AN INPUT OUTPUT MODEL TO QUANTIFY THE BENEFITS OF TOURIST AIRPORTS ON REGIONAL ECONOMY

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Abstract

Airports are widely recognized as having a considerable economic and social impact on their surrounding regions. These impacts go far beyond the direct impact of an airport's operation, extending also to the wider benefits that air service accessibility brings to regional business interests. Airports provide essential infrastructure to support regional social and economic growth. According to ACI, airports are major economic assets offering significant economic returns and benefits. A growing literature on this subject highlights the difficulties to calculate the effects of airports. This paper deals with the estimation of benefits of tourist airports on regional economy. The methodology approach is based on an input-output model that - estimates the key categories of effects from tourist airport operations. Conventional wisdom is to present a well-organized modeling framework, appropriate for planners, managers and decision makers in order to quantify the effects of tourism airports on regional economies. The application is a new airport on the island of Crete in Greece, one of the most attractive tourist destinations in southeast Mediterranean.

Keywords: tourist airport, economic effects, regional development

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1 INTRODUCTION

Airports are recognized as engines of economic and social development, by creating job opportunities and financial growth. According to ACI (1998) airports are major economic assets offering significant economic returns and benefits. Decisions made in respect of airports affect local regional and economic performance. Moreover, the impact of regional tourist airports is very vital due to the fact that there is a high interrelation between airports and tourism. Based on data from World Tourism Organization (UNWTO) and Euro statistics, it is concluded that 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. The relationship and the complexity between tourism and air transport have been an investigation area in many researches; in the research presented by Cooper *et* al. (2000) it is concluded that tourism is depended upon aviation industry and any changes in its efficiency is a significant counterpart of the region development.

This research measures the contribution of a new international tourist airport to the region, in terms of jobs and added economic value. The application is a new airport in the island of Crete in Greece (at Kastelli valley), which is one of the most popular tourist destinations in southeast Mediterranean.

The methodology is based on an econometric Input-Output model that measures three separate impacts: the Direct, the Indirect and the Induced. The Direct impact represents the employment and activity in the aviation sector. The Indirect impact includes the employment and activity supported down the supply chain to the aviation sector. Finally, the Induced impact, as mentioned by Britton *et* al. (2005), considers the employment and activity supported by the spending of those directly or indirectly employed in the aviation sector,. The airport's total economic impact is the sum of the direct, indirect, and induced effects. In addition, the study quantifies the net economic effects (e.g. on employment, incomes, etc.) resulting from the contribution of air transport to tourism (demand-side effects).

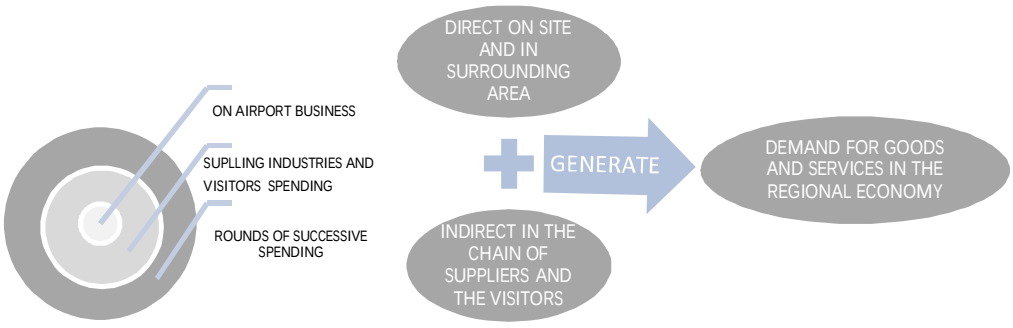
1.1 METHODOLOGICAL FRAMEWORK

The methodology is based on input output analysis. As Lynch (2000) highlights the most commonly used tool for studying the impact of transportation projects is the input-output model, because this model not only captures the direct effects of the project, but also captures all the secondary indirect and induced effects. According to Transportation

Research Board (TRB, 2008) report the method provides economic impacts in three categories: direct, indirect, and induced impacts. The sum of the three categories comprises the total economic impact of the airport studied. The induced economic impact category looked at the jobs lost should the airport(s) cease to exist. A more detailed description of each type of impact is as follows:

- Direct effects include employment and output generated directly by the airport and refer to the employment and revenues attributable to the commercial activities, which take place directly at the airport.
- Indirect effects represent employment and output generated by firms primarily off-airport, but whose activities are attributable to the airport. These impacts measure the purchase of goods and services by airport businesses from other firms, in terms of the employment and revenues related to the business activities resulting from their operations in support of airport operations.
- Induced effects are the multiplier effects caused by successive rounds of spending throughout the economy as a result of an airport's direct and indirect effects. These impacts estimate the increase in employment resulting from direct and indirect airport activities. The jobs sustained by the direct and indirect airport activities generate an increase in household income.
- The Total economic impact is the sum of the direct, indirect, and induced effects.

Figure 1: Distribution of Economic Impacts of an Airport



1.2 DESCRIPTION OF THE MODEL

1.2.1 The Equations

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:

$$(I-A)\ X=Y \qquad (1)$$

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 and

n= number of production sectors in which (I−A)−1 is referred to as the multiplier, or Leontief inverse matrix (Chiang e*t* al., 2005).

1.2.2 The Input Output Transaction Table

The monetary input output table shows the magnitude of transactions that occur between the different sectors of the economy and provides a useful overview of the economy structure. Augusztinovics (1995) recognizes that in this table the sum of every sectoral final output value equals with 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 a kind of balance in the economic system between final output values and values added.

The model used a matrix of technical coefficients that was derived from the input-output table for the year 2005, drawn up by EUROSTAT (2008) for the economies of the European Union. The data used for updating the model consist of the input-output table for the reference year, including the import matrix, growth rate forecasts of value added per sector (agriculture, industry, services) and the forecasts of components of final demand (consumption, investments, exports and imports). The updated input-output table was estimated by a process of iteration that provides estimations on the intermediate consumption of imported goods and services, the structural composition of final demand by product, domestic production by product, and imports by product. The Transaction table for the region is presented in the Appendix.

1.2.3 The Technological Coefficient Matrix

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 a country's (or a region's) economy and helps predict the effect of changes in one industry on others; in addition, it shows all the connections between the different branches of the economy. The rows of this matrix consist of the outputs that concern resources supplied by a given sector to each of the sectors of activity and to the final demand. The columns consist of the inputs from the different sectors.

The matrix of technical coefficients is created from the national INPUT–OUTPUT TABLE which shows the input and output structure of the Greek industries. The technical coefficients have been calculated from the values taken from the matrix of transactions divided by total production. The technical coefficients serve to provide indications on the technical structure of the economy. This shows which sectors have a high level of value added, productivity and exports. These coefficients summarize the induced effects. The matrix of technical coefficients for the region of Crete is calculated and presented in the Appendix.

The changes in the final demand because of the existence of the new airport are measured in terms of increased employment and increased output. Based on the multipliers per industry category, the total impact of the proposed airport on the region economy is estimated by multiplying the matrix by the changes in the final demand caused by the new airport.

2 MODELING APPLICATION IN THE NEW AIRTPORT OF CRETE (KASTELLI)

2.1 REGIONAL ECONOMY OF CRETE

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 are presented below.

Table 1: Gross Value Added by Industry in million euros (current prices)

Industries	Agriculture, forestry, fishing	Industry including energy	Construction	Trade, household hotels and restaurants, transport	real estate, rents and business activities	Other services
GREECE	7,670	27,110	12,077	66,943	37,484	48,517
CRETA	755	827	616	3,261	1,655	2,636

Source: EL.STAT (2007)

Table 2: Total Employment by Industry in million Euros

Industries	Agriculture, forestry, fishing	Industry including energy	Construction	Trade, household hotels restaurants, transport	real estate, rents and business activities	Other services
GREECE	544,983	550,711	385,282	1,539,228	409,856	1,271,732
CRETA	49,072	19,982	24,653	98,255	18,076	60,901

Source: EL.STAT (2007)

2.2 TOURISM IN CRETE

Traditionally, Crete 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 archeological places. Crete is a faraway European destination (over 3.000 miles) 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.

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 the Greek National Tourism Organization (GNTO) and the Hellenic Institute of Tourism Research 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.

2.3 KEY FIGURES OF THE NEW AIRPORT AT KASTELLI VALLEY

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. The new airport will re-allocate aviation activities from the existing airport to new airport. Key objectives of this project 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 to be a hub in an eastern Mediterranean region.

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. Currently, 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. 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 have been used charter flights in 2007 (Greek National Statistics, 2009). The existing

international airport of Heraklion (named Nikos Kazantzakis) is the second busiest airport in Greece after Athens International Airport. The international air transports represents the second international airport in Greece (3,927,292 in 2007) and has become overused during the peak holiday season, given that it receives more international charter flights during peak season than any other Greek hub.

The demand for air travel in the Greece is predicted to grow from the current levels by the year 2025. Failure to increase the airport capacity will have a negative impact on regional and national economic growth and international competitiveness. Taking into consideration that the existing airport has reached its capacity and that the tourist market and regional business are growing, the new airport is expected to meet the future needs. In addition, it will contribute significant to the tourist and aviation business in local, regional, national and European level.

The new airport will be almost twice as large as the existing one. It will be located in northwest part of Heraklion prefecture, close to the town of Kastelli. The new airport will be the primary commercial, serving the air transportation needs of the people and businesses in and around the island of Crete. The airport's auxiliary facilities and infrastructure will cover an area of 600 hectares with a runway length 3,800m, 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, in the south-west part of the new airport. In addition, a passenger (approximately 70,000 m^2) and a freight terminal (approximately 15,000m^2) will be included. The apron area will accommodate up to 44 airplanes.

Table 4: Traffic Key Figures for the Existing and the New Airport

	PAX in 30^{th} design hour	Aircraft Movements	Scenario
Existing Airport	3,000	200	Real Value
New Airport in 2015	3.500	302	Pessimistic
	3.750	322	Medium
	4.000	338	Optimistic
New Airport in 2025	4.250	354	Pessimistic
	5.000	388	Medium
	5.500	426	Optimistic

2.4 ASSESSMENT OF DIRECT ECONOMIC IMPACT

The direct impact is the employment and income generated by the direct operation of the airport. This is the most obvious economic impact, the most easily measured, and the most frequently quantified (Graham, 2008). The direct employment is depended on the volume of passenger traffic. This is equivalent to the number of employees per million passengers per year. The direct impacts are calculated based on observable and historical relationships between airport activity and changes in employment, considering the three areas that generate employment at the airport: the airlines related industry, the airport industries and the commercial related companies. The direct impacts are equal to the number of total staff on site and number of total jobs (both part time and seasonal jobs). According to ACI 2004 from the European airports, an average of 950 jobs is supported per million passengers, depending on the measures taken by airports to reduce costs and increase productivity (ACI, 2004). The new airport is estimated to support 4000 jobs and the output that will generate is estimated around 850 million Euros.

2.5 ASSESSMENT OF INDIRECT ECONOMIC IMPACT

The indirect impact is composed of the supplying industries and of the spending of air passenger visitors in the area serviced by the airport. The industries including transportation are estimated to create 1500 jobs, due to the existence of the airport, and an output of 45 million euros. Thousands of visitors arrive daily at the tourist destination of Crete. These visitors stay and spend money on hotels, shopping, entertainment, ground transportation and food. The 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, 2007). In particular:

Non residents tourist arrivals =2,135,198

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 = 2,135,198 x 15 x 109=3,491,048,730 euros

2.6 ASSESSMENT OF INDUCED ECONOMIC IMPACT

The circulation of direct and indirect impacts through the regional economy generates additional multiplier impacts associated with suppliers' additional earnings and wages.

Induced impact is the employment and income generated by the spending of incomes by the direct and indirect employees on local goods and services such as housing, transport, food, retail. Spending resulting from direct and indirect activities is spent again by the recipient employees and local businesses. Employees use their salaries and wages to purchase goods and services from other businesses. Businesses make their own purchases and hire employees, who also spend their salaries and wages throughout the local, regional, and state economies. Induced impact is an estimate of the recycling of euros through the economy, and is estimated using the impact multipliers.

3 RESULTS -TOTAL ECONOMIC IMPACT ON THE REGION

The following tables summarize the total economic impact that the airport will have on the region:

Table 4: Measures of Direct and Indirect Impact

Impact Measure	Direct Impact	Indirect Impact
Employment (FTE Jobs)	4000 jobs	1500 jobs
Output (million Euro)	850 million Euro	45 million
Value added (million Euro)	700 million Euro	23 million

Table 5: Total Direct Impact on the Region

Impact Measure	Direct Impacts	Multiplied Impacts	Total Impacts	% Creta	%Greece
Employment (Jobs)	4000 jobs	4096 jobs	8096 jobs	3.00%	0.18%
Output (million Euro)	850 million Euros	375 million Euros	1225mil. Euros	10.00%	0.50%
Value added (million Euro)	700 million Euros	210million Euros	910 mill. Euros	7.8%	0.38%

Table 6: Total Indirect and Induced Impact on the Region

Impact Measures	Indirect Impacts	Induced Impacts	Total Impacts	%Greta	%Greece
Employment (Jobs)	1500 jobs	605 jobs	2105 jobs	0.78%	0.04%
Output (million Euro)	45 million Euro	57 million Euro	102 mill. Euro	0.8%	0.04%
Value added (million Euro)	23 million Euro	37 million Euro	60 million Euro	0,51%	0.03%

*GDP of Greece (2008) =239.141 million EURO, *GDP of Crete (2008) =11.641million EURO,
*Total Employment Greece: 4.701.792 jobs, *Total Employment Crete: 270.939 jobs
Source:EL.STAT. (2007)

4 CONLUSIONS

The above results provide an instructive defensible picture of the economic and employment impacts that can arise from the development of the new airport. The new airport will be itself an industry that will generate jobs, earnings and great economic activity. The tourist airport will have a great profound impact on the economic prosperity of the state. It will facilitate tourism and encourage foreign investment and international trade.

As was calculated in the input output analysis approximately 4000 direct and 1500 indirect jobs are estimated to be supported inside the airport. The circulation of direct and indirect impacts through the regional economy will generate additional multiplier impacts associated with suppliers and additional earnings and wages. The application of the method suggested that these impacts will result in an additional 10.200 regional jobs and output of 970 million Euros in the region. The total value added of the airport on the Region of Crete will be 970 million Euros. Moreover, the air passenger visitor spending that was not included in the model approach is considered as an external variable. The total additional spending of the tourists in the region of the island of Crete is estimated to be 3.491.048.730 euro. This is equal with 1.5% of the GDP of Greece and 30% of the GDP of Crete; this result indicates the importance of tourism in Crete and the value that will be added if the capacity will be met in the future.

In addition to supporting the region's economy, Crete's New International airport will be itself an economic generator. Beyond the economic impact that is quantified in this report, the airport system will also provide essential qualitative benefits to the residents, businesses and visitors, who will also rely on the airport system for health, welfare, and safety needs. These impact assessments will be used for a number of purposes in order to promote understanding of the Great economic and social role of a regional tourist airport and its development from the decision makers and stakeholders and use them as a tool in order to examine investments, approaches to airport development and planning policies.

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APPENDIX A: The Input Output Transaction Table with the 16 Sectors for the Region

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	OUTPUT
A	1748	2	0	90	0	0	89	392	25	0	32	0	174	1	2	0	13645
B	0	54	0	0	0	0	0	74	4	0	1	0	0	0	0	0	1 134
C	4	0	17	0	0	611	7	13	1	0	5	0	0	0	0	0	796
D	8	23	0	637	1	1	458	218	15	1	18	29	2	10	2	0	7897
E	111	0	30	121	495	55	808	578	84	42	48	124	11	89	21	0	6 111
F	11	0	12	32	19	3	153	105	47	45	1588	351	28	80	1	0	26 526
G	893	64	27	415	144	2 294	1032	1746	562	40	85	664	160	791	31	0	38264
H	0	0	0	6	1	1	13	0	263	4	4	49	0	9	265	0	20 474
I	32	9	25	22	14	95	1647	6	521	41	49	443	7	12	40	0	20587
J	299	19	14	68	133	272	1756	253	134	334	382	545	43	85	55	0	9 935
K	0	0	17	103	23	345	1664	235	93	88	96	232	10	124	71	0	22 881
L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21 239
M	0	0	0	0	0	0	0	0	2	6	0	26	5	33	0	0	11 283
N	5	0	0	0	0	0	0	0	6	39	2	140	0	58	0	0	11 989
O	0	0	0	0	0	0	0	31	14	0	0	0	0	7	5	0	3 306
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 317
Total	4 566	283	286	2132	2 140	13 678	13848	8 447	10 275	2 035	2 723	6 310	1 033	3 917	622		361 134
Taxes	24	36	31	133	158	1 342	921	449	1087	220	83	501	70	326	36		20 195
Total intermediate consumption	4591	320	317	2265	2 299	15 021	14769	8 897	11362	2 254	2 806	6 811	1 102	4 243	659	0	381 330
Value added	7627	727	377	1828	3 665	11 136	29807	11 577	8739	7 052	20 074	14 338	10 148	7 690	2 647	1 317	
Output	12218	1 047	695	4093	5 965	26 157	44576	20 474	20101	9 306	22 881	21 149	11 250	11 933	3 306	1 317	
Imports	1427	87	102	3804	147	369	0		486	629		90	33	55			
Total Input	13645	1 134	796	7897	6 111	26 526	44576	20 474	20587	9 935	22 881	21 239	11 283	11 989	3 306	1 317	

Source:Eurostat 2005

A:Agriculture, B:Fishing, C:Mining, D:Manufacture, E:Electricity, F: Construction, G: Trade, H: Hotels and Restaurants, I: Transportation, G: Financial intermediation services, K: Real Estate, L:Public administration and defense, M:Education, N:Health, O:Other services, P: Private Households with employed

APPENDIX B: The Inverse Matrix of the Technical Coefficients in the Region

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
A	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C	0.00	0.00	1.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	0.08	0.01	0.09	0.00	0.05	0.24	0.04	0.1	0.07	0.01	0.03	0.04	0.02	0.1	0.03	0.00
E	0.02	0.00	0.10	1.13	1.09	0.01	0.01	0.04	0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.00
F	0.00	0.00	0.05	0.03	0.01	1.00	0.01	0.01	0.00	0.01	0.03	0.01	0.00	0.01	0.01	0.00
G	0.10	0.04	0.07	0.01	0.03	0.12	1.04	0.10	0.04	0.00	0.02	0.05	0.02	0.08	0.02	0.00
H	0.00	0.00	0.00	0.11	0.00	0.00	0.00	1.00	0.00	0.03	0.00	0.00	0.00	0.00	0.02	0.00
I	0.01	0.07	0.04	0.00	0.01	0.03	0.09	0.02	1.12	1.06	0.03	0.05	0.00	0.01	0.02	0.00
J	0.03	0.02	0.03	0.02	0.02	0.05	0.06	0.04	0.02	0.14	0.03	0.04	0.01	0.01	0.03	0.00
K	0.02	0.01	0.07	0.03	0.03	0.07	0.10	0.06	0.07	0.00	1.11	0.06	0.02	0.03	0.13	0.00
L	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
M	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	1.01	0.00	0.00
O	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.00	0.02	0.01	1.04	0.00
P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00