AIR TRANSPORT SPATIO-TEMPORAL ANALYSIS; THE CASE OF CRETE, GREECE

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Abstract

Air transport has always been affected and influenced by spatio temporal factors such as geographical and economic features. The island of Crete, Greece accommodates three airports and accounts for over 50% of Greece's international tourist arrivals. The paper discusses the distribution, asymmetry and evolution of countries and cities on both international and domestic passenger traffic, as well as domestic cargo traffic. The evolutionary patterns of concentration have been analysed using a number economic geography indices such as the Herfindahl-Hirschmann Index. The tourism industry comprises a number of different sectors, including air transport and accessibility in general. Tourist expenditure may have a significant positive impact on the local economy. The latter are compared against economic characteristics of the island, such as GDP, expenditure and tourism related income. The paper concludes with suggestions for the future and trends of the international and domestic passenger traffic.

Keywords:

Air Transport and Tourism

Air Transport policy, regulation and liberalisation

Economic Geography and Air Transport

1. Introduction

Air transport and tourism are interrelated (Page, 1999). Civil aviation is regarded as the most prominent of the tourism industries, forming the main mode of international travel (Papatheodorou, 2002). In the Mediterranean in particular, air traffic's share of total arrivals exceed 90% (World Tourism Organisation, 1992). Island destinations depend heavily on air access as there is no land transport to compete against, like high speed trains. Greece is characterised by a fragmented geographical structure. The Greek archipelago has more than 6,000 islands and islets of which 227 are inhabited; islands cover about 25,000 km^2, i.e. almost a fifth of the total area of Greece (Greek National Tourism Organisation, 2007). Twenty-eight airports operate on the islands compared to eleven on the mainland (Figure 1): this asymmetry aims at facing land transport deficiencies, but also serves tourism (about 73% of tourists visit Greece by air; 60% of lodging establishments are located on the islands) and military purposes especially in the Aegean Sea.

Figure 1. Map of commercial Greek airports highlighting Crete.

The aim of this paper is to examine the changes in air transport supply and tourism flows on the Island of Crete. Crete is the biggest island in Greece, located in the South Aegean Sea, a very popular destination both for domestic and international tourists. Crete is Greece's most popular destination, with both adequate accommodation supply and transport connections to Athens by high speed sea vessels and direct flights. The international air traffic movements, the load factors and the city pairs serving Crete are compared over a 10 year period using spatio temporal analysis.

In more detail, the paper focuses on the airports of Heraklion and Sitia as they share many differences. Heraklion is Greece's second busiest airport, serving over 5 million international passengers annually making it Crete's main gateway; Sitia airport is located on the eastern part of the island, it is not state owned and serves only domestic routes, all of them under the Public Service Obligation scheme. The airports are compared on three different levels, that is destination level, country level and aggregate level, for domestic traffic, whereas international traffic is analysed only for Heraklion airport.

2. Liberalisation

The impact and the effect the liberalisation packages had on European aviation are well known therefore just some facts will be highlighted. According to a 2003 European Commission report, European air traffic, between 1992 and 2000, consequently increased, the number of scheduled airline routes between European countries increased by nearly 75%, the number of flights increased by 88% and the number of seats offered more than doubled.

The relationship between air access liberalization and tourism development in a destination is of particular interest. In fact, air access in international tourism encompasses the availability and conditions of air transport connecting tourist-generating countries and destination countries that is with respect to prices, frequencies and travel time among others (Richman and Lyle, 2005). More specific, island destinations are heavily dependent on exports including tourism, to sustain economically. Infrequency of air service can make the routes to these islands expensive (WTO, 2001). Liberalization of air transport affected these dimensions positively with a resulting increase in the total number of tourist arrivals in a destination, the increase in airline capacity, in particular islands (Vellas, 2001). More de-restrictions of routes and bilateral air access may result in a significant expansion in airline capacity and enhance competition on a destination's major routes with increases

in air services (direct flights reduce time of travel as well) between the destination and its major markets (Boopen, 2006).

3. Methodology

The distribution of economic activities, including air transport and tourism may be viewed as forming a pattern or spatial distribution (Wheeler, 1998). Since spatial economic patterns are a result of human decisions, many approaches to the analysis of economic systems involve studying behaviour as a spatial process. Economic patterns change because of human decisions, which may be based on different economic goals, perceptions or economic alternatives.

To further elaborate on the issue of airport traffic flows, evolutionary patterns of concentration have been studied using the Herfindahl – Hirschman Index (HHI) analytical tool. The HHI is a standard and widely used measure of concentration defined as (Scherer and Ross, 1990):

$$HHI = \sum_{i=1}^{N} s_i^2$$

where s_i is the traffic share of airport i (expressed as a percentage) in a total of N. The HHI ranges between zero (infinitesimal firms – totally fragmented market structure) and 10,000 (the case of monopoly with one firm having 100% traffic share). Due to the presence of the square power, larger shares are weighted more than smaller ones, because of their possible impact on restraining spatial competition.

On a stand-alone basis, however, the HHI would provide misleading results as the number of cities offering services to the islands varies significantly from onth to month and from year to year, ranging between 0 and >100. To overcome this limitation, the Equal Distribution Index (EDI) was used; this shows the HHI value when traffic flows are equally distributed among the destinations and is defined as follows:

$$EDI = \left(\frac{100}{N}\right)^2 N = \frac{10000}{N}$$

The Spatial Asymmetry Index (SAI) shows the prevailing asymmetry of the spatial distribution of traffic flows and is defined as the ratio of HHI to EDI:

$$SAI = \frac{HHI}{EDI}$$

The least value for SAI is 1 representing the case where the HHI is equal to the EDI. The SAI effectively takes into consideration the number of cities with traffic flows to/from the selected airports enhancing the comparison across months and years.

A different ratio had to be applied to tourism statistics as there was not an extensive list of all countries. Infinitesimal contribution was ranked under one geographic location; for example, the highest ranking countries were extensively listed, but the remaining ones were listed as "Rest of Europe".

The concentration ratio is the percentage of market share owned by the largest *m* firms in an industry, where *m* is a specified number of firms, often 4, but sometimes a larger or smaller number. The concentration ratio often is expressed as CR_m, for example, CR_4, CR_8, CR_{10}.
The concentration ratio can be expressed as:

$CR_m = s_1 + s_2 + s_3 + \ldots\ldots + s_m$

where s_m = market share of the m^{th} firm, in this case country.

If the CR_4 were close to zero, this value would indicate an extremely competitive industry since the four largest firms would not have any significant market share. In general, if the CR_4 measure is less than about 40 (indicating that the four largest firms own less than 40% of the market), then the industry is considered to be very competitive, with a number of other firms competing, but none owning a very large chunk of the market. On the other extreme, if the CR_1 measure is more than about 90, that one firm that controls more than 90% of the market is effectively a monopoly.

While useful, the concentration ratio presents an incomplete picture of the concentration of firms in an industry because by definition it does not use the market shares of all the firms in the industry. It also does not provide information about the distribution of firm size. For example, if there were a significant change in the market shares among the firms included in the ratio, the value of the concentration ratio would not change.

In the case of this report the “firms” are the countries and the CR_4, CR_8, and CR_{10} give a sound picture of the degree of the market concentration.

4. Heraklion airport

4.1 International Traffic

Figure 2 shows the evolution of the number of cities with international air passenger services to/from Heraklion on a monthly basis between 1997 and 2006. Not surprisingly, the pattern of connectivity is highly seasonal due to the leisure tourism character of the traffic flows and the associated operation of charter services and carriers; illustratively, there was one international connection in February 2006 whereas on the other hand just fewer than 100 cities were recorded in August 2006. The peak months are June to September with April, May and October also exhibiting substantial connectivity. On the other hand, the number of cities served is much smaller in March and November, while connectivity is extremely low in January, February and December. This has inevitably important implications for air transport costs in terms of both money and time. Over time, the connectivity trend is positive between April and November without any shoulder period, as December to March have very little traffic; in other words, the seasonality pattern seems to accentuate over time with possibly detrimental effects on the international accessibility.

Figure 2 – Number of Cities with International Air Passenger Services to/from Heraklion

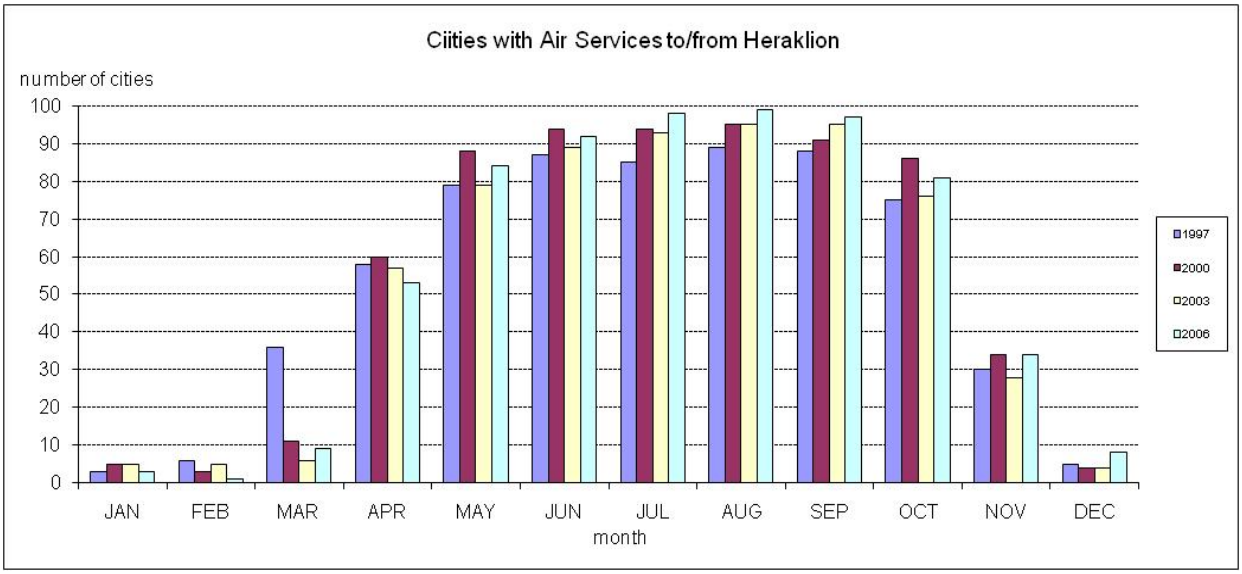
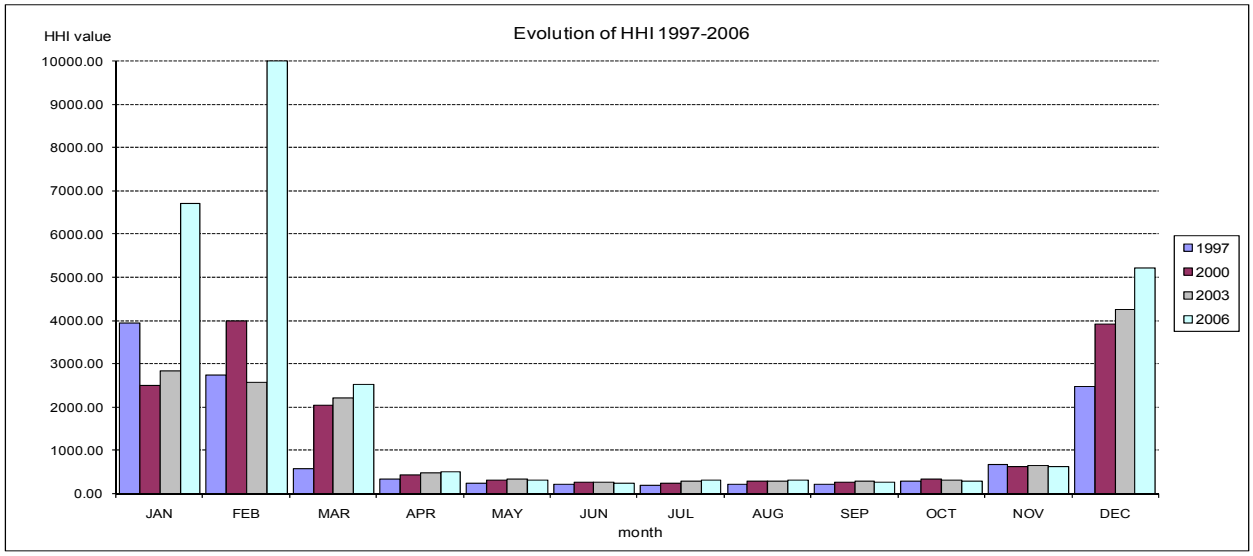


Figure 3 shows the evolution of the air traffic concentration using the HHI. As expected, concentration is inversely related to connectivity. In particular, the HHI is high in the off peak months; it even attains a value of 10,000 representing a 100% market share of a sole destination served. Heraklion though, is a well served destination for most of the year, which is reflected in the low HHI values.

Figure 3 – Concentration of Int. Air Traffic Flows to/from Heraklion, Crete



The following figure 4 shows the evolution of the SAI between the examined years on a monthly basis. SAI does not fluctuate as much as the HHI, remaining fairly stable over the years.

Figure 4 – Asymmetry of Int. Air Traffic Flows to/from Heraklion, Crete

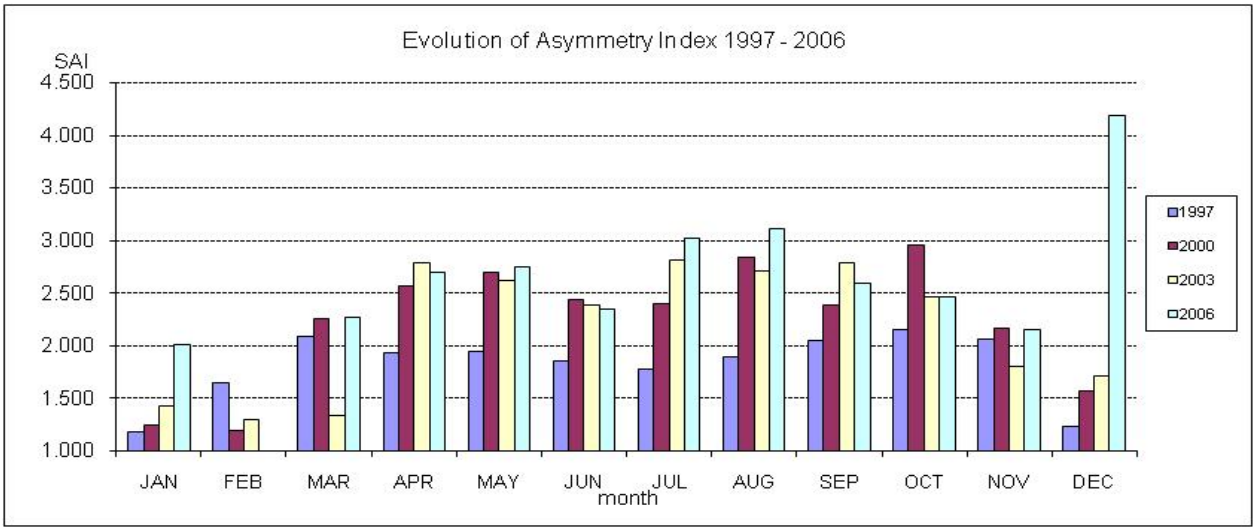


Table 1 shows the countries with international air services to/from Heraklion ranked in descending order according to the number of cities served in 2006. The total number of cities exhibits a cyclical

movement between 97 to 103 cities. On a similar basis the number of countries fluctuates between 27 and 30. The number of cities offering services to/from Heraklion has increased for United Kingdom and Italy, when the number of cities from Austria has remained unchanged and the ones from Netherlands decreased. Connections from France have decreased also, from 7 in 1997 down to 2 in 2003 up to 3 in 2006.

Table 2 shows the evolution of the air passenger shares of the abovementioned countries ranked in descending order according to their market share in 2006. There is an increasing trend over time with the exception of 2003, where the total number of passengers remained fairly stable compared to 2000. Germany's market share has significantly decreased from 36% in 1997 to 24% in 2006, still remaining the country with the highest market share, followed by the United Kingdom with 21% (2006) compared to almost 14% ten years earlier. Nevertheless it is noted that the market shares of those two countries are still over 45% in 2006 down from 49% in 1997, exceeding 50% in the other two given periods. Netherlands seem to stabilise around 9% over the years followed by Italy which has almost doubled its share from 3.07% to 6.07%. France's, Belgium's and Austria's shares fluctuate from 3.5% to 7%, reflecting a stable market both for Heraklion and Crete in General. The top ten countries include three Eastern European countries, Czech Republic, Poland and Russia. Those countries have doubled or even tripled their share over the given period.

Table 1 – Countries with Cities having Int. Air Services to/from Heraklion

Country	Cities 97	Cities 00	Cities 03	Cities 06
Germany	19	19	18	19
Italy	10	13	14	15
United Kingdom	11	10	12	13
Austria	6	6	6	6
Netherlands	5	6	4	4
Poland	3	5	5	4
Sweden	4	4	4	4
Belgium	3	3	3	3
Czech Republic	2	2	2	3

France	7	6	2	3
Russia	2	2	3	3
Switzerland	3	3	3	3
Denmark	3	2	2	2
Norway	4	4	4	2
Romania	0	0	0	2
Slovakia	1	1	1	2
Spain	2	2	2	2
Cyprus	1	1	1	1
Egypt	1	0	1	1
Estonia	0	1	1	1
Finland	2	1	1	1
FYROM	0	1	0	1
Hungary	1	1	1	1
Ireland	1	1	1	1
Israel	1	1	1	1
Jordan	0	1	0	1
Luxembourg	1	1	1	1
Serbia	0	1	1	1
Slovenia	1	1	1	1
Ukraine	1	1	1	1
Algeria	1	0	0	0
Latvia	1	1	0	0
Lebanon	0	0	1	0
Lithuania	0	1	0	0
Total no of Cities	**97**	**102**	**97**	**103**
Total no of Countries	**27**	**30**	**28**	**30**

East European countries on the table, like Estonia, Latvia, Slovakia, Hungary, Ukraine and Slovenia which might still hold an insignificant market share, but they seem to expand rapidly. On the other

hand, the market share of Sweden, Switzerland and Denmark has notably decreased. Sweden has lost more than 60% from 5% to 3%, Switzerland and Norway almost 50% from 5% to 2.5% and 2.5% to 1.1% accordingly. There are also countries with an erratic pattern like Egypt, Jordan, Lithuania and Algeria which do not offer services to Heraklion throughout the whole examined period. The HHI decreases steadily from 1729 to 1284 reflecting a more even distribution of the countries and their market shares. The EDI fluctuates from 370 to 333 to 357, before it decreased to a value of 333 in 2006. It reflects the increase in the number of destinations. Similarly, the SAI remains cyclical before it declines to 3.85 in 2006; the value of the SAI has been relatively low, due to the large number of airports and passengers flying from/to Heraklion.

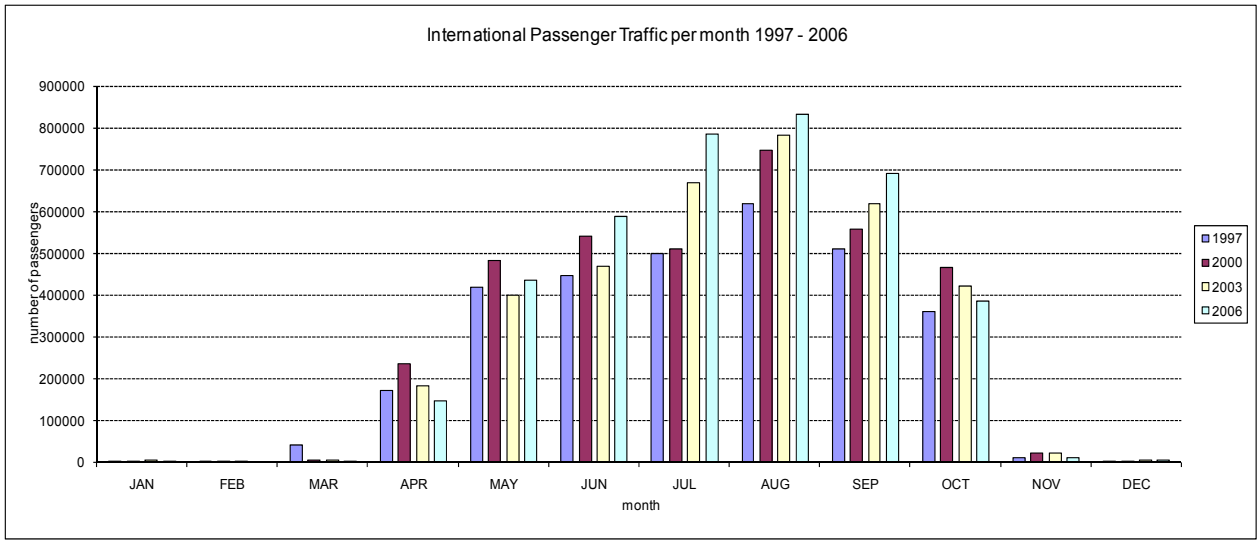
Table 2 – Market Shares of Countries with Int. Air Services to/from Heraklion

Country	% Pax 97	% Pax 00	% Pax 03	% Pax 06
Germany	36.04	33.65	27.92	24.10
United Kingdom	13.78	18.69	22.16	21.20
Netherlands	9.33	8.87	8.21	9.36
Italy	3.07	4.26	6.18	6.07
France	5.59	4.97	6.99	5.90
Belgium	3.52	3.39	3.99	5.05
Austria	5.27	4.69	4.93	4.99
Czech Republic	1.52	1.47	1.92	3.30
Poland	0.90	2.29	2.16	2.78
Russia	1.22	0.61	1.15	2.75
Switzerland	5.04	3.31	2.36	2.57
Sweden	5.07	4.21	2.42	1.93
Cyprus	0.36	0.44	1.00	1.24
Ireland	0.75	1.17	1.45	1.18
Norway	2.52	2.27	1.98	1.14
Israel	0.34	1.14	1.65	0.96
Hungary	1.28	0.85	0.46	0.91
Slovakia	0.14	0.24	0.16	0.83

Denmark	2.58	1.60	0.84	0.77
Luxembourg	0.47	0.39	0.53	0.67
Romania	0.00	0.00	0.00	0.63
Ukraine	0.08	0.07	0.15	0.37
Finland	0.86	0.97	0.89	0.36
Slovenia	0.16	0.18	0.18	0.33
Serbia	0.00	0.03	0.11	0.24
Estonia	0.00	0.05	0.01	0.19
Spain	0.02	0.03	0.07	0.16
FYROM	0.00	0.02	0.00	0.04
Jordan	0.00	0.01	0.00	0.01
Egypt	0.00*	0.00	0.12	0.00*
Latvia	0.06	0.06	0.00	0.00
Lebanon	0.00	0.00	0.00*	0.00
Lithuania	0.00	0.06	0.00	0.00
Total Pax	**3,093,631**	**3,583,853**	**3,588,091**	**3,893,501**
HHI	**1729.29**	**1685.44**	**1498.10**	**1284.96**
EDI	**370.37**	**333.33**	**357.14**	**333.33**
SAI	**4.67**	**5.06**	**4.19**	**3.85**
Note: Asterisks (*) indicate infinitesimal percentages				

Figure 5 illustrates the monthly evolution of air traffic to and from Heraklion over the examined period. There is a high concentration over the summer months, with traffic in January, February, March, November and December in most cases below 5000 arrivals per month. Traffic in June, July, August and September seems to rise over years, indicating that Heraklion is a vibrant destination selected by Tour Operators and tourists during the peak season.

Figure 5 – Evolution of International Air Passenger Traffic to/from Heraklion



4.2. Domestic Traffic

Figure 6 shows the number of cities operating domestic services to/from Heraklion airport. After a long stable period, the number of domestic origins/destinations has increased in 2006. Throughout the rest of the examined period the number of cities operating to/from Heraklion remained stable at three. As Heraklion is the major entry/exit point for Crete, situated in the centre of the island, it serves most of Crete, especially Eastern, as there are not enough connections from Sitia airport and the selection of carriers is better at Heraklion, offering more capacity and more services.

Figure 6 – Number of Cities with Domestic Air Passenger Services to/from Heraklion

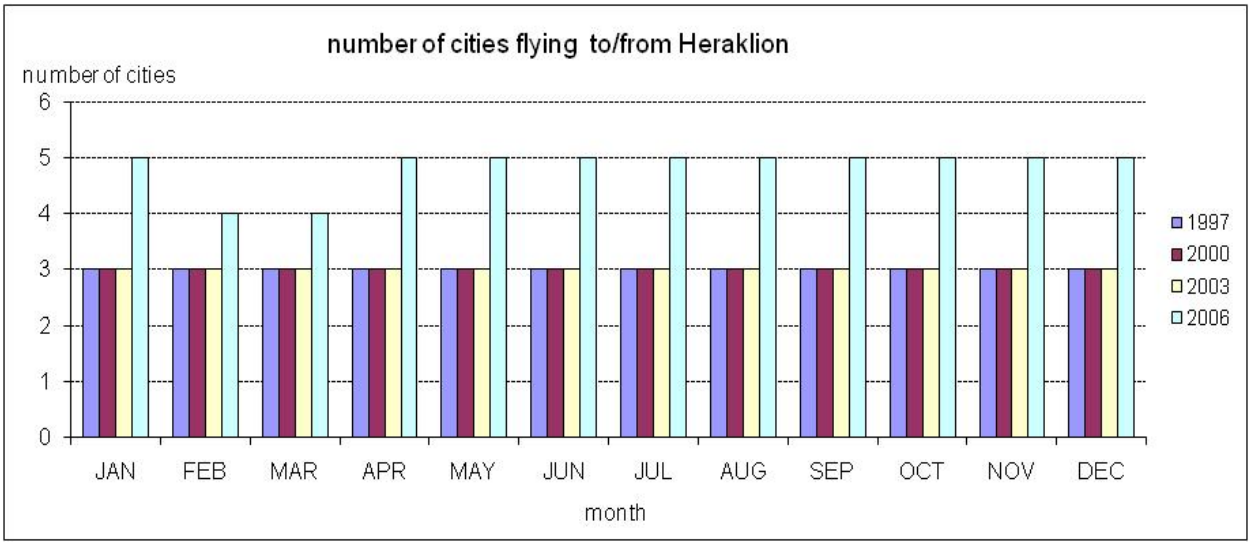
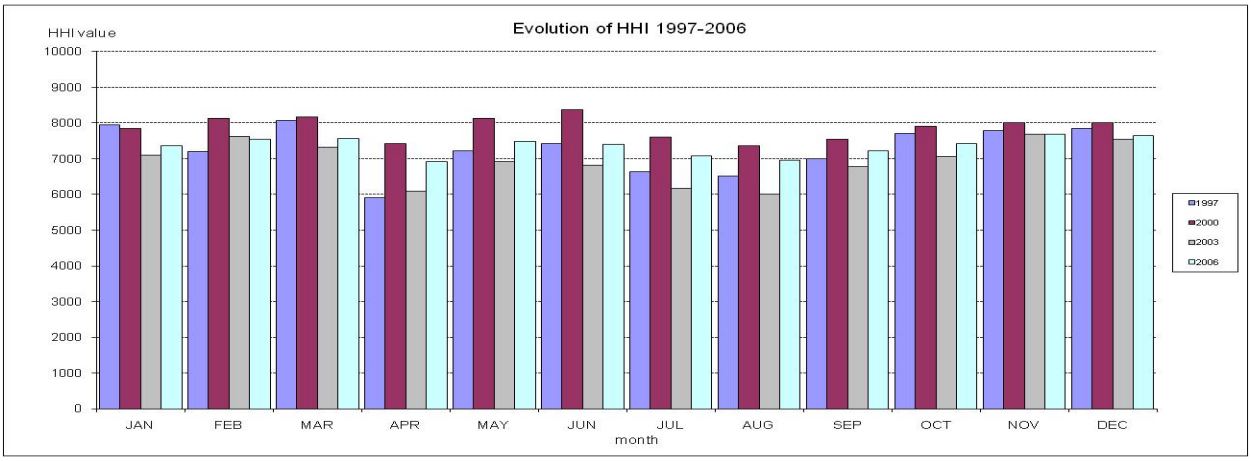


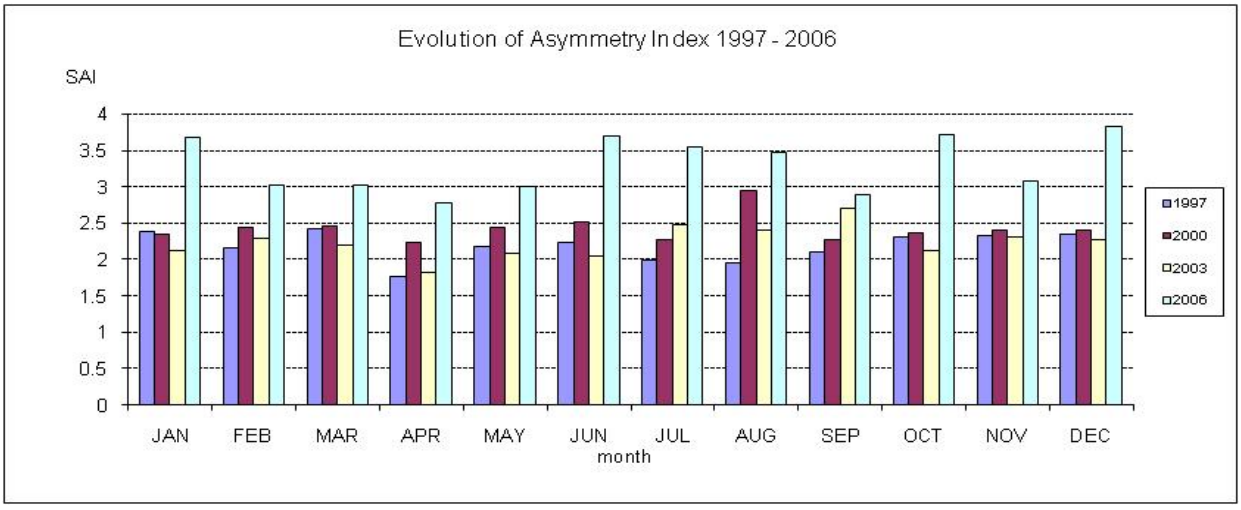
Figure 7 – Concentration of Domestic Air Traffic Flows to/from Heraklion



In the above Figure 7 the evolution of the HHI is illustrated. Although there is no high fluctuation on a monthly basis, the value of the index remains extremely high even it has a decreasing pattern. It ranged between 6,500 to around 8,500 between June 2000 and April 2006. Yet again, the dominance of Athens is reflected on the high HHI value.

Like on the previous figure, the asymmetry is reflected especially in 2006 which has significantly increased compared to the previous years. It indicates that although there are more cities connected to Heraklion, Athens in particular is so dominant in shaping the market that have such a major impact on the Asymmetry Index. The introduction of more city pairs in domestic services has created instability reflected in the value of the SAI.

Figure 8 – Asymmetry of Domestic Air Traffic Flows to/from Heraklion



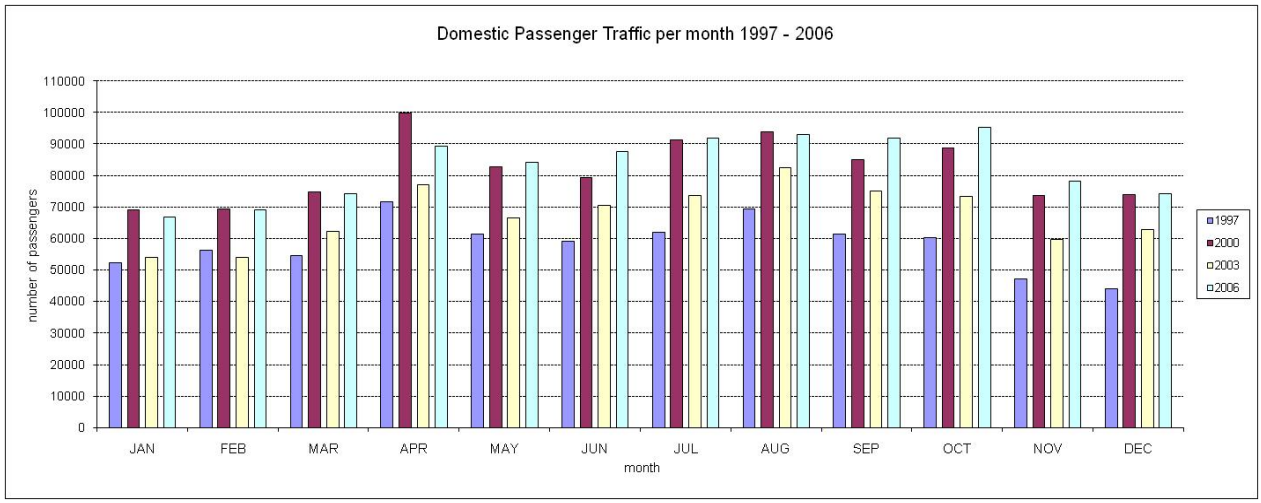
On the following Table 3, the cities with domestic Air Services to/from Heraklion are ranked in descending order, according to their market share in 2006. Athens is dominant in all years, followed by Thessaloniki. Thessaloniki's market share fluctuates possibly due to the availability of direct services. The shares of other cities are insignificant to alter the image, as Thessaloniki and Athens account for over 95% of the total market in all years. Rhodes holds a small percentage, not high enough to affect the market.

Table 3 – Market Shares of Cities with Domestic Air Services to/from Heraklion

City	Pax 97 %	Pax 00 %	Pax 03 %	Pax 06 %
Athens	83.78	88.10	81.42	84.82
Thessaloniki	10.81	8.02	13.63	11.20
Rhodes	5.41	3.87	4.91	3.69
Kos	0.00	0.01	0.04	0.31
Karpathos	0.00	0.00	0.00	0.01
Chios	0.00	0.00	0.00	0.01
Kasos	0.00	0.00	0.00	0.00*
Total Pax	**699,916**	**982,034**	**811,934**	**995,636**
HHI	**7165.66**	**7840.51**	**6838.92**	**7333.91**
EDI	**3333.33**	**2500.00**	**2500.00**	**1428.57**
SAI	**2.15**	**3.14**	**2.74**	**5.13**
Note: Asterisk indicate infinitesimal percentage				

Figure 9 illustrates the monthly evolution of domestic air traffic to/from Heraklion between 1997 and 2006. The market has grown significantly, probably due to the entry of more carriers into the market. In 1997 the number of passengers remained almost unchanged over the year with the fluctuation being very low. The introduction of more carriers since 2000 is reflected on the passenger numbers. There was a period of consolidation, mergers and acquisitions which resulted in a lower 2003, before reaching the 2006 recovery. Since 2000 the aviation market in Greece experienced a controlled explosion. Many carriers started operating some only in the domestic market, other both in the domestic and international market. The competition was fierce and the first affected was Olympic Airlines. The increased competition led some companies in the red, forcing them either out of the market or into another company through mergers or acquisition. This situation is reflected in the passenger numbers as well as on the number of passengers per aircraft later in the report.

Figure 9 – Evolution of Domestic Air Passengers Traffic to/from Heraklion

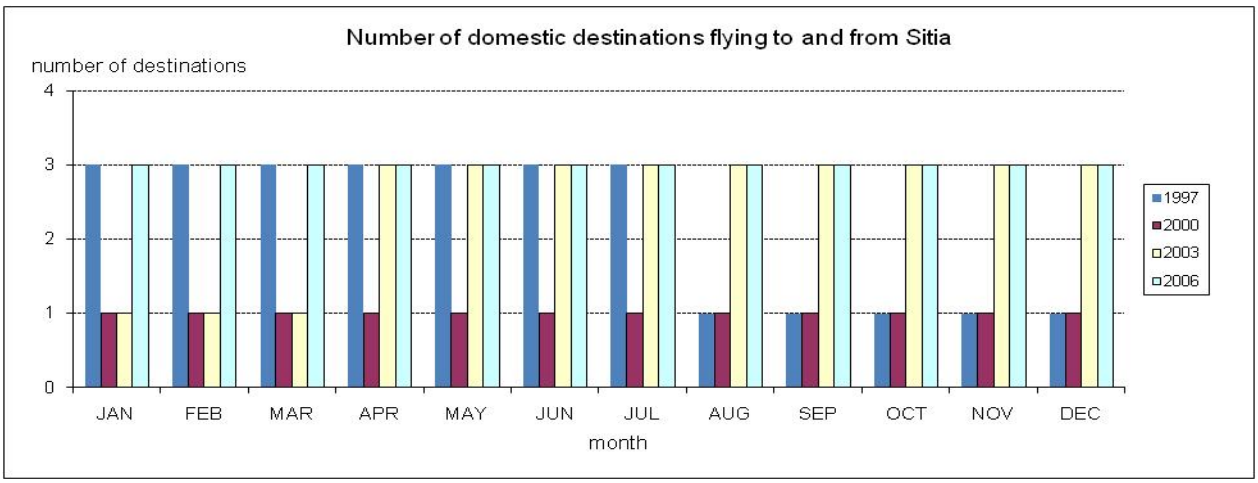


There is a clear distinction between peak (April to October) and off peak (November to March) months throughout the whole period examined. Within each period there are no significant fluctuations with passenger numbers ranging from 65-78 thousand in the off peak period and 85-95 thousand in the peak period.

5. Sitia airport

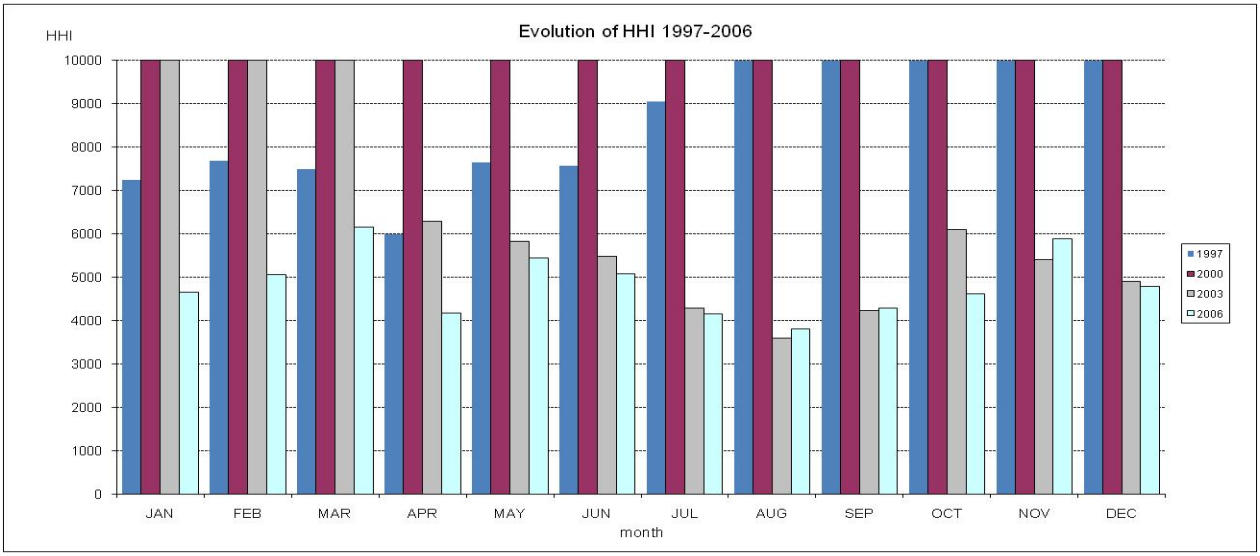
Sitia airport is still under development, judging from the increase in the number of cities serving it, from one in 1997 and 2003 to three in 2006. Given its geographical location, it serves PSO (Public Service Obligation) routes, which are subsidised by the state. It is only Olympic Airlines operating these routes to Sitia, as no other carrier has placed a bid for them.

Figure 10 – Number of Cities with Domestic Air passenger Services to/from Sitia



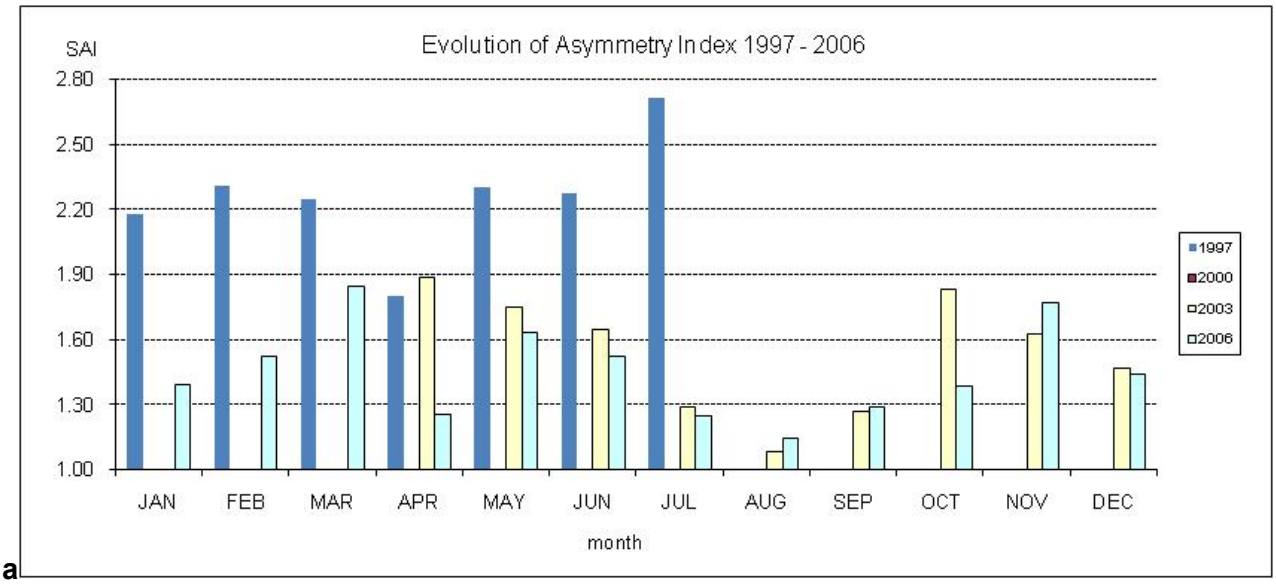
In Figure 11 it is evident that the introduction of the second and later third route affects the value of the HHI. When the other routes were introduced in April 2003, the HHI value dropped by 40% to stabilise in the region of 5,000 in 2006.

Figure 11 – Concentration of Domestic Air Flows to/from Sitia



Similarly in Figure 12 the Asymmetry is reflected when more routes are introduced. The SAI value is not exceeding 2 after 1997, yet again reflecting the small number of cities serving Sitia. In many years there is no bar, as the minimum value the SAI attains, is 1.

Figure 12 – Asymmetry of Domestic Air Traffic Flows to/from Sitia



In Table 4, the share of each city is presented. As stated earlier, although Athens is the most popular city, it holds a steady share in 2003 and 2006 which keeps both the SAI and HHI in low values.

Table 4 - Market Shares of Cities with Domestic Air Services to/from Sitia

City	Pax 97 %	Pax 00 %	Pax 03 %	Pax 06 %
Athens	91.53	100.00	63.33	57.44
Thessaloniki	0.00	0.00	0.00	33.68
Preveza	0.00	0.00	12.43	8.89
Alexandroupoli	0.00	0.00	24.24	0.00
Karpathos	5.72	0.00	0.00	0.00
Kasos	2.75	0.00	0.00	0.00
Total Pax	**3270**	**1690**	**12063**	**20050**
HHI	**8417.85**	**10000.00**	**4753.18**	**4511.99**
EDI	**3333.33**	**10000.00**	**3333.33**	**3333.33**
SAI	**2.53**	**1**	**1.43**	**1.35**

The geographic location of Sitia and the lack of direct sea routes to major metropolitan areas on mainland in conjunction with the lack of high speed motorway to Heraklion is a good reason for passengers to fly directly to Sitia rather than to Heraklion and carry on their journey. The peaks in April and the summer months reflect that there is leisure traffic to Sitia. During the other months, a figure of 1000 passengers per months gives the impression that Sitia's airport is still expanding.

Figure 13 – PSO routes operating to/from Sitia

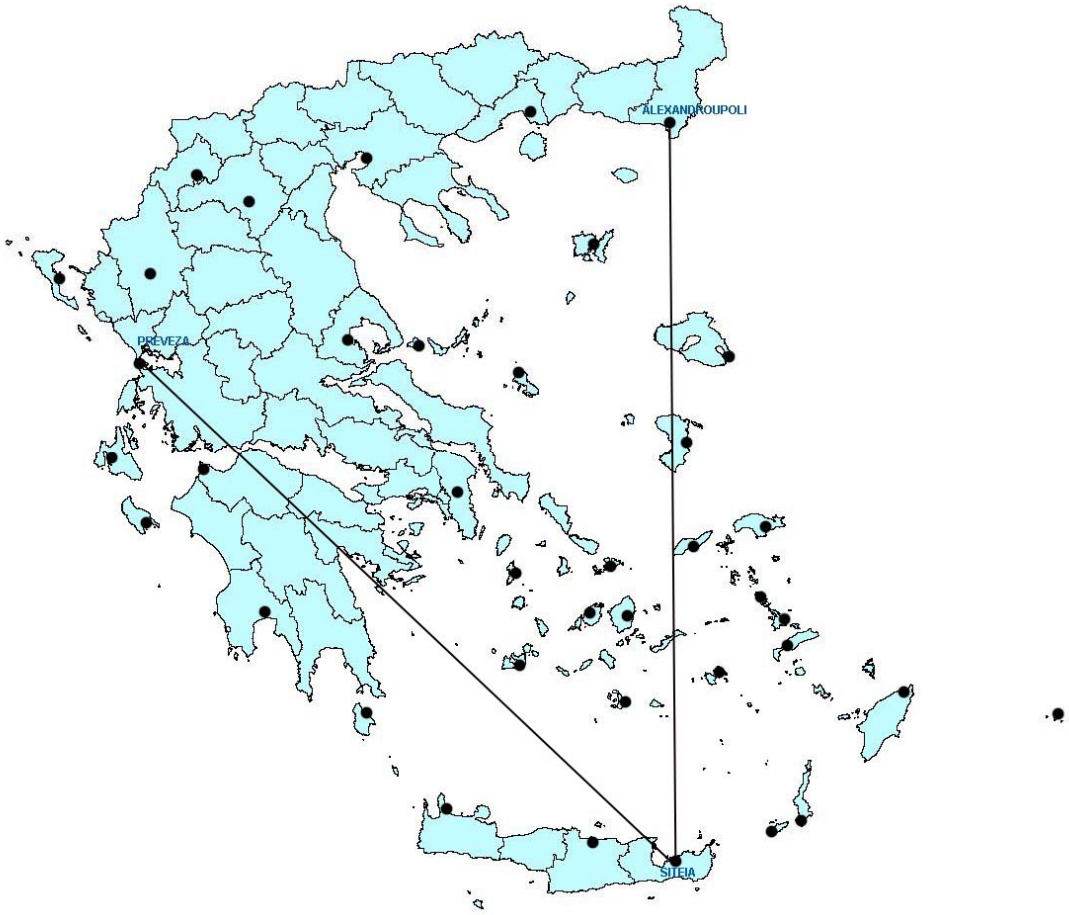
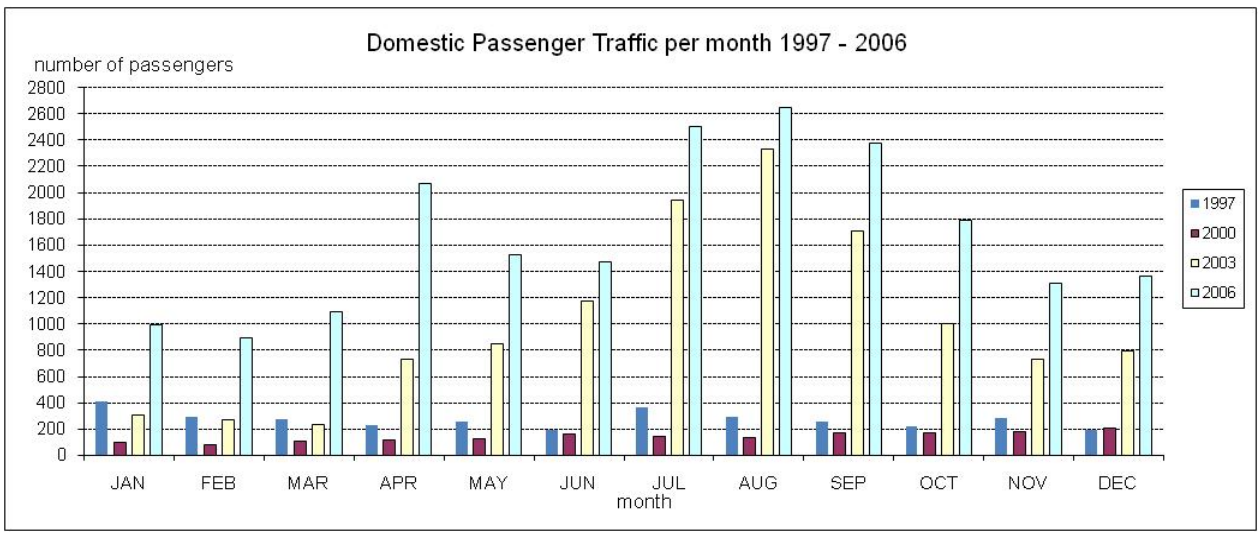


Figure 14 – Evolution of Domestic Air Passenger Traffic to/from Sitia



Since the introduction of more routes in 2003, Q3 stands out to validate the argument on leisure traffic discussed earlier. Q1 in 2003 should not raise questions, as there was still only one route to/from Sitia in that given period.

5. Tourism Analysis

5.1 Heraklion

Arrivals from Germany and France (Table 5) have undoubtedly been the strongest. Greece is the second and later third most popular origin market, reflecting again the significance of domestic tourism. The ranking of Netherlands remains stable in sixth place, followed by a number of countries which enter and exit the top 10.

Table 5 - Top 10 countries in arrivals – Prefecture of Heraklion

1997	2000	2003
GERMANY	GERMANY	GERMANY
GREECE	GREECE	FRENCE
FRANCE	FRANCE	GREECE
SWITZERLAND	ITALY	UNITED KINGDOM
ITALY	UNITED KINGDOM	ITALY
NETHERLANDS	NETHERLANDS	NETHERLANDS
AUSTRIA	ISRAEL	BELGIUM
BELGIUM	SWITZERLAND	AUSTRIA
UNITED KINGDOM	BELGIUM	SWITZERLAND
SWEDEN	AUSTRIA	ISRAEL

In the following Table 6 the top 10 countries according to the nights spent by tourists are listed. Germany and France produce the higher number of nights. Nights spent by Greeks still appear in the top 5 in 2003 down from the third place in 1997. All countries are European with the exception of Israel which appears in the top 10 in some years.

Table 6 - Top 10 countries – Nights spent by tourists – Prefecture of Heraklion

1997	2000	2003
GERMANY	GERMANY	GERMANY
FRANCE	FRANCE	FRANCE
GREECE	UNITED KINGDOM	UNITED KINGDOM
SWITZERLAND	ITALY	ITALY
NETHERLANDS	GREECE	GREECE
AUSTRIA	NETHERLANDS	NETHERLANDS
ITALY	SWITZERLAND	BELGIUM
BELGIUM	BELGIUM	AUSTRIA
UNITED KINGDOM	AUSTRIA	SWITZERLAND
SWEDEN	ISRAEL	IRELAND

The concentration of tourist arrivals at the Prefecture of Heraklion (Table 7) remains almost unchanged in both percentage and number of tourist arrivals for the CR_4. As far as CR_8 and CR_{10} are concerned, there was an increase in 2000 both in the concentration and the absolute number of tourist arrivals but decreased in 2003; actually lower to the 1997 figures.

Table 7 – Concentration Ratio of tourist arrivals -Prefecture of Heraklion

	CR_4		CR_8		CR_{10}		Total
Year	tourists	%	tourists	%	tourists	%	tourists
1997	448,931	62.15	585,199	81.01	628,236	86.97	722,364
2000	435,943	60.67	589,896	82.09	638,001	88.79	718,582
2003	447,627	60.84	581,949	79.09	623,839	84.79	735,780

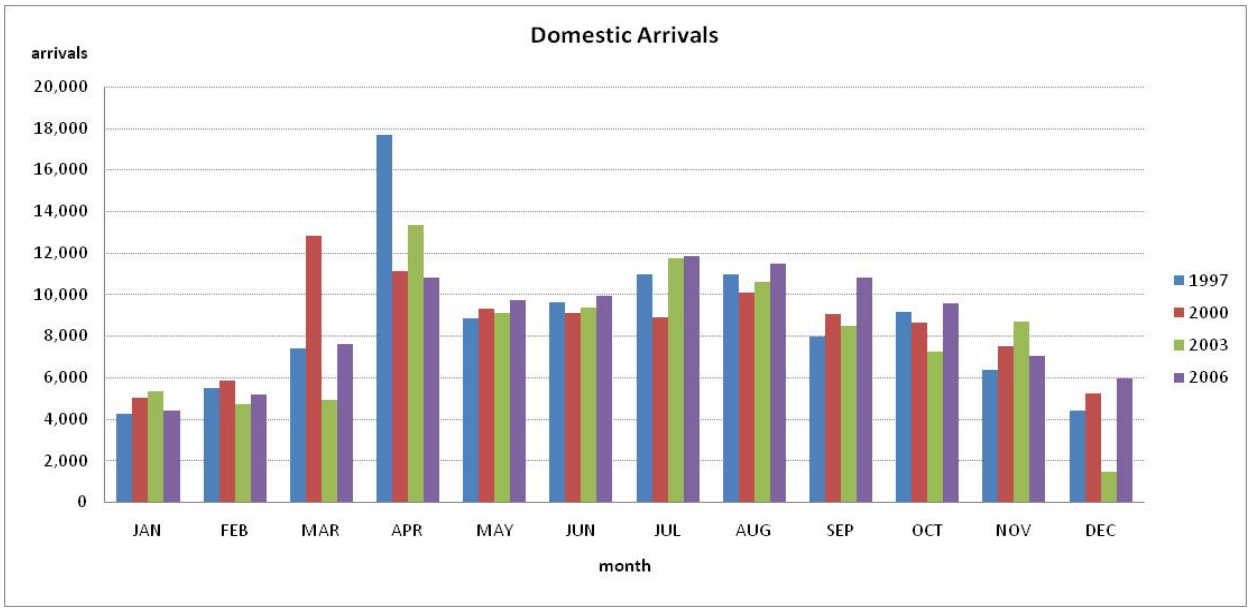
The number of tourist nights as presented in Table 8 shows a different pattern. Both concentration and nights spent have dramatically decreased in all three indices since 1997. Having a look at Figure 107 further below the total picture is not the same. Total nights spent have increased, which means that the strongest originating countries have lost market share and the “smaller” origins get stronger.

Table 8 - Concentration Ratio of tourist nights - Prefecture of Heraklion

	CR_4		CR_8		CR_{10}		Total
Year	Nights	%	Nights	%	Nights	%	Nights
1997	3,601,458	62.16	4,816,100	83.12	5,187,848	89.53	5,794,284
2000	2,283,686	42.14	3,256,717	60.10	3,331,992	61.49	5,418,803
2003	2,169,242	38.30	3,050,415	53.86	3,384,374	59.76	5,664,027

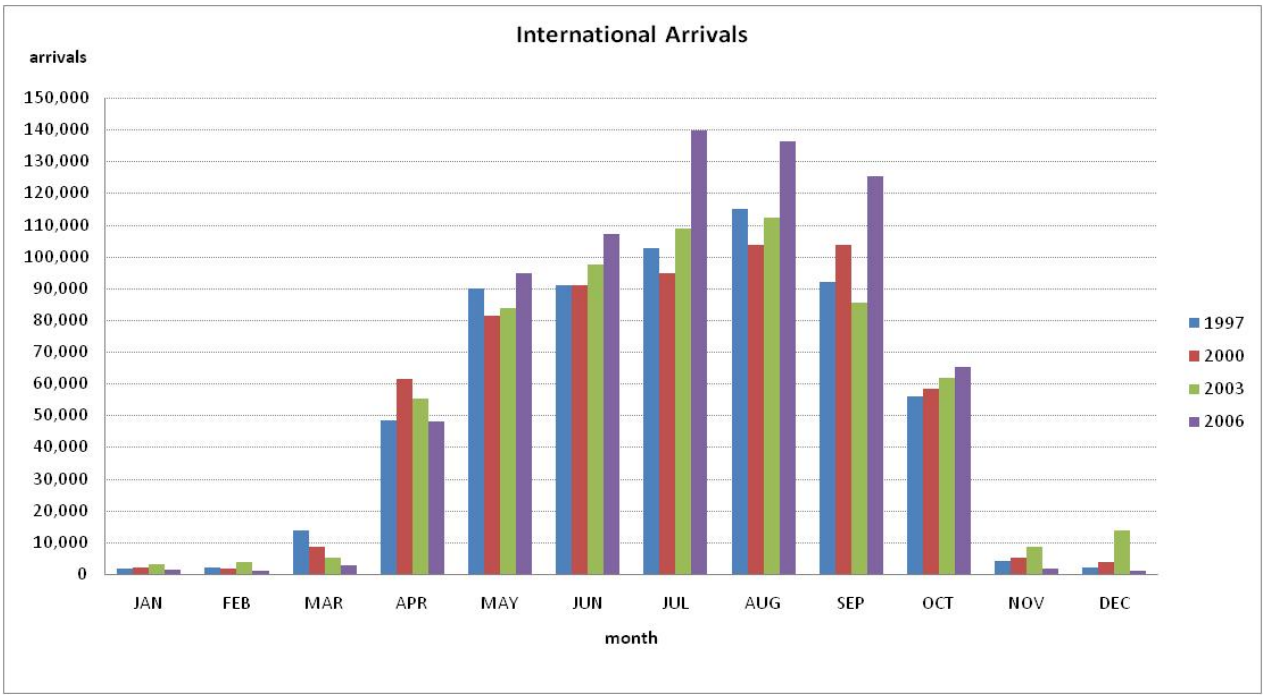
Domestic Arrivals in Figure 15 exceed 4,000 in most months. It is noted that apart from April there are no other steep highs or lows. It reflects that Heraklion is a year round destination both for leisure and business. There is no particular pattern over the years, as some months are better than the one the previous year and vice versa. It is noted that April, which traditionally is busy due to Easter holidays, shows a steady decrease since 1997 from almost 18,000 domestic arrivals to 12,500 in 2003.

Figure 15 – Domestic Tourist arrivals – Prefecture of Heraklion



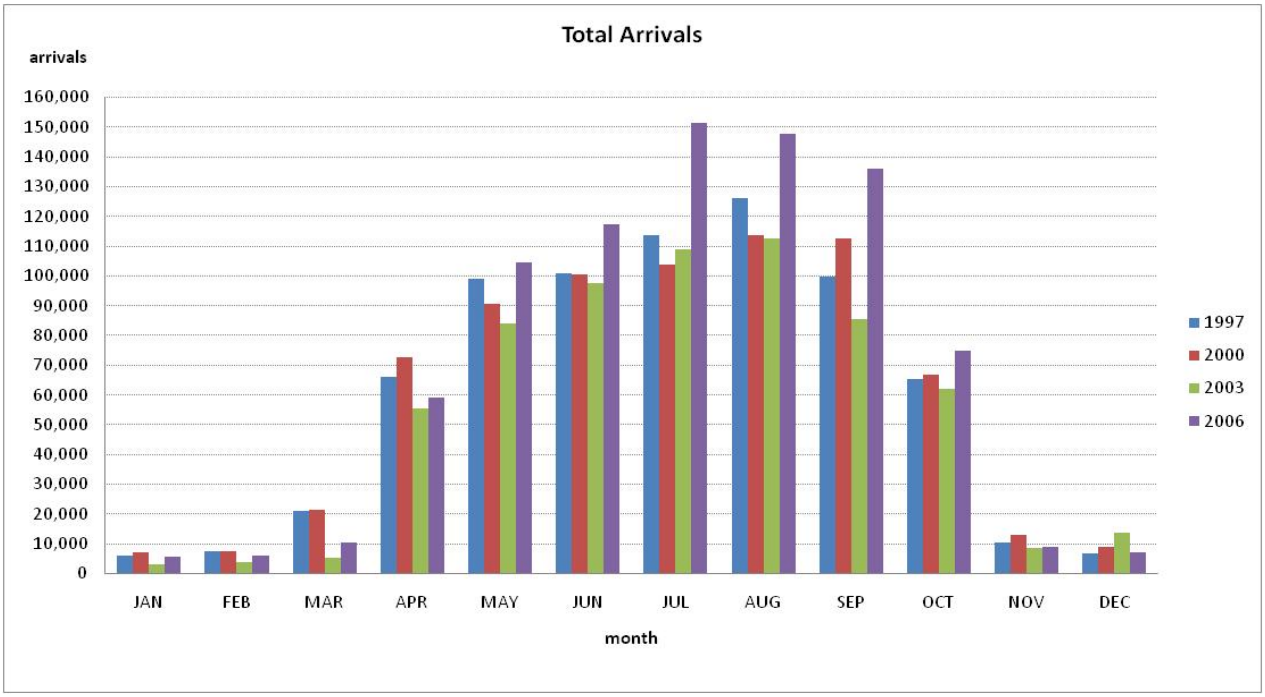
International tourist arrivals at the Prefecture of Heraklion (Fig 16) are characterized by their large volume, exceeding 100,000 in most summer months in the period examined. It is noted that during 2000 there was a decline which was recovered in most months in 2003. It is also worth mentioning that even in November and December international arrivals are around 10,000 a fairly high number for this time of the year.

Figure 16 - International Tourist Arrivals – Prefecture of Heraklion



Total tourist arrivals (Fig 17) are very strong in the 7 month period (April – October). In November and December the total number seems to stabilise around 10,000, when in March 2003 there was a significant reduction to less than 5,000. January and February traditionally remain the quieter months of the year.

Figure 17 - Total tourist Arrivals – Prefecture of Heraklion



5.2 Prefecture of Lasithi

In Table 9 the top 10 countries in terms of tourist arrivals are listed. Arrivals from Germany are the highest followed by the United Kingdom and France. All countries are European and it is interesting that the top 10 is concluded with Poland in 2000 which moves further higher in 2003.

Table 9 – Top 10 countries – Tourist arrivals – Prefecture of Lasithi

1997	2000	2003
GERMANY	GERMANY	GERMANY
UNITED KINGDOM	UNITED KINGDOM	FRANCE
AUSTRIA	FRANCE	UNITED KINGDOM
FRANCE	SWEDEN	SWEDEN
SWEDEN	AUSTRIA	AUSTRIA
ITALY	NETHERLANDS	ITALY
SWITZERLAND	ITALY	NORWAY
BELGIUM	NORWAY	NETHERLANDS
AUSTRALIA	BELGIUM	POLAND
NETHERLANDS	POLAND	SWITZERLAND

As far as the nights are concerned (Table 10), the situation in the top two places remains unchanged over the examined period. Like in arrivals, Poland is in the top 10 countries holding this position in 2000 and 2003.

Table 10 – top 10 countries – tourist nights – Prefecture of Lasithi

1997	2000	2003
GERMANY	GERMANY	GERMANY
UNITED KINGDOM	UNITED KINGDOM	UNITED KINGDOM
SWEDEN	FRANCE	FRANCE
AUSTRIA	AUSTRIA	AUSTRIA
ITALY	SWEDEN	SWEDEN

FRANCE	NORWAY	NORWAY
BELGIUM	POLAND	POLAND
SWITZERLAND	NETHERLANDS	NETHERLANDS
NORWAY	ITALY	ITALY
NETHERLANDS	BELGIUM	SWITZERLAND

Overall there is a decrease in the number of tourist arrivals in all three ratios used. In addition the Concentration Ratios have decreased when comparing 1997 and 2003. Between 2000 and 2003 there was a small increase in all three ratios.

Table 11 - Concentration Ratio – Tourist arrivals – Prefecture of Lasithi

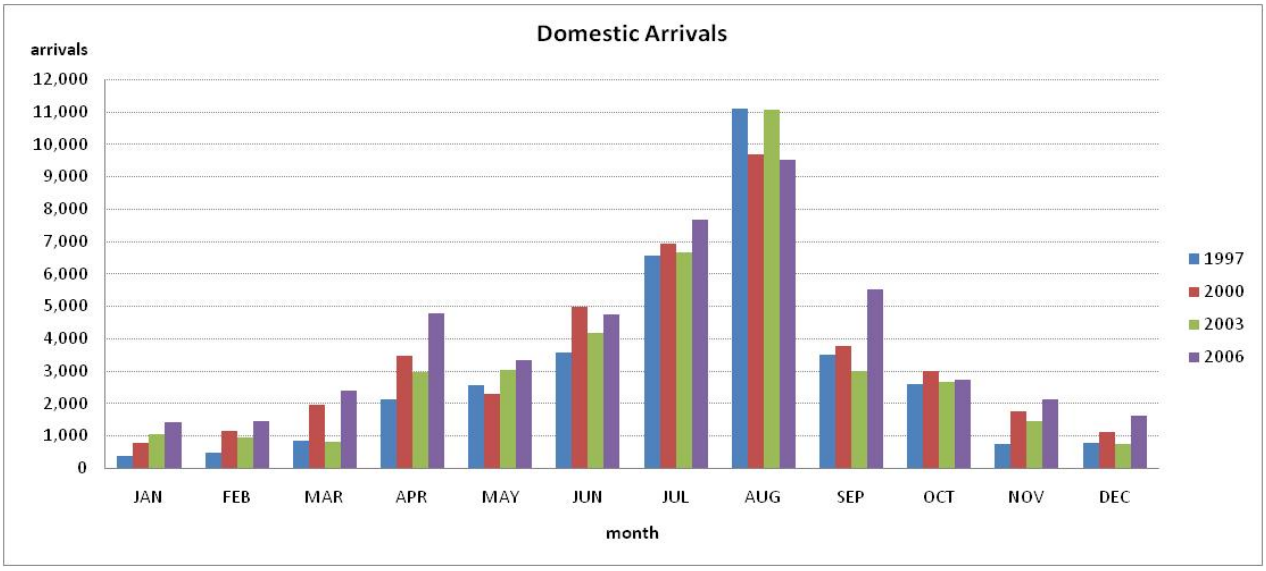
	CR_4		CR_8		CR_{10}		Total
year	Tourists	%	Tourists	%	Tourists	%	Tourists
1997	135,086	53.04	178,337	70.02	193,981	76.17	254,678
2000	125,121	50.80	159,307	64.69	171,104	69.48	246,279
2003	118,306	52.46	150,892	66.91	161,471	71.60	225,519

Unlike tourist arrivals, tourist nights show a higher concentration when comparing 1997 to 2003 (Table 12). There was a decline in 2000 comparing it to 1997 and a recovery in 2003. The absolute numbers follow the same pattern too.

Table 12 - Concentration Ratio – Tourist Nights – Prefecture of Lasithi

	CR_4		CR_8		CR_{10}		Total
year	nights	%	nights	%	nights	%	nights
1997	1,113,897	60.76	1,420,093	77.46	1,535,155	83.74	1,833,321
2000	1,065,930	59.20	1,346,589	74.79	1,443,507	80.17	1,800,537
2003	1,057,627	63.15	1,365,129	81.52	1,470,902	87.83	1,674,660

Figure 18 - Domestic Tourist Arrivals - Prefecture of Lasithi



In Figure 18 domestic arrivals to Lasithi Prefecture are illustrated. As Lasithi is the least developed area of Crete, it is evident that the level of arrivals is low. Arrivals in December to March are very low, lying around 1000. In April, arrivals pick up and May remains at the same level, like October. The period between May – September is significantly higher with August being the highest in arrivals reaching 11,000. It has to be stated that in June, July, September and October the number of domestic arrivals in 2003 is lower to the 2000 ones.

Figure 19 - Lasithi – International Tourist Arrivals – Prefecture of Lasithi

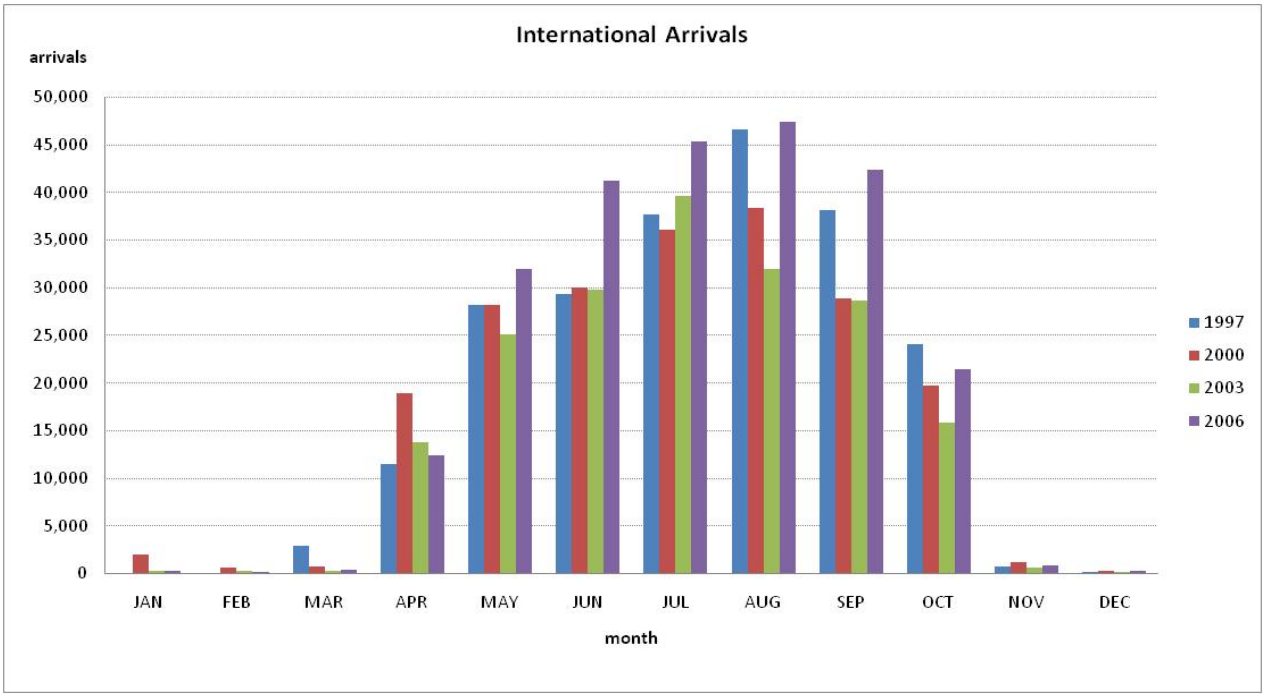
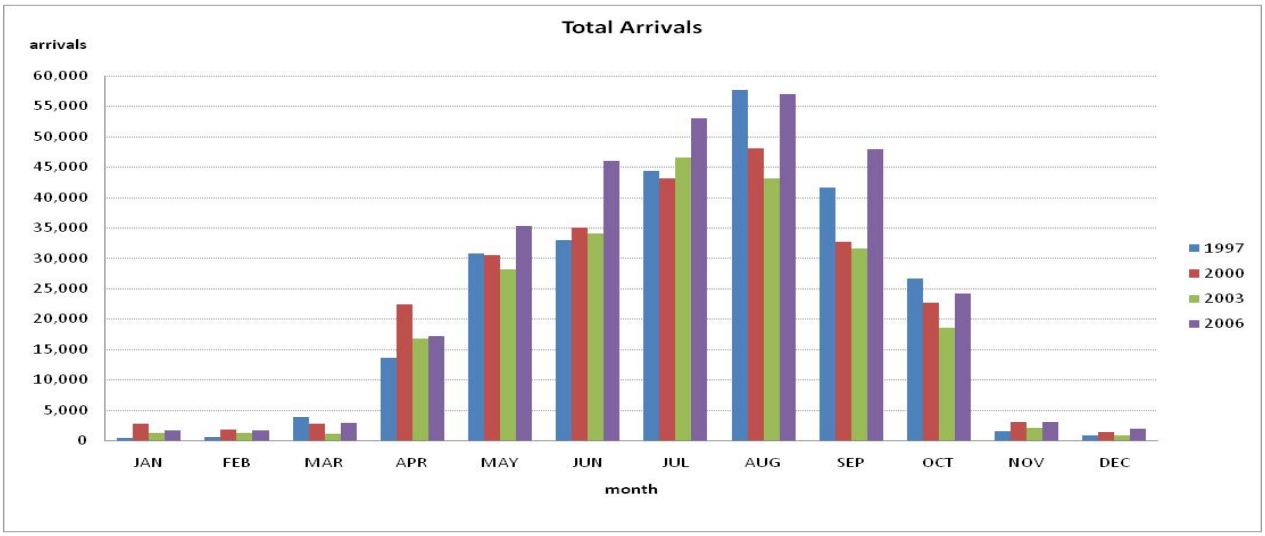


Figure 19 illustrates international arrivals to Lasithi. Lasithi is known for Elounda resort where many exclusive resorts are located. In April, May, August, September and October 2003 international arrivals are significantly lower to the previous years. Between November to March, international arrivals are very low reflecting again the high seasonality nature of the destination.

Figure 20- Total Tourist Arrivals- Prefecture of Lasithi



In Figure 20, the total arrivals are illustrated, highly affected by the international ones. Arrivals between November – March are very low; they start to rise from April onwards to peak in August. Nevertheless, with the exception of July 2003, there has been a decline in all other months. The higher number of arrivals was in August 1997 followed by July 2003 making it the busiest month that year.

Table 13 - Summary of air passenger traffic and tourist arrivals - Prefecture of Heraklion

	1997	2000	2003	2006
International pax	3,093,631	3,583,853	3,588,091	3,893,501
Domestic pax	699,916	982,034	811,934	995,636
Total pax	3,793,547	4,565,887	4,400,025	4,889,137
Available beds	259,065	248,069	243,787	n/a
Dom. Tourist arrivals	103,154	102,736	94,970	n/a
Int. tourist arrivals	618,906	615,115	639,936	n/a
Total tourist arrivals	722,364	718,582	735,780	n/a

The Prefecture of Heraklion is the busiest of all four Cretan regions. It accommodates the largest airport of the island and feeds international tourists to the nearby Elounda resort which is at the Prefecture of Lasithi. The rate of growth in 2003 although positive in most cases, shows some stagnation. The Prefecture of Heraklion has been redefining its tourism product trying to extend the season by both investments and product differentiation i.e. MICE, golf, second/holiday homes. The GDP per capita in 2003 was almost double the 1997 one. There is a better utilisation of available beds rising from 2.78 in 1997 to 3.01 in 2003. The low domestic tourist arrivals/beds ratio indicates that the majority of domestic arrivals are business traffic

Table 14 - Summary of air passenger traffic and tourist arrivals – Prefecture of Lasithi

	1997	2000	2003	2006
International pax	0	0	0	0
Domestic pax	3,270	1,690	12,063	20,050
Total pax	3,270	1,690	12,063	20,050
Available beds	87,431	92,822	87,887	n/a
Dom. Tourist arrivals	35,243	40,898	38,621	n/a
Int. tourist arrivals	219,220	205,207	186,632	n/a
Total tourist arrivals	254,678	246,279	225,519	n/a

6. Conclusions

This paper analysed international and domestic air passenger traffic flows to/from the Heraklion airport from a spatio-temporal perspective. In particular, the monthly and yearly evolution of traffic flows at three spatial levels (namely city, country and aggregate) was examined over the period 1997-2006; results were presented in tabular and diagrammatic format with a suitable commentary in each case. It is evident that international air passenger flows exhibit a strong seasonal pattern at all spatial levels; this was rather expected due to the large number of inbound leisure tourists visiting Heraklion and the nearby areas especially during the summer period. Although spatial concentration at a city level is not significant (at least between April and October), over 45% of traffic flows are related to the United Kingdom and Germany at a country level. This double (i.e. temporal and spatial) concentration of traffic flows may have serious policy implications: temporal seasonality may

result in high prices, congestion and customer dissatisfaction in the peak period while it cannot sustain tourism employment throughout the year to the detriment of professionalism in the sector. As British and German leisure tourism is effectively controlled by a small number of tour operators, it may be argued that the large passenger share of these two countries raises issues of dependency and possible exercise of oligopsonistic power by intermediaries on local tourism providers (e.g. hoteliers). Local and national policymakers should implement measures to develop a sustainable all-year round tourism product with a strong brand name in the international market. The introduction of direct international scheduled services to Heraklion will possibly alter the pattern of the destination.

Domestic passenger traffic was analysed from the same Spatio – Temporal perspective. Domestic passenger traffic does not demonstrate high seasonality like international does. There is an adequate volume of traffic throughout the year, during all years examined. Nevertheless there is some seasonality in April and in summer months, reflecting traffic generated due to the Easter break and summer vacations. In 2006 there were more domestic connections, due to the PSO initiative but only Rhodes accounted for a higher than 3% percentage. In all cases Athens holds the major share which reflects the lack of other major metropolitan areas in Greece.

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