

The efficiency of the tourism industry in Greece during the economic crisis (2008 - 2016)

Panagiotis Pegkas ^{1*}

¹ School of Science, University of Thessaly, Greece. Email: papeg@cs.uth.gr

*Corresponding author

Abstract

This paper investigates the efficiency of the tourism industry in Greek regions during the economic crisis (2008 – 2016). It applies the methodology of stochastic frontier analysis that allows us to estimate the regional efficiency scores and rankings. The results show that the tourism industry in Greece enjoys high average efficiency levels and seems to not fall behind in comparison to its competitors. The regions of South Aegean and Crete are regarded as the leaders in the efficiency ranking. Greece, in order to achieve more economic, social, and cultural benefits from tourism should continue the structural reforms, improving the prospects of the sector.

Keywords: tourism; efficiency; stochastic frontier; Greece; regions

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1. Introduction

Tourism as one of the largest and fastest-growing industries in the world has attracted considerable attention in the worldwide economic theory and its beneficial advantages are well-documented in the literature (Pablo-Romero and Molina, 2013; Aratuo and Etienne, 2019). The tourism sector impacts positively on economic growth through many channels and generates positive spillovers to the other determinants of economic growth. It contributes positively to employment (Balaguer and Cantavella-Jorda, 2002), enhances investment by stimulating investment in new infrastructure (OECD, 2018), improves the balance of payments (Shahzad *et al*, 2017), creates economies of scale, fosters innovation and the diffusion of technical knowledge (Walder *et al*, 2006) and additionally, boosts personal earnings and enterprise profits, as well as government revenues in the form of charges (OECD, 2014).

In 2016, the global tourist arrivals expanded by 4% to 1.235 billion, and international tourism receipts increased by 2,6% in real terms over the previous year, reaching \$1,22 trillion (UNWTO, 2017). UNWTO based on long-term forecasts, reports that international tourist arrivals worldwide are expected to reach 1.8 billion by 2030. Almost half of the international tourist arrivals worldwide were accounted for by visits to Europe. In Europe, international tourist arrivals reached 616 million in 2016, a 2,1% increase over the previous year, with the most remarkable arrivals' growth led by Southern and Mediterranean destinations (including Greece).

Greece every year attracts millions of international tourists and is a major player in the European and global tourism industry. In 2016, Greece ranks 13th and 7th in international and European tourism arrivals respectively, while ranks 22nd and 8th in international and European tourism receipts, respectively (UNWTO, 2018). In 2016, Greece attracted 24,7 million international tourists, who spent 514 euros on average. The same year, the tourism industry produced a considerable 18,6% of the Greek GDP, generating receipts of 12,7 billion euros. It also supports about 860 thousand jobs, providing employment for almost 24% of the total Greek workforce (SETE, 2016) and accounts for a remarkable 15,7% of total investment (World Travel & Tourism Council, 2017).

In 2008, the bankruptcy of the Lehman Brothers triggered a global financial crisis that led to a devastating recession in European countries and especially in Greece. Greek economy having long-standing market distortions and many unsolved problems (fiscal, financial, structural, imbalances, etc.) faced high levels of public debt and as a result, Greece appealed to the European Support Mechanism in 2010 (Pegkas, 2018). The effects of the economic crisis were painful for the Greek economy. It lost more than 25% of its GDP, while the unemployment rate reached 27% in 2013, the highest in the EU. Also, the Greek economy and its sectors lost a lot of their competitiveness (European Commission, 2019).

On the other hand, the Greek tourism industry has experienced continued growth. Over the period 2008-2016, has been a significant increase in tourist arrivals (12%), while tourism receipts followed by a smaller increase (7%). Also, inbound tourism contributed about €105 billion to the Greek economy, while income increased by 14% (Bank of Greece, 2020). In terms of macroeconomic multipliers, for every euro spent on tourism, GDP increases by 2.2 to 2.6 euros (SETE, 2018). Also, other sectors of the economy, such as trade, financial services, real estate, construction, and manufacturing benefit from tourism development (Jarbouli *et al*, 2015). In 2016, tourism services account for about 52.8% of total service balance receipts, while net tourism receipts account for 73.2% of the service balance surplus. The employment in tourism between 2008 and 2016 increased by 8.3%, in contrast to the total employment that declined by 20.3% in the same period. The number of tourism firms has on average increased by 2.9% in the period 2008-2016, while for the total economy firms decreased by 9.4%

(Hellenic Confederation of Professionals, Craftsmen & Merchants, 2019). Also, in the same period, tax revenues from tourism grew from 41% to 61%, while the economy as a whole increased from 37% to 48%.

The purpose of this study is to empirically investigate the efficiency of the tourism industry in Greece during the period of economic crisis (2008-2016). As the tourism industry is one of the most important industries in Greece, it is worth paying more attention to evaluating tourism efficiency. Tourists choose to visit destinations in Greek regions that have different natural and cultural resources. That has been strengthened by the development of low-cost carriers and the launch of flights to regional airports directly from source countries. So, due to the specific morphology of the country, it is worthwhile to focus on the destination competitiveness, providing a measure of efficiency at a regional level of Greek firms in the tourism sector. Thus, this study by giving helpful information and exact outcomes sets the basis for additional policy enhancements.

The rest of the paper is structured as follows. Section 2 reviews the literature. Section 3 provides a brief description of the methodology and the data, presents the econometric analysis, reports, and discusses the empirical results and section 4 presents the concluding remarks.

2. Literature Review

The literature that investigates the efficiency in the tourism sector is typically achieved on the micro-level (e.g. hotels, restaurants, etc.) and the majority of the studies focus on the regional hotels' units. Limited studies have included all the units of the tourism sector (hotels and restaurants) in their dataset. For comparative results, the following literature review includes only empirical studies that have investigated the case of a single country.

Barros and Alvaro (2006) applied a frontier model to evaluate the cost efficiency for a sample of 25 Portuguese travel agencies over the period 2000 - 2004. The results show that the average technical efficiency score is 96.7%. Hu *et al*, (2010) by using the stochastic frontier approach estimated the cost inefficiency for 66 international tourist hotels in Taiwan during the period 1997-2006. They found that on average international tourist hotels in Taiwan operate at a 91% cost efficiency level. Pulina *et al*, (2010) investigated the efficiency of the hotel sector for the Italian regions over the period 2002-2005. Their empirical findings indicate that the hotels in Italia operate at an 82% efficiency level. Barros *et al*, (2011) analysed the efficiency of the hotels in 22 French regions over the period 2003-2007. The results show that the average efficiency score is 61.5%. Huang *et al*. (2012) analysed the efficiency of the hotel industry in 31 Chinese regions over the period 2001-2006. They found that the average technical efficiency score is 85%. Brida *et al*, (2012) examined the efficiency of the tourism sector, including hotels and restaurants, of the Italian regions over the period 2000-2004. The results show that the average efficiency decreases from 95% in 2000 to 90% in 2004. Ashrafi *et al*, (2013) investigated the efficiency of the hotel industry in Singapore over the period 1995 - 2010. They found that the average efficiency score of the hotel industry is 95%. Detotto *et al*, (2014) examined the efficiency of the hospitality sector in 21 Italian regions during the period 2000-2004. The empirical findings show that the average efficiency score is 84.5%. Parte-Esteban and Alberca-Oliver (2015) analysed the efficiency of the tourism industry for a sample of 1385 Spanish hotel firms for the years 2001, 2006, and 2010. The results indicate that the average efficiency score is 50%. The efficiency scores increase before the financial crisis and decrease during the crisis period. Solana-Ibáñez *et al*, (2016) examined the efficiency of the Spanish tourism regions over the period 2005-2013 and the estimated results show that the average efficiency score is 61%. Poldrugovac *et al*, (2016) investigated the efficiency of 605 hotels in Croatia. They found that the average efficiency score of the hotel sector is 73%. Arbelo-Perez *et al*, (2017) estimated the cost efficiency

of 838 hotels from all the regions of Spain over the period 2009-2013. The results show that the average efficiency score is 92.8%. Chaabouni (2019) examined the tourism efficiency for 31 Chinese provinces over the period 2008–2013. The empirical results show that the average tourism efficiency is 76.3%.

The majority of the studies that have investigated the case of a single country found high-efficiency scores in the tourism industry. In particular, the empirical studies for the European countries showed high levels of efficiency, mainly in Italy and Spain. Also, the empirical findings indicate that the economic crisis led to a decrease in the efficiency of the tourism industry.

3. Empirical analysis

Herein, we propose a translog cost function using the stochastic frontier technique over a balanced data set of the Greek regions over the period 2008-2016. We estimate the model by using the maximum likelihood (ML) estimation method and we calculate the region's specific efficiency. Finally, the section presents the results and the discussion of the findings.

3.1. Methodology

Stochastic production frontier models suppose that each firm potentially produces less than it might because of a degree of inefficiency. Cost inefficiency is the deviation from minimum costs to produce a given level of output with given inputs prices. As Kumbhakar and Lovell (2000) argue in the cost function, the inefficiency effect denotes the raised expenditure given the price cost of inputs and output. Following the method of Kumbhakar and Lovell (2000), we assume that a firm has a production function $f(z_i, \beta)$ and without inefficiency produces

$$q_i = f(z_i, \beta) \quad (1)$$

In our empirical analysis, we consider a stochastic frontier model with inefficiency term, so the i th firm produces

$$q_i = f(z_i, \beta)\xi_i, \quad (2)$$

where ξ_i is the level of firm's efficiency. The level of efficiency for a region (firm or country) at time t must be in the interval $(0, 1]$. If it is 1, the firm is achieving the optimal output with the technology embodied in the production function, while if it is less than 1, the firm is not making the most of the inputs given the technology embodied in the production function. Output is assumed to be positive ($q_i > 0$) and so the efficiency is assumed to be strictly positive ($\xi_i > 0$). Considering that output follows random shocks equation (2) transformed as

$$q_i = f(z_i, \beta)\xi_i \exp(v_i) \quad (3)$$

Taking the natural log of both sides yields

$$\ln(q_i) = \ln\{f(z_i, \beta)\} + \ln(\xi_i) + v_i \quad (4)$$

Assuming that there are k inputs and that the production function is linear in logs, defining $u_i = -\ln(\xi_i)$ yields

$$\ln(q_i) = \beta_0 + \sum_{j=1}^k \beta_j \ln(z_{ji}) + v_i - u_i \quad (5)$$

Because u_i is subtracted from $\ln(q_i)$, restricting $u_i \geq 0$ implies that $0 < \xi_i \leq 1$.

Next, based on Kumbhakar and Lovell (2000) we specify from the above production function the cost function problem as follows:

$$\ln(c_i) = \beta_0 + \beta_q \ln(q_i) + \sum_{j=1}^k \beta_j \ln(p_{ji}) + v_i + u_i \tag{6}$$

where c_i is cost, q_i is output, z_{ji} are inputs quantities, and p_{ji} are input prices.

Our model includes the gross output and prices and quantities of three production inputs (physical capital, labour and intermediate inputs). The parameters of our stochastic frontiers are estimated using the maximum likelihood method. This method is consistent and asymptotically efficient (Coelli, 2005). An increase in the gross output and cost inputs is expected to cause an increase in the total cost of the firms and reduce efficiency. The price of labour is defined as the total annual salary per firm’s employee divided by the total number of employees. The price of capital is defined as the capital expenses (interest paid) divided by the capital stock. The price of intermediate inputs is defined as the intermediate inputs costs (including materials and energy costs) divided by the intermediate inputs. So, we defined the output and total cost as the sum of labour expenses, capital expenses, and intermediate inputs expenses. First, we obtained an explicit cost function of input [employment (wL), physical capital (wK) and intermediate inputs (wM)] and output (Y), by minimising the production cost for a given level of output. Thus, the three factor cost function (C) can be written as follows:

$$C(Y;wL,wK,wM) = wL(wL, wK, wM, Y) + wK(wL, wK, wM, Y) + wM(wL,wK,wM,Y) = \min_{L,K,M} wL+wK+wM, \text{ subject to } Y = f(L,K,M) \tag{7}$$

Taking natural logarithms, we get the linear equation:

$$\ln(c) = \log a_0 + a_1 \cdot \log(wL) + a_2 \cdot \log(wK) + a_3 \cdot \log(wM) + a_4 \cdot \log(Y) + v_{it} + u_{it} \tag{8}$$

Next, from Equation 8 we expose the translog cost function in the following form:

$$\ln(c) = c_0 + c_1 \ln(Y_{it}) + c_2 \ln(wL_{it}) + c_3 \ln(wK_{it}) + c_4 \ln(wM_{it}) + \frac{1}{2} c_5 [\ln(Y_{it})]^2 + \frac{1}{2} c_6 [\ln(wL_{it})]^2 + \frac{1}{2} c_7 [\ln(wK_{it})]^2 + \frac{1}{2} c_8 [\ln(wM_{it})]^2 + c_9 \ln(Y_{it}) \cdot \ln(wL_{it}) + c_{10} \ln(Y_{it}) \cdot \ln(wK_{it}) + c_{11} \ln(Y_{it}) \cdot \ln(wM_{it}) + c_{12} \ln(wL_{it}) \cdot \ln(wK_{it}) + c_{13} \ln(wL_{it}) \cdot \ln(wM_{it}) + c_{14} \ln(wK_{it}) \cdot \ln(wM_{it}) + v_{it} + u_{it} \tag{9}$$

where t is the observation period ($t = 1, \dots, T$) of region i ($i = 1, \dots, N$). In stochastic frontier cost models, u_{it} represents the technical inefficiency of region i at time t , and is supposed to be independently distributed and to follow a truncated-normal distribution with $u_{it} \sim N^+(\mu, \sigma^2)$. Also, the sign of the efficiency error term is positive, since inefficiency raises the cost of the firms. The random error v_{it} is assumed to be independent and identically distributed and to follow a normal distribution with $v_{it} \sim N[0, \sigma^2_v]$.

Two specifications of the model were applied, the time-varying random-effects model (Battese and Coelli, 1992) and the time-invariant model (Battese and Coelli, 1988). The time-varying is the most unrestricted specification, allowing efficiency to vary over time. The efficiency error term u_{it} , in this case, takes the following form:

$$u_{it} = \exp\{-\eta(t - T_i)\}u_i \tag{10}$$

where $u_{it} \sim N^+[\mu, \sigma^2_u]$ and $v_{it} \sim N(0, \sigma^2_v)$ are distributed independently to each other in the model, η is the rate of inefficiency decay for region i in time t and T_i is the last time in the i^{th} panel and the base efficiency level for the region. When $\eta > 0$, the degree of technical inefficiency decreases over time; when $\eta < 0$, the degree of technical inefficiency increases over time.

The time-invariant is the simplest specification in which u_{it} is a time-invariant truncated-normal random variable with non-zero mean and constant variance. In the time-invariant model, the efficiency error term u_{it} in Equation (10) for $t=T$ and $\eta=1$ takes the following form:

$$u_{it}=u_i \tag{11}$$

where, $u_{it} \sim N^+[\mu, \sigma^2_u]$ and $v_{it} \sim N(0, \sigma^2_v)$, and u_i and v_{it} are distributed independently to each other in the model. The time-varying model is more flexible than its time-invariant counterpart because efficiency can vary over time.

So, in our empirical analysis, we should check for the distribution of the model, the existence of the technical inefficient effects and if the residual error term is time-invariant or time-varying. The model will follow the normal truncated distribution if the null hypothesis of $\mu=0$ is rejected. Also, if the null hypothesis that γ tends to zero holds, it means that there are no technical inefficiency effects in the model. Furthermore, technical efficiency effects are invariant over time if the null hypothesis of $\eta=0$ is presented in the model, while if the inefficiency decay term η is statistically significant, then the time-varying efficiency model would be preferred.

3.2. Data set

All regional data are annual and were taken from the database of the Hellenic Statistical Authority (EL.STAT, 2021), for data on the price of capital¹ that were obtained from the Bank of Greece (2021). The variables of the gross output and investment are transformed and measured at 2010 constant prices. Tourism data include all the units of the sector. Specifically, accommodation services include hotels and other types of accommodation (camping grounds, recreational vehicle parks, etc.), while food services include restaurants and other types of catering and food service activities, based on the structural business statistics survey of the Hellenic Statistical Authority. Table 1 provides the descriptive statistics on the variables employed in the study.

Table 1. Descriptive Statistics

	Gross* output	Capital* stock	Capital* cost	Labour** (employees)	Labour* cost	Intermediate* inputs	Material* costs
Mean	720,950	2778,748	143,374	25805	194,724	441,716	323,121
Max	882,480	3790,566	896,220	37550	222,335	553,608	373,927
Min	610,667	1969,872	12,043	20173	146,626	357,830	242,959
Standard Deviation	104566	639505	159089	6648	23396	70114	46139

Note: All data are obtained from the Authors' calculations. *In thousand euros. ** Thousands of persons employed.

We estimate the capital stock by using the perpetual inventory method. Capital stock at the end of each year has been calculated as the sum of the previous year's capital stock and the current year's capital investment, after deducting the amount of depreciated capital, as presented by the following equation:

$$\text{Capital stock}_t = \text{capital stock}_{t-1}(1 - \delta) + I_t \quad (12)$$

where capital stock_t and capital stock_{t-1} stand for capital stock of the current and the previous year respectively, I_t is the annual capital investment in year t and δ is the annual depreciation rate. In addition, a starting value of the capital stock, which is necessary for the application of the perpetual inventory method, is calculated using the formula:

$$\text{Capital stock}_{t_0} = I_{t_0}/(\delta + g) \quad (13)$$

where I_{t_0} is the annual capital investment at the time t_0 , δ is the annual depreciation rate² and g is the average yearly growth rates of capital investment over the examined period.

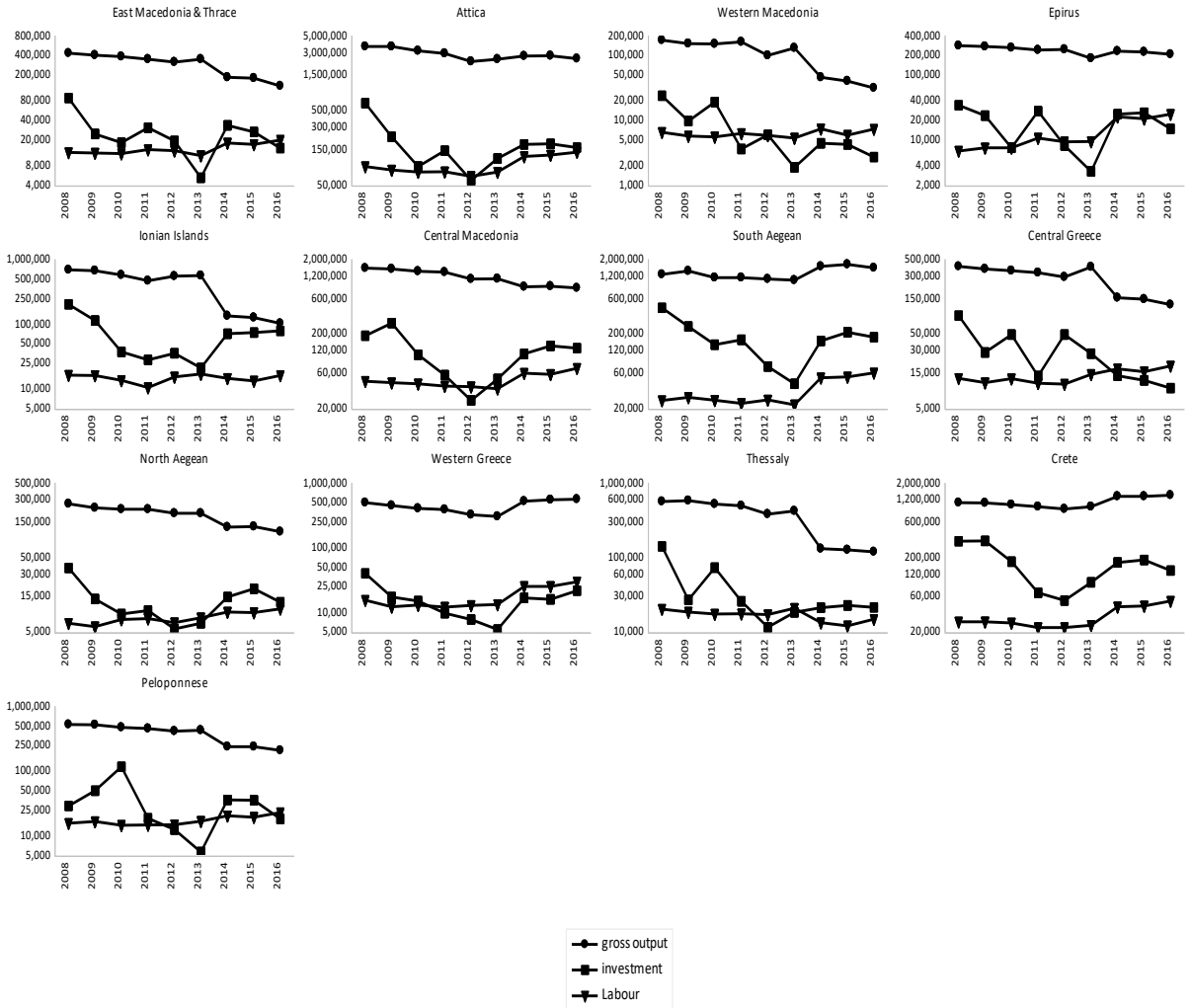
Figures 1 and 2 present the movement of gross output, investment and labour of the tourism industry in Greek regions over the period 2008-2016. Gross output has decreased for most of the regions, but after 2012 for some regions such as South Aegean, Crete, Attica and Western Greece started to increase. The highest levels of regional gross output and investment were recorded in Attica, South Aegean and Crete regions, while the lowest were in the regions of Western Macedonia and North Aegean. Also, the leading regions in the ranking of regional labour on tourism were Attica and Central Macedonia, while Western Macedonia and North Aegean were the lowest regions in the ranking.

Investment shows the most substantial variations concerning the other variables and varying among regions. The highest average annual growth rate was mainly in 2014 and the lowest in the years 2011 and 2012. In the opposite direction, labour and gross output follow a more stable course. For the most regions, the highest average annual rate of labour was in 2014 and the lowest in 2012. Almost half of the regions (including Attica, South Aegean and Crete) showed the highest average annual rate of gross output in 2014, while the other half shows the lowest over that year.

Also, the main conclusion is that for the regions of South Aegean, Crete, Attica and Western Greece the rates of change in gross output, investment and labour move in the same direction for the most years. On the other hand, for the other regions, the rates of change between the inputs and the output tend to move in the opposite direction, meaning that, when investment and labour inputs increased, the output decreased. As a result, these regions are expected to be less efficient than the others.

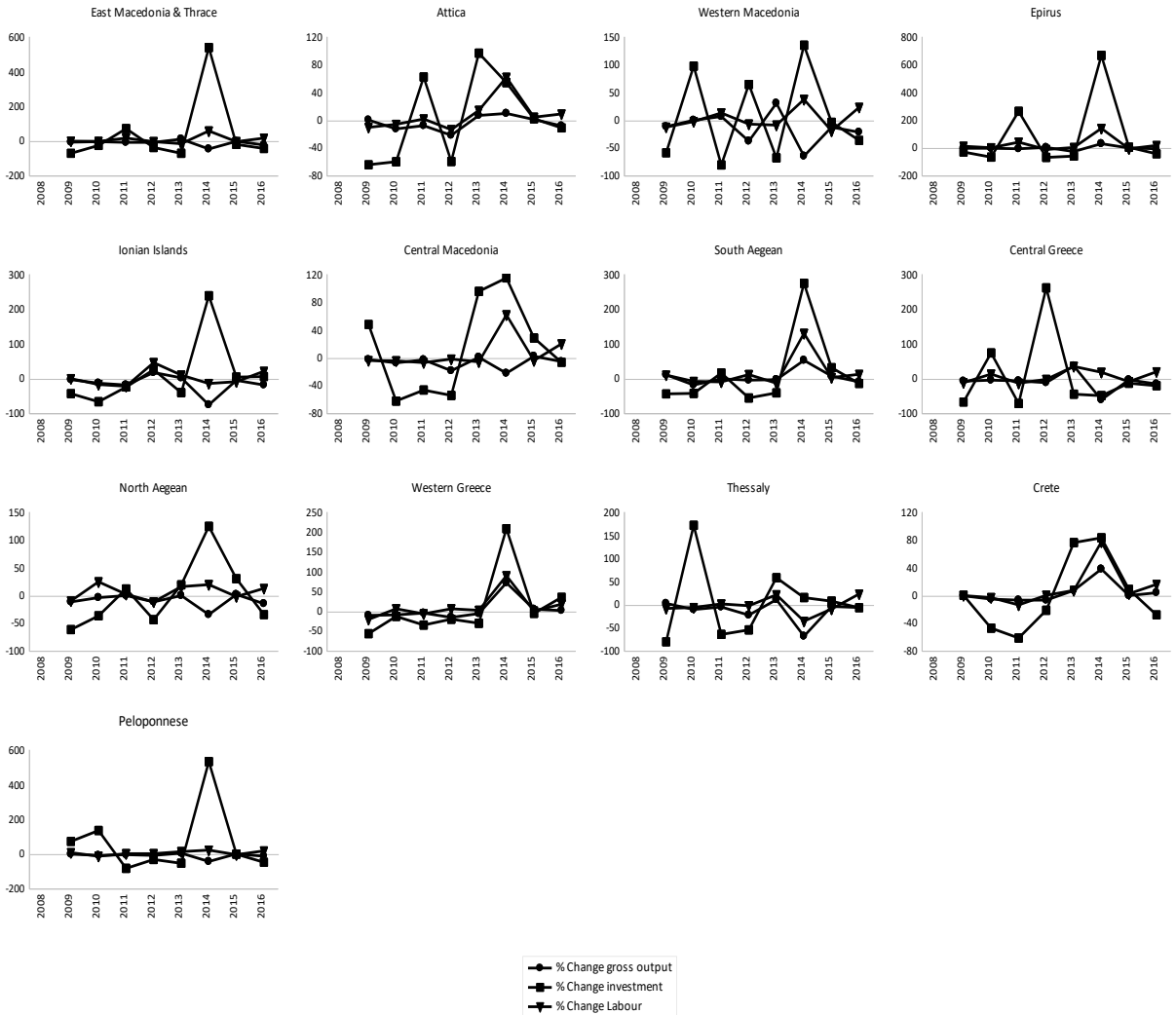
Table 2 presents the tourist arrivals and their growth rates in Greek regions throughout 2008-2016. Greek destinations welcoming on an annual average of more than 16 million visitors during the entire period of economic crisis experienced an average annual growth rate of 2.59%. Five Greek regions have the most popular destinations and are the leaders in terms of arrivals, accounting on average for 78% of total arrivals: Attica (3,347 million tourists), Crete (2,898 million tourists), South Aegean (2,744 million tourists), Central Macedonia (2,211 million tourists) and the Ionian Islands (1,221 million tourists). In 2016, tourism traffic was significantly slower than the previous year. The biggest pressure has been reported in North Aegean, as arrivals dropped 19%, while Crete posted an increase averaging at 11.7%. The main reasons for that fall in Greek tourism traffic were the political instability in the first half of 2015 and its financial consequences (capital controls and bank restrictions on withdrawals) in combination with the increasing influx of refugees from Syria and immigrants from Asian countries.

Especially, the latter had a significant negative impact on tourism arrivals in North Aegean, because most refugees were hosted by this region. It should also be noted that this fall in 2016 is coming after three consecutive years of a significant positive growth rate in arrivals and receipts for Greek tourism.



Source: The amounts of gross output and investment are expressed in € thousand, while labour is the number in persons of the tourism employment. All data are obtained from the Authors' calculations.

Figure 1. Levels of the variables



Source: The variables are expressed in growth rates. All data are obtained from the Authors' calculations.

Figure 2. Growth rates of the variables

Table 3 presents the capacity of the 5 and 4-stars hotels in the Greek regions for the years 2008 and 2016. It is worth noting that throughout the economic crisis hotels, rooms and beds have been upgraded, followed by a 39%, 29% and 30% increase in 5 and 4-star hotels, respectively. Investments of €1.8 billion were made between 2010 and 2015 in 5-star hotels (Pricewaterhouse Coopers, 2018). The same five regions with the most popular destinations as mentioned above accounted for the biggest capacity in rooms and beds of 5 and 4-stars hotels. Also, these regions have the most and busiest airports in Greece.

Table 2. *Tourist Arrivals in Greek Regions*

	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
East Macedonia & Thrace	650371	632129	551129	531214	446398	543273	571948	649716	627114	578144
Growth rate		-2,80	-12,81	-3,61	-15,97	21,70	5,28	13,60	-3,48	0,24
Attica	3417557	3318689	3217078	3235434	2703122	3050091	3637192	3818338	3732336	3347760
Growth rate		-2,89	-3,06	0,57	-16,45	12,84	19,25	4,98	-2,25	1,62
Western Macedonia	203871	203474	188270	166236	120900	132265	126992	122935	118766	153745
Growth rate		-0,19	-7,47	-11,70	-27,27	9,40	-3,99	-3,19	-3,39	-5,98
Epirus	389802	441706	435080	432384	360257	380809	403559	397448	419061	406678
Growth rate		13,32	-1,50	-0,62	-16,68	5,70	5,97	-1,51	5,44	1,26
Ionian Islands	1082821	1145736	1165462	1188138	1083362	1166842	1261084	1391263	1508475	1221465
Growth rate		5,81	1,72	1,95	-8,82	7,71	8,08	10,32	8,42	4,40
Central Macedonia	2185239	2208315	2052006	2092664	1954631	2136763	2256172	2490170	2530212	2211797
Growth rate		1,06	-7,08	1,98	-6,60	9,32	5,59	10,37	1,61	2,03
South Aegean	2169706	2213866	2534567	2783836	2544425	2794225	3060827	3253653	3348242	2744816
Growth rate		2,04	14,49	9,83	-8,60	9,82	9,54	6,30	2,91	5,79
Central Greece	625443	640239	608505	566936	437036	477583	501590	534244	559429	550112
Growth rate		2,37	-4,96	-6,83	-22,91	9,28	5,03	6,51	4,71	-0,85
Western Greece	811730	812374	761809	716271	594123	613028	576931	668933	604924	684458
Growth rate		0,08	-6,22	-5,98	-17,05	3,18	-5,89	15,95	-9,57	-3,19
North Aegean	311237	310589	290514	299987	259919	300132	323532	353364	286460	303970
Growth rate		-0,21	-6,46	3,26	-13,36	15,47	7,80	9,22	-18,93	-0,40
Thessaly	868060	886974	849858	839419	707573	763919	803592	834133	831893	820602
Growth rate		2,18	-4,18	-1,23	-15,71	7,96	5,19	3,80	-0,27	-0,28
Crete	2287742	2383297	2464814	2825736	2739308	3076113	3262005	3328716	3719412	2898571
Growth rate		4,18	3,42	14,64	-3,06	12,30	6,04	2,05	11,74	6,41
Peloponnese	1009990	1107289	1122303	1067351	839237	897286	957782	999771	1051148	1005795
Growth rate		9,63	1,36	-4,90	-21,37	6,92	6,74	4,38	5,14	0,99
Total arrivals	16013569	16304677	16241395	16745606	14790291	16332329	17743493	18842684	19337472	16927946
Total Growth rate		1,82	-0,39	3,10	-11,68	10,43	8,64	6,19	2,63	2,59

Note: Tourist arrivals are in million people. Data are obtained from EL.STAT. database (2021).

Overall, for the most regions, on average, the number of firms, investment and employment have increased, but on the other hand, the total output of the tourism industry has decreased. This was most apparent mainly in the regions with low tourist arrivals, low occupancy in high-quality hotels and fewer airports.

Table 3. Hotel Capacity in Greek Regions

Regions	Hotels 5* and 4*								
	Units			Rooms			Guest beds		
	2008	2016	Growth rate (%)	2008	2016	Growth rate (%)	2008	2016	Growth rate (%)
East Macedonia & Thrace	24	40	66.67	1620	2945	81.79	3220	5923	83.94
Attica	112	137	22.32	13385	14736	10.09	25148	27768	10.42
Western Macedonia	11	21	90.91	194	477	145.88	405	1016	150.86
Epirus	44	100	127.27	1190	2740	130.25	2455	5733	133.52
Ionian Islands	110	145	31.82	13525	15952	17.94	25816	30974	19.98
Central Macedonia	104	148	42.31	13181	16574	25.74	25424	33170	30.47
South Aegean	354	500	41.24	40498	53094	31.10	78613	105806	34.59
Central Greece	39	52	33.33	3163	3641	15.11	6258	7214	15.28
Western Greece	30	44	46.67	3309	3623	9.49	6805	7281	6.99
North Aegean	37	38	2.70	2121	2354	10.99	4073	4457	9.43
Thessaly	117	143	22.22	3453	4600	33.22	6840	9273	35.57
Crete	275	346	25.82	35277	44307	25.60	68537	87703	27.96
Peloponnese	75	142	89.33	4186	6926	65.46	8159	14095	72.75
Total	1332	1856	39.34	135102	171969	27.29	261753	340413	30.05

Note: Data are obtained from EL.STAT. database (2021).

3.3. Empirical Results

Table 4 reports the estimated results of the parameters obtained by panel estimation, based on the stochastic frontier analysis for the 13 Greek regions over the period 2008-2016. For both specifications, the coefficients of output and cost inputs have the expected sign. The positive values indicate that an increase in these cost inputs will lead to an increase in cost inefficiency. Intermediate inputs and labour costs appear to greatly influence the cost of the firms in Greek regions.

Regarding the distribution of the inefficiency term u_{it} , only in the time-varying specification of the translog cost function model, we reject the null hypothesis of half-normality assumption on technical inefficiency. The parameter of the mean inefficiency μ is significantly different from zero at 1% and 5% levels, showing that the model follows a normal truncated distribution.

Also, the tests indicate that the null hypothesis of no technical inefficiency effects ($\gamma = 0$) in the estimated cost frontier is rejected in both specifications of the models. The values of the gamma (γ) term, are statistically significant, which indicates the presence of variable cost inefficiency. For time-invariant and time-varying specifications, inefficiency is estimated to explain 42% and 93% of the error variance respectively, indicating that the technical inefficiency is likely to have an important effect in explaining output variability among regions. According to the estimated variances, output variability is mainly due to technical inefficiency rather than statistical noise. Consequently, most of the regions in

the sample operate below the cost frontier and thus, a significant part of cost variability among them is explained by the existing differences in the degree of technical efficiency.

Next, we check the time trend of the inefficiency term. Based on the value of the parameter η we test whether efficiency is time-varying or not. If we accept the null hypothesis, then efficiency is time-invariant. The coefficient of parameter η is statistically significant at 1% level and for that reason, the null hypothesis is rejected. This finding reveals that the time-varying specification is preferred. For that reason, the technical efficiency varies across regions and overtime periods. Also, the negative and statistical significant estimated value of the parameter η means that technical inefficiency increases over time. The value of η is 0.59 and is found to be high in absolute value. Thus, a significant trend in declining technical efficiency is found.

Table 4. Cost Function Estimates

Variable	Translog Cost Function	
	Time invariant	Time varying
lnw ₁	-0.44 (1.31)	-0.25 (1.15)
lnw ₂	2.48* (1.33)	2.21* (1.21)
lnw ₃	1.85 (1.49)	2.42* (1.37)
lny	-1.45 (0.95)	-0.82 (0.77)
lnw ₁ ²	-0.01 (0.26)	-0.04 (0.23)
lnw ₂ ²	0.47 (0.32)	0.51 (0.40)
lnw ₃ ²	-0.29 (0.37)	-0.34 (0.34)
lny ²	0.21*** (0.06)	0.12*** (0.06)
lnw ₁ *lnw ₂	-0.04 (0.16)	0.12 (0.15)
lnw ₁ *lnw ₃	-0.07 (0.11)	-0.08 (0.11)
lnw ₂ *lnw ₃	0.05 (0.30)	0.31 (0.26)
lny*lnw ₁	0.04 (0.08)	0.03 (0.08)
lny*lnw ₂	-0.24** (0.10)	-0.23** (0.09)
lny*lnw ₃	-0.05 (0.09)	-0.09 (0.08)
con	12.85** (5.97)	9.15** (4.46)

Variable	Translog Cost Function	
	Time invariant	Time varying
σ^2_v	0.004 ^{***} (0.000)	0.002 ^{***} (0.0002)
σ^2_u	0.003 (0.03)	0.03 (0.02)
$\sigma^2 = \sigma^2_u + \sigma^2_v$	0.007 ^{***} (0.002)	0.03 (0.02)
$\gamma = \sigma^2_u / (\sigma^2_u + \sigma^2_v)$	0.42 [*] (0.25)	0.93 ^{***} (0.04)
μ	0.15 (0.10)	0.24 ^{***} (0.07)
η		-0.59 ^{***} (0.10)
Log likelihood function	139.2	176.93
Total number of observations	117	117

Notes: Y is the gross output, w1 is the price of capital, w2 price of labour; w3 price of intermediate inputs, respectively. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

After the translog model estimation, cost efficiency scores for each sampled region are calculated and ranked, based on the time-varying specification of the model. Table 5 presents the efficiency scores measured from the residuals of the above model estimations.

Table 5. *Cost efficiency scores and ranking*

ID	Regions	Average Cost efficiency	Ranking
1	Attica	0.934	5
2	Central Greece	0.865	12
3	Central Macedonia	0.901	11
4	Crete	0.990	2
5	Epirus	0.905	10
6	Ionian Islands	0.909	7
7	North Aegean	0.948	4
8	Peloponnese	0.908	9
9	South Aegean	0.993	1
10	Thessaly	0.918	6
11	East Macedonia & Thrace	0.909	8
12	Western Greece	0.982	3
13	Western Macedonia	0.856	13
Average efficiency			0.925
Highest efficiency			0.993
Lowest efficiency			0.856
Median efficiency			0.909
Standard deviation			0,044

Note: All data are obtained from the Authors' calculations.

From the results of Table 5, it can be verified that the average efficiency score for Greek regions is high. The average technical efficiency is 92.5% and this value indicates that, to operate efficiently, the firms of Greek regions in the tourism industry should reduce their input costs by 7.5% without decreasing their outputs or that around 7.5% of tourism industry-specific inefficiency effects are affecting the production process in achieving the maximum feasible output. The average technical efficiency of the regions' sample ranges from the lowest efficiency score of 85.6% to the highest efficiency score of 99.3%. The median technical efficiency of the median regions was 9.1% lower than that of the frontier region, while the average standard deviation is 4.4%. The average efficiency is higher than the median, meaning that five regions appear with efficient scores much higher than the mean. The range of efficiency scores suggests that there is realistic and not considerable cost inefficiency in the Greek tourism industry. Also, the efficiency scores show that South Aegean is the most cost-efficient region, with costs 0.7% above the frontier region³. Central Greece and Western Macedonia are the most cost-inefficient regions, with costs 13.5% and 14.4% above the frontier region, respectively.

Prevalent coastal function destinations seem to be more efficient or competitive than the other regions (e.g., South Aegean, Crete, Western Greece, North Aegean and Attica, etc). Island regions showed more resilience than continental regions, during the period of economic crisis (Giannakis and Bruggeman, 2017). In brief, the stochastic frontier model shows that technical efficiency in the tourism industry varies greatly between Greek regions. The regions with a bad performance or efficiency score less than the average are Western Macedonia, Central Greece, Central Macedonia, Epirus, Peloponnese, East Macedonia and Thrace, Ionian Islands and Thessaly. The regions with a good performance or efficiency score more than the average are South Aegean, Crete, Western Greece, North Aegean and Attica.

Table 6 summarises the cost technical efficiency scores for each year of the Greek regions and the growth rates from 2008 to 2016. The results reveal that the mean technical efficiency is declining over time, but especially in 2015 and 2016, it decreased rapidly. The efficiency scores varied between a low value of 67% in 2016 and a high value of 99.8% in 2008. This variation is characterised by a decrease of the average annual growth rate to the order of 4.6% during the period 2008-2016.

Table 6. Average cost efficiency scores by year

Year	Average Cost efficiency	Growth rate
2008	0.998	
2009	0.996	-0.2
2010	0.992	-0.4
2011	0.986	-0.6
2012	0.975	-1.1
2013	0.953	-2.2
2014	0.913	-4.2
2015	0.835	-8.5
2016	0.672	-19.5
Total average	0.925	-4.6

Note: All data are obtained from the Authors' calculations.

3.4. Discussion of the empirical findings

The basic findings from the literature review indicate high-efficiency scores for firms in the tourism industry, mainly in Italy and Spain. In the same direction with these studies, our empirical results reveal

that the Greek regions in the tourism industry enjoy high average efficiency levels. This is a significant finding because the destinations in these countries are competitive with those of Greece.

Furthermore, the empirical analysis reveals most of the regions in the sample operate below the cost frontier and for that reason, a significant part of cost variability among them is explained by the existing differences in the degree of efficiency. Although arrivals and receipts have on average increased during the examined period, the rise of the labour and intermediate inputs costs and the high taxation probably has reduced the efficiency of the Greek firms. Also, the results indicate that the degree of inefficiency increases over time, implying that Greek firms in the tourism sector continue their production without consideration given to their technical inefficiency.

Apart from technical inefficiency that comes from the production process, there can be a wide variety of reasons that increase inefficiency. Greek tourism faces three major structural problems that probably reduce its efficiency. The first is the low daily tourist expenditure per night based on the low quality of the tourist mix, the second is the seasonality and the third is the large differences between Greek regions in tourist arrivals and tourism revenues. As the National Bank of Greece (2017) reports, the major aspect concerning the first problem is that the daily spending of foreign tourists in Greece remains at a level of 15% lower than the average of directly competing destinations and that the share of high-income foreign tourists has been decreased to 23% in 2016 from 27% in 2008. Also, during the period 2008-2016, tourism receipts in the third quarter (July-September) accounted on average for 67%. Greek firms to face the seasonality problem and to raise their operating profit, increase the prices more than competitors over the high-demand period (July-August) while reducing the prices more than competitors in the remaining months. So, over the last years, the tourism industry became less efficient and competitive compared to other countries. Also, according to the Bank of Greece (2020), in 2016 a percentage of 88% of the total receipts (12.749 billion euro) was carried out only in five regions, as follows: South Aegean (3.136 billion euro), Crete (3.095 billion euro), Attica (1.734 billion euro), Central Macedonia (1.688 billion euro) and Ionian Islands (1.503 billion euro). In addition, tourist arrivals accounted for 77% of the total tourist arrivals in these five regions. Another main factor that reduces the efficiency and competitiveness of Greek firms was the high tax burden. OECD (2019) ranks Greece among the countries with the highest tax burden on both individuals and firms. Furthermore, in 2015 the imposition of capital controls and exchange restrictions with the high political uncertainty conditions of the country have negatively influenced the tourism industry.

4. Conclusions

In Greece, in the last years, important structural reforms and legislative initiatives have taken place and have contributed to tourism growth by mitigating the impact of the economic crisis through the sectoral restructuring of the economy. Greek firms have become more competitive (better pricing policy) and have improved the quality of their output by increasing employment and investment in high-quality hotels. As a result, tourism arrivals and receipts have significantly increased. On the other hand, as the empirical results reveal these policies did not improve significantly the efficiency of the Greek tourism firms. In addition, structural imbalances of the sector, high taxation and the country's economic and political uncertainty have risen the inefficiency of the tourism industry.

Taking into consideration these aspects, Greece should continue the structural reforms on tourism and improve the prospects of the sector. Greece could achieve more economic, social and cultural benefits from the tourism industry. The main challenges for Greek tourism are the extension of the tourist season to the standards of directly competing destinations, and at the same time to achieve a qualitative composition of tourists in Greece that will have a higher propensity to high consumption. A new policy

plan is also required for the development and improvement of the tourism product in the unpopular tourist destinations of the Greek regions, that characterised by low levels in tourist arrivals and receipts. Furthermore, other actions should be taken to further strengthen tourism by providing investment incentives, such as the reduction of corporate taxation. Moreover, after the privatisation of the 14 regional airports, additional investments are required in regional infrastructures (roads, ports, airports, archaeological sites, etc). Also, the Greek government should simplify the licensing process for all tourism firms and improve competition at the airlines level, as reducing airline ticket prices will facilitate the increase in tourism demand. These reforms will directly increase revenues, enhance competitiveness, improve the efficiency of the Greek tourism industry and boost the country's long-term potential growth.

In conclusion, Greece to consolidate and ultimately improve its position in international competition in the field of tourism, cannot be based only on the relatively good performance of the overall number of tourists arriving at the country's borders. Greek tourism needs to be reintroduced to the international market, by upgrading, diversifying and enriching its product and at the same time, by applying a long-term marketing strategy. The outlook for the course of tourism in Greece in the coming years will depend to a large extent on the ability of the tourism product and its operators to adapt to the increasing and renewed demands of international demand. Critical factors will be to improve its competitiveness in the international tourism market and to cease opportunities and challenges, to effectively deal with threats and risks in the international environment. The main target of the Greek economy is to recover and return to positive and sustainable growth rates, leaving behind the great adventure of the economic crisis. In this effort, tourism could be the key factor of the Greek economy.

Endnotes

1. The price of capital depends upon the interest rate, the depreciation rate and the deflator of capital and is estimated as the sum of the interest rate and the depreciation rate divided by the deflator of capital. Interest rates are the average annual interest rates for loans (including loans 1-5 years and over 5 years).
2. The depreciation rate for the capital stock was set at 10%. The depreciation rate is under the Greek Government Law 4110/2013 concerning the depreciation of fixed assets.
3. The frontier region's cost efficiency is normalised to 1. The cost efficiency gap between a given region and the frontier is calculated using $\text{gap} = (\text{score} - 1)$. For example, South Aegean is $(1.007 - 1) * 100 = 0.7\%$ less cost-efficient than the frontier.

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