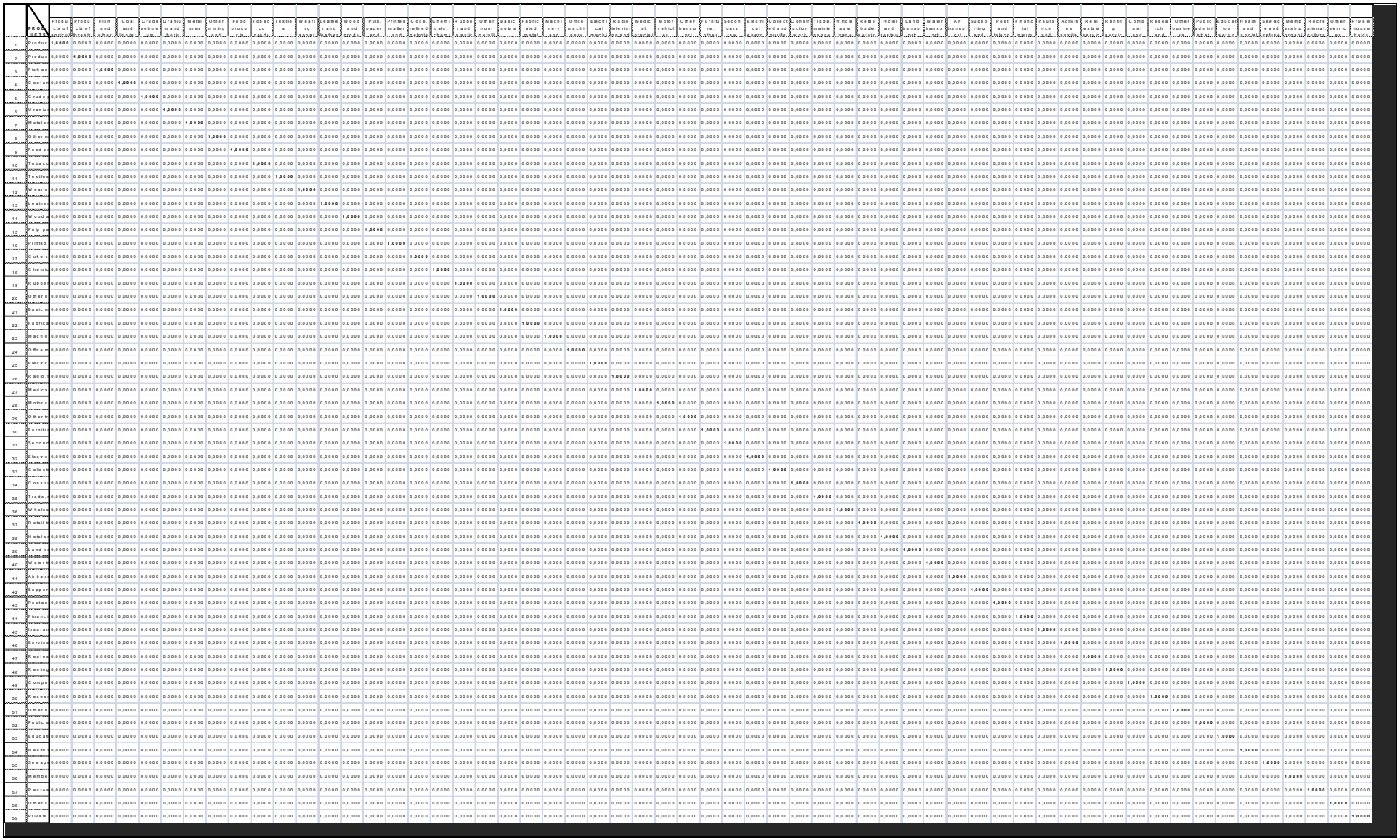
APPENDIX A

In the following appendix all the matrix calculations are given analytically.

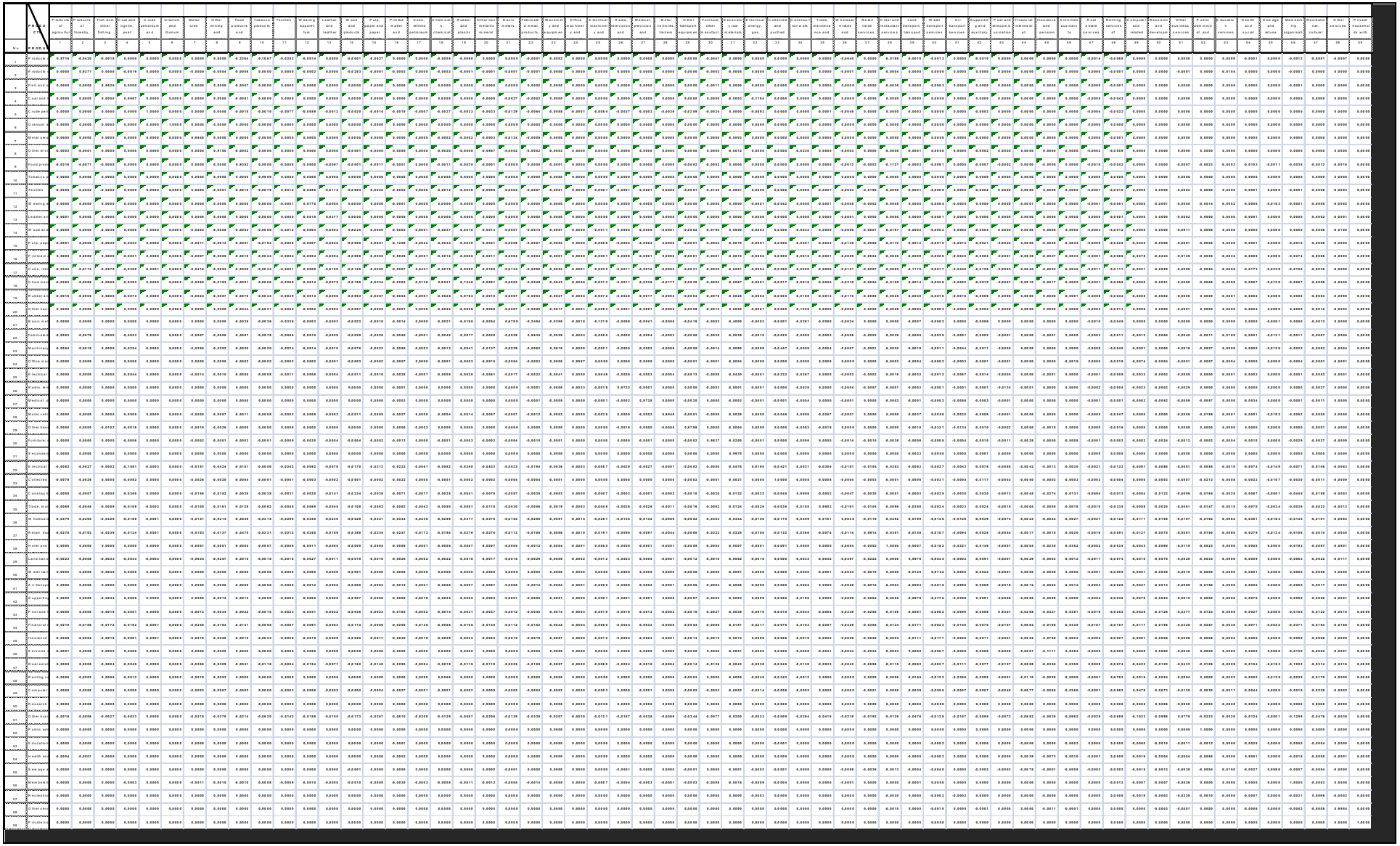


MATRIX I 1: TRANSACTION TABLE YEAR 2005

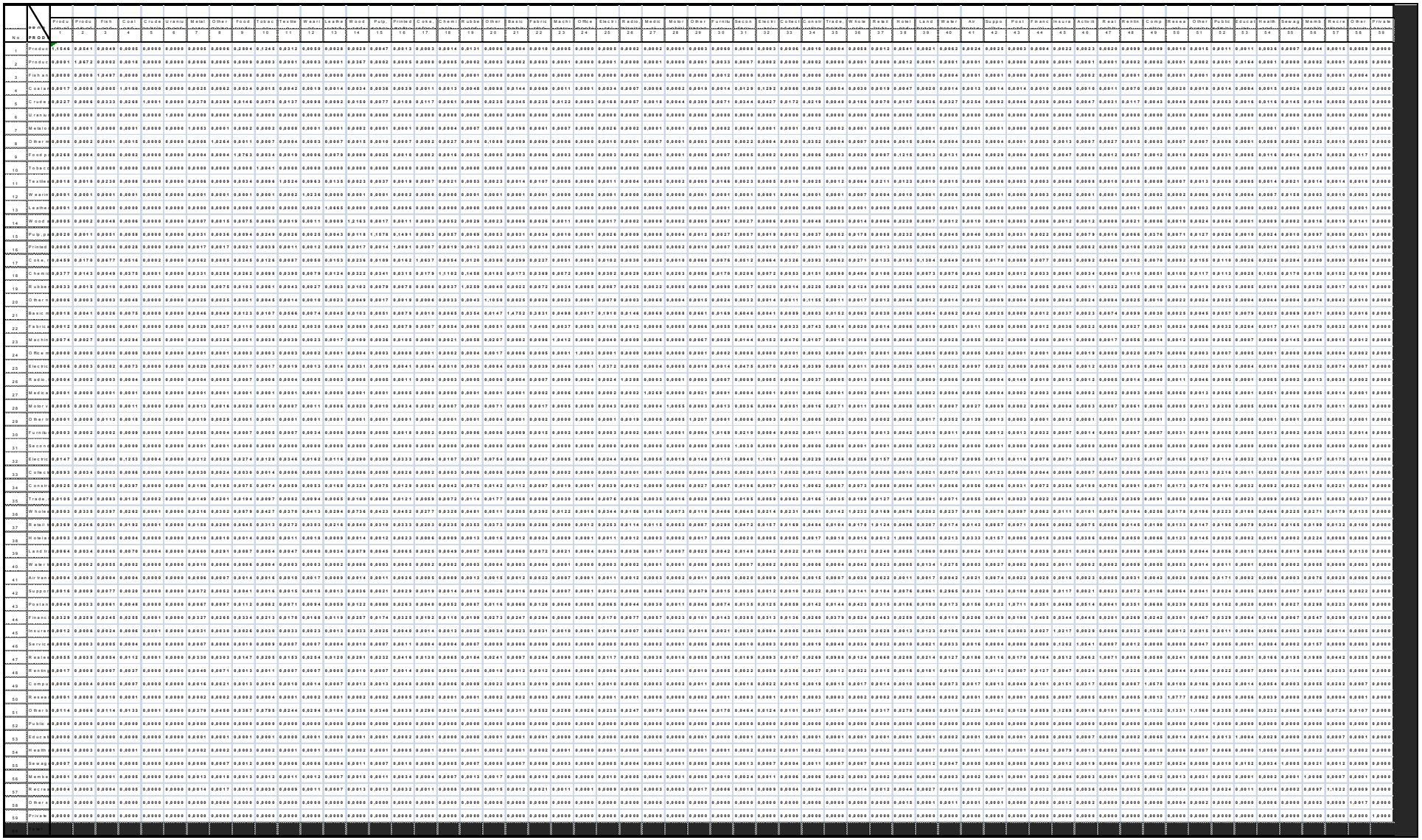
MATRIX 2: TECHNOLOGICAL COEFFISIENT MATRIX



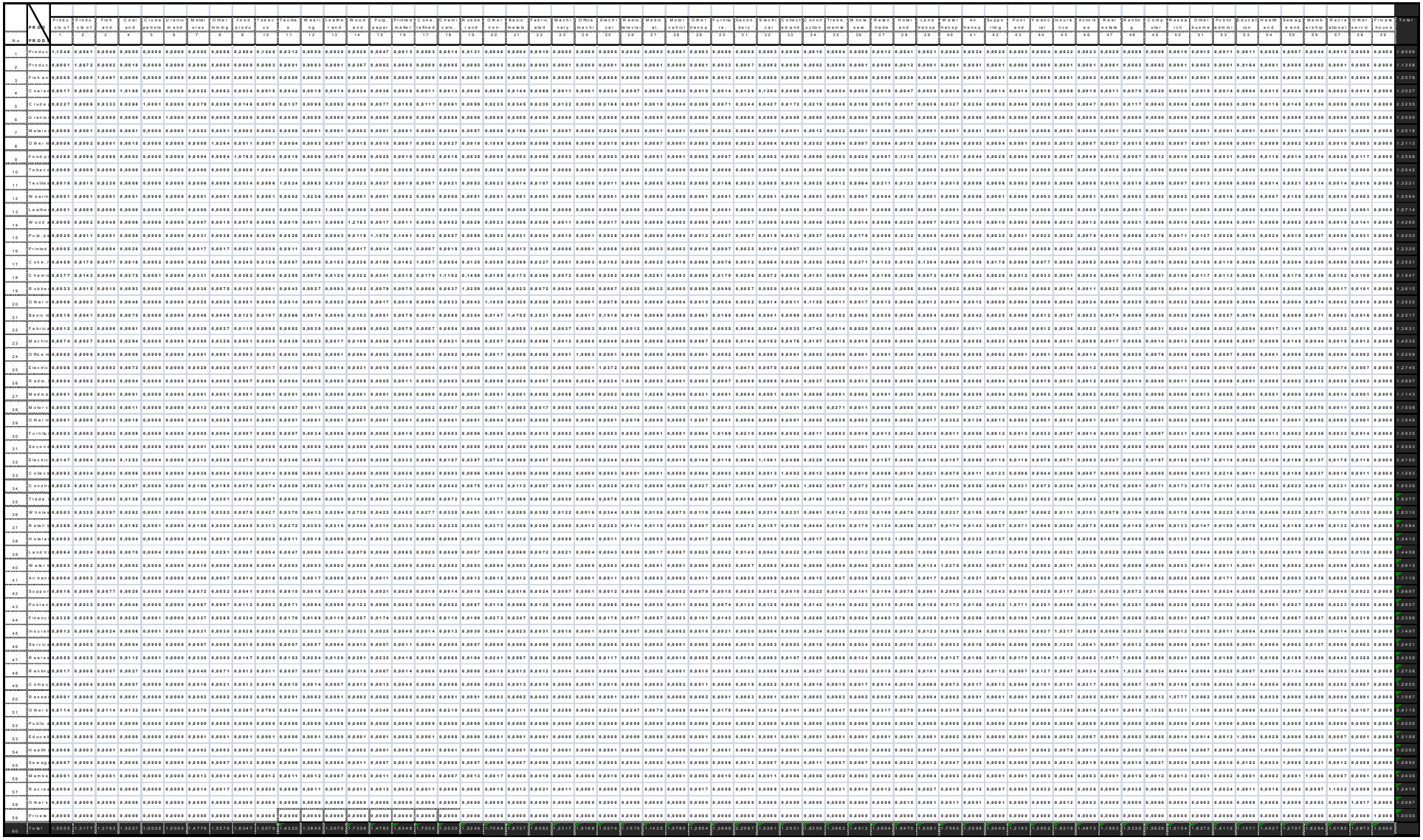
MATRIX 3: I MATRIX



MATRIX **4: I-A MATRIX**



MATRIX 5: INVERSE MATRIX



MATRIX 6: MULTIPLIERS MATRIX