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Data Envelopment Analysis (DEA) for Measuring the Efficiency of the Hotel Industry in Ecuador

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Abstract: The level of contribution of the hotel industry depends on different factors of production that they use in the provision of their services. The way they use these factors of production will allow them to act efficiently, in order to improve profitability and market position. Ecuador, in recent years, has directed public policies betting on the development of this industry. In this sense, this research seeks to measure the efficiency and productivity of the Ecuadorian hotel industry. For this purpose, a significant sample has been selected; it consists of 147 businesses that provided hotel services during the period 2013–2017. These businesses are classified according to their quality and geographic location. This information has been useful to make a balanced panel data with one output (Revenue) and three inputs (Total_personnel, the non-current assets, and Consumption) by using the Data Envelopment Analysis (DEA). The results, which proved to be solid and accurate, indicate that the most efficient businesses are the ones in the third class, whereas those hotels located in zones with tourist attractions and activities have a better optimization of those resources. This situation has an effect on the significant improvement of their productivity.

Keywords: hotel efficiency; productivity change; panel data; DEA; Ecuador

1. Introduction

Ecuador is a tourist destination that, due to its location in the Andean Ridge area, is divided into four clearly defined regions: Coast, Highlands, Orient, and Galapagos Islands. These regions are different in terms of natural attractions, cultural heritage, and historical richness. The tourism potential in Ecuador is fostered by the communication existent among the four regions, whether by air or land.

The central government of Ecuador gives a high strategic value to the tourism sector. Therefore, a series of policies oriented to achieve sustainable development are proposed, not only in main cities but also in the rest of the regions of the country. For this purpose, the Ministry of Tourism works on three fundamental axes: (1) fostering domestic tourism, (2) increasing receptive tourism, and (3) generating and attracting investments.

In order to achieve this development, it is considered necessary that the destinations can be productive and efficient in all their services. From these services, lodging, specifically its quality, has a priority position, not only in the objective quality, but also in the quality perceived by users. The aim is to elicit from users an essential attitude of prescription that visualizes a destination, adds notoriety to it, amplifies its potential as an attraction, and generates a significant added value.

According to the General Coordination of Statistics and Research of the Ecuadorian Ministry of Tourism [1], there are 5177 hotels that offer 96,717 rooms, which generates 224,317 lodging areas. All of this is distributed into hotels, hostels, motels, shelters, refuges, and other types of regulated lodging.

As for the tax collection from tourism activities, in terms of hotels and restaurants, the province that contributes the most is Pichincha (54.1%), followed by Guayas (25.3%) and other provinces with lesser percentages and relevance. This means that Ecuador has an important hotel infrastructure with a significant contribution to the country's revenue.

Companies must be profitable, to stay in the market. An indicator of this profitability is the efficiency of companies, which is based on comparing what a company does with what it should have done in order to maximize its production. The precursor of these studies, Farrell, 1957 [2], established the efficiency measure for companies that use two productive factors to obtain a solo exit, using technology characterized by constant returns to scale. In this definition, three types of efficiency come to light: technical efficiency, price efficiency, and global efficiency. Technical efficiency is defined by Koopmans, 1951 [3], by establishing that it is impossible to obtain more quantity of one product without producing less quantity of the other products, or without using more quantity of at least one other factor.

On the other hand, the quality of the service is a highly relevant factor for the development of the hotel sector; thus, according to this basic idea, this article is focused on determining, with the highest goodness of fit, the analysis of efficiency in the Ecuadorian hotel sector.

Concern for the hotel and tourism industry has been frequent worldwide, for its contribution to the complications of countries (Kundu & Contractor [4]). There are various approaches to studies carried out in the hotel industry, an environmental approach and performance management by Molina-Azorín, Claver-Cortés, Pereira-Moliner, and Tarí [5], income management (IM) by Rodríguez-Algeciras and Talón-Ballesterero [6], and the importance of consumer perceptions regarding the strength and height of a hotel industry brand (Forgacs [7]).

Efficiency studies in this sector in Latin America are not abundant, and in Ecuador, an efficiency analysis has not been carried out to date, which allows tourism companies and rectors to have knowledge about this aspect. Research has been conducted on management models, strategic plans, quality management, and customer service.

In an emerging economy, such as Ecuador, the efficiency of the business fabric is transcendental. The hotel industry is one of five main economic activities that concentrate more than 72.35% of the companies that contribute to its development (INEC) [8]; thus, knowing with certainty if resources are managed efficiently is a concern for managers. The implementation of appropriate strategies will allow companies in the hotel sector to be more efficient and productive; therefore, contribute to a better level of competitiveness to be more sustainable in a globalized economy.

For this analysis, we considered the main cities in Ecuador due to their high representativeness, and the potential extrapolation of the results to other urban contexts. The measure of efficiency in the hotel industry allows for the comparison of what hotels are better using their production factors, making them more efficient.

It is necessary to highlight that tourism activities have currently generated important developments, resulting in positive and negative impacts. Among the first is business, economic, and social growth. The negative aspects include environmental wear and do not have corrective actions or comprehensive support plans. In this sense, efficiency studies are fundamental factors for the development of sustainability, in the case of the hotel service.

The present study aims to measure the efficiency and productivity of the Ecuadorian hotel industry during the period 2013–2017. In order to accomplish this, we divided our work into five sections. In the first one, a literature review about the hotel industry has been completed; in the second section, the situation of the hotel industry in Ecuador is discussed; in the third, we describe the data and method used; the fourth section shows the results obtained. Finally, the conclusions drawn after the data analysis are presented.

2. Literature Review

This section aims to establish our research theme and reveals the existence of some studies that apply DEA to determine the efficiency of the hotel and tourism industries. These studies mainly differ in the type of inputs and outputs employed, the samples considered, and/or the methods used.

The data envelope analysis, (DEA) initiated by Charnes et al. [9], is an approach based on mathematical programming to measure, in a relative way, the efficiency of a group of decision-making units (DMU) with common inputs and outputs. The constant returns to scale (CCR) model, Charnes et al. [9], and the variable returns to scale (BCC) model, Banker, Charnes, and Cooper [10], allow each DMU under evaluation to choose weights for inputs and outputs by themselves, so that they obtain their maximum optimum performance score of efficiency.

Lado-Sestayo and Fernández-Castro [11] applied a four-stage DEA that broke down the superefficiency into two parts: one part attributable to the tourist destination and the other part attributable to hotel management. To assess efficiency, they considered variables from 400 hotels and 97 tourist destinations in the year 2011. The inputs employed were labor costs, depreciation, and operating costs. The output was sales revenue. The main results indicated that the tourist destination was the main cause of the differences in the level of efficiency among hotels. Additionally, the occupancy rate, the degree of seasonality, and the market concentration were the variables with the most impact on efficiency.

Sellers-Rubio and Casado-Díaz [12] implemented a two-stage double-bootstrap DEA. This study was conducted in 17 autonomous communities in Spain during the period 2008–2016. The inputs were the number of hotels in the region, number of beds available in the region, and number of employees. The outputs were Average Daily Rate (ADR), Revenue per Available Room (REvPAR), and average occupancy rate. The environmental variables were duration of stay, number of international tourists that arrived in Spain, number of quality hotels, and the model of sun and sand tourism (dummy). The main results exhibit a high degree of hotel inefficiency in the Spanish regions and a significant effect of the environmental variables considered. Regarding the efficiency of the hotels located in the different regions, La Rioja and the Canary Islands showed the highest efficiency levels for the period under study in both models, while Galicia, Castilla-León, and Castilla-La-Mancha had the lowest levels obtained by the hotels.

Chatzimichael & Liasidou [13] carried out a study in 25 European countries during the period 2008–2015. The methods applied were DEA for efficiency and productivity frontier, as well as a flexible translog production function that allowed us to differentiate between the Hicks-neutral technical change and the partial factor. The inputs consisted of the number of beds and number of employees, and the only output was the number of overnights. One of the main results was that the concavity of the production technology, with respect to the capital inputs, and labor, was satisfied in the point of approximation that implied positive and diminishing marginal products.

Karakitsiou et al. [14] measured the efficiency of the hotel industry and restaurants in the thirteen regions of Greece during the period 2002–2013. They applied DEA with the CCR and BBC models. The input variables considered were the number of local units, number of employees, and investments. The output was invoicing. The main results indicated that the most efficient regions were Attica, the North Aegean, and the South Aegean, while the regions of Eastern Macedonia and Thrace, Thessaly, and Central Greece had a lower efficiency. Overall, the performance of many Greek regions could be considerably improved. The local organizations of destination management must do a great effort to increase the tourist performance of Greek destinations by balancing inputs and outputs.

The evaluation of the hotel industry in the island of Sardinia, Italy, during the period 2004–2013 was carried out by Pulina and Santoni [15]. They applied a standard DEA along with the Simar–Wilson approach. In addition, they conducted a post-DEA study to identify factors that have an influence on the economic efficiency of hotels. The inputs were tangible and intangible assets, as well as labor costs. The output was sales revenue. For the post-DEA, the financial variables were short-term debt index, cost of loans, and long-term debt index. The geographic variables were the administrative

province of Cagliari and Olbia-Tempio. The results obtained in this study demonstrate that the inefficiency of businesses, as well as cost of money, have a negative effect on the performance of hotels. Moreover, the businesses located in highly specialized areas with strong seasonality are relatively inefficient. On the other hand, the short-term debt index and long-term debt index have a positive impact on efficiency.

Chaabouni [16] also analyzed the efficiency of tourism and its determinants—in this case, in the 31 provinces of China during the period 2008–2013. For this study, a two-stage double-bootstrap approach was used. The scores of efficiencies of bias-corrected DEA were first calculated by employing the smoothed homogeneous bootstrapped procedure [17]. Afterwards, the Tobit regression was utilized with a set of explicative variables. The inputs were employment, GDP of the tourism sector, social capital, and number of arrivals. The variables that were used in the Tobit regression were regional trade openness, education level, and number of hotels. Urbanization and temperature were also included in the regression model to obtain their influence on the efficiency of tourism. The results show that the efficiency of tourism in China was low during the period under study. At a regional level, the average tourist efficiency in Eastern China was higher than in the center and West. The results also indicate that trade openness, climate change, and intensity of the competition in the market increase the efficiency of tourism.

Xia et al. [18] applied DEA, and Chaabouni [16] implemented the Malmquist index (MI) methodology to calculate the efficiency of Chinese tourism enterprises between the years 2005 and 2014. The inputs considered were fixed assets, number of employees, number of businesses in scenic places, travel agencies, and hotels. The outputs were operating income of scenic places, travel agencies, and hotels. The results obtained point out that the efficiency and index of total factor productivity change (TFPC) of tourist enterprises remained low and both have decreased. On the other hand, the efficiency of regional tourist enterprises in all of China is high in the eastern region, low in the central region, and high in the northwestern and western regions, which is like what [16] obtained.

A study was conducted in Taiwan by Ang, Chen and Yang [19]. They measured the efficiency of hotel chains in Taiwan and their subsidiary hotels. The study data referred to seven hotel chains and their 21 subsidiaries during the period 2011–2015. A methodology of group efficiency was applied along with group cross-efficiency models. For group efficiency, they developed two definitions. First, the average performance that viewed group efficiency as the average performance of their members. Second, the weakest performance that used the worst efficiency of the members to indicate group efficiency. Regarding group cross-efficiency, they developed two models based on the average performance and the weakest performance as the group efficiency. The results obtained in this study reveal that the Royal Hotel and the Regent Hotel obtained better results from 2011 to 2015 in comparison with other hotel chains.

Another important study is that of Mendieta-Peñalver et al. [20] who assessed the relationship between the competitiveness of the tourist destination and the competitiveness of international hotel companies, with a comprehensive approach based on Porter, was a mediation model to link the competitiveness of the destination, efficiency, and competitiveness of the company. For global technical efficiency, pure technical efficiency and scale efficiency were estimated using data wrap analysis techniques. The results confirm a positive relationship between destination competitiveness and company competitiveness, but efficiency did not play a mediating role that united both.

In Latin America, particularly in Chile, the study by Figueroa et al. [21] was aimed at evaluating the efficiency of the regions in Chile and their capacity to attract tourist flows between 2009 and 2014. In this study, the regions were taken as territorial units that could determine their own degree of tourist attraction, so the tourist flow was adopted as the variable to be optimized. Therefore, a virtual production function was applied to consider the tourist flow as production and lodging capacity, and other tourist and cultural activities as the main supplies. The DEA applied had two stages. In the first one, a non-parametric DEA was used to determine efficiency indexes in the performance of the tourism industry. In the second stage, a bootstrapped truncated regression model was utilized to

identify the explicative factors that affect those efficiency levels. They have taken into consideration the external variables, mainly related to natural and cultural resources typical of the regions, as well as other installations related to their conditions of accessibility.

Carrillo & Gómez [22] assessed the efficiency of 15 hotels in the city of Bucaramanga, Colombia, in the year 2013. The method used was DEA. The results obtained were a classification of hotels in groups with similar efficiency levels. Besides being an input for improvement in each hotel, the results are a solid base to undertake joint administrative actions in a way that the associativity and strengthening of the hotel industry are favored. It could be observed that there is no homogeneity in the information displayed in the financial statements by the organizations of the sector. Furthermore, the information is not enough and does not include all of the hotels.

Another study on the hotel sector that the DEA applies to is that by Sanjeev [23], to evaluate the efficiency of hotel and restaurant companies operating in India. The results show 16 out of 68 hotel and restaurant companies are fully technically efficient, having obtained a score of 1 (or 100 percent). This implies that these companies are optimally utilizing the inputs—capital employed, gross fixed assets, current assets, and the operating costs to produce the outputs—operating income and profit before depreciation, interest, and tax.

Other methodologies applied, unlike the DEA, is the stochastic frontier—a parametric method applied by Oliveira et al. [24] to evaluate the efficiency of hotel companies in the Algarve (Portugal), a tourist destination of excellence in southwest Europe. Relevant levels of inefficiency were found. The results also indicate the important role of the operating environment, the location of the hotel, and the existence of golf facilities. Star rating and multi-hotel ownership do not seem to be as relevant.

Guetat et al. [25] evaluated the efficiency of 63 hotels during 2011–2012 in order to measure the impact of corporate governance on the performance of Tunisian hotels. The results reveal that corporate governance has a positive and significant impact with hotel performance, and that hotels in Tunisia are, on average, operating at 65.02% efficiency.

Finally, it is important to remark that we have not found previous studies in Ecuador about the efficiency of the hotel sector. The research conducted so far in the Ecuadorian context has been focused on case studies aligned with management models, strategic plans, quality management, and customer service. Therefore, the convenience and relevance of the present study is highlighted, since it contributes to our research field, and could be the basis for future research.

3. Situation of the Hotel Sector

Currently, the tourism industry in Ecuador shows a high dynamism due to stimulus policies directed to local economies through specific actions for employment generation (income and investment, among others). These factors have a clear effect on the economic growth of a tourist destination. According to the General Coordination of Statistics and Research of the Ecuadorian Ministry of Tourism (CGEIMINTUR) [1] and based on the World Tourism Barometer of the World Tourism Organization (UNWTO), from a global perspective, it was determined that, in the year 2016, there were 1.237 billion international arrivals in different parts of the world. From these arrivals, 49.9% were in Europe, 24.8% in Asia, 3.9% in the Pacific region, and 16.1% in America. Moreover, the report indicates that there is an increase of 3.9% in comparison to the year 2015, which is a positive review for this important sector.

Consequently, according to the World Tourism Organization [26], there has been a continuous fostering of traveling in 2017. An evidence of two digits was detected, in terms of arrivals in Chile, Colombia, Ecuador, Paraguay, and Uruguay. In the case of Ecuador, according to the Ministry of Tourism [27], the tourism industry has gained more prominence since it became a strategic sector in the development of the country. This industry registered, due the tourist activity and the balance of payment, an important amount of \$1,449.3 million, which places tourist activity as the third source of revenue of non-oil exports, after banana and shrimp activity.

In this emergent industry, the hotel industry of Ecuador acquires great relevance because, in order to consolidate the country as an attractive tourist destination, it is necessary to continue improving the

lodging offer. The purpose of this improvement is to attract more visitors and ensure optimal customer loyalty. It is important to emphasize that, in Ecuador, the main cities have 4 and 5-star lodging services, especially in Quito, Guayaquil, and Cuenca.

According to the tourism indicators of CGEIMINTUR [28], in Ecuador, tourism activity plays a fundamental role in the engine of the economy, becoming one of the main sources of economic income for the country. In addition to conceiving a series of benefits, reflected in the generation of work, it is so, the employment in the industry, according to the Ministry of tourism, in the third quarter of 2019, represented around 522,508 employees. In relation to the same period of 2018, an increase of 1.8% was generated, which represented 6.6% of national employment. The contribution to the tourism sector of The World Travel & Tourism Council (WTTC) data of 2018 indicated that GDP corresponded to 2.8% directly, and 6% of the total, while in relation to employment it was considered that 2.6% generated directly and 5.5% of the total. Finally, an investment in capital of \$1.2 billion, also foreign investment in this tourist activity, represented 5.01% of the total Foreign direct investment (FDI) in this period

Continuing, with the indicators of the Ministry of Tourism, international arrivals, according to nationality from January to December 2018, have reached 2.4 million people, with an increase of 50.9% compared to 2017, generating \$1,878.6 million for the tourism industry and an average expenditure per person of \$1287. The main issuing markets are the United States, Colombia, Peru, and Spain. Another important fact is that 44.4% are arrivals by air [28].

The aforementioned data are complemented by González [29], who points out to a specific destination, and shows that Quito, Ecuador, has negative records in the three indicators. The occupancy rate decreased by 1.3% to 58.3%; the average daily rate in dollars dropped by 5.1% (US\$ 94.54) and the RevPAR by 6.3% (US\$ 55.11).

Regarding the hotel industry, for 2018, it relied on a wide network of buildings, including a remarkable presence of international franchises, located mostly in cities such as Quito (Pichincha province), Guayaquil (Guayas province), Cuenca (Azuay province), as well as the Galapagos Islands. To a lesser extent, these hotels are also located in other cities of the country (see Table 1). On the other hand, this industry absorbs a significant amount of labor, observing that the largest of these are men, and their distribution behaves, approximately, related to the number of hotels in the province.

This offer of high-quality lodging has had a very positive effect on the growth that, over the last few years, tourism has experienced in Ecuador. In 2018, tourism drew \$2.398 billion into the Ecuadorian economy, which makes it the third revenue source not related to oil, after exports of banana and shrimp [27]. Likewise, tourism is one of the most important quality employment sources, both direct and indirect, with a positive impact on the design of models aimed at the economic and social development.

As for employment, this sector has generated in the first quarter of 2018, a total of 491,698 employment opportunities, including lodging and food services, which, in macroeconomic figures, represents 6.3% of the total of employees in the general economy of the country. It is worth mentioning that this activity includes the sectors of lodging and food services, and it is among the five industries with the most contribution to national employment.

We need to mention that there is information in Ecuador about hotel indicators only from 4- and 5-star hotels. The Hoteles de Quito Metropolitano (HQM) group is the one that generates 4- and 5-star hotel activity in this city. Their last report was released in December 2018 and, evidently, this is a major limitation regarding information about regulated lodging. For instance, an indicator of the hotel industry that is considered a common term in this sector is the RevPAR, which allows us to know the revenue per variable room—and it is not applied in all the hotel industry.

Table 1. Distribution of lodging buildings by class and people, lodged by gender and province, for the year 2018.

PROVINCE	CLASS					TOTAL	PERSONNEL EMPLOYED			
	*****	****	***	**	*		LODGING	Male	Female	Total
	LUXURY	FIRST	SECOND	THIRD	FOURTH					
	Number of Buildings									
Azuay			100	103	37	6	311	759	1079	1838
Bolívar		3	8	23	3	2	39	91	81	172
Cañar			22	33	3		58	102	125	227
Carchi		4	5	14	4		27	92	78	170
Cotopaxi		11	30	59	15		115	206	304	510
Chimborazo	1	6	23	39	35	9	113	288	283	571
El Oro	2	23	43	61	4		133	608	504	1112
Esmeraldas	1	31	167	154	3	2	358	905	964	1869
Guayas	11	48	138	212	12	3	424	3457	2439	5896
Imbabura	2	34	53	61	10	3	163	588	664	1252
Loja	2	16	59	78	11	2	3	62	510	945
Los Ríos	1	7	28	50	10		96	226	215	441
Manabí	3	47	149	388	27	7	621	1833	1508	3341
Morona Santiago		3	17	51	5	2	78	138	168	306
Napo	2	12	53	72	18	13	170	415	385	800
Pastaza		2	15	20	18	1	56	93	131	224
Pichincha	17	144	286	369	52	6	874	4359	3139	7498
Tungurahua	1	35	48	219	39	3	345	736	863	1599
Zamora Chinchipe		1	12	25	7		45	69	91	160
Galápagos	2	28	203	2		48	283	517	770	1287
Sucumbíos	2	3	26	86	11	3	131	421	430	851
Orellana	1	4	16	69	15	5	110	405	357	762
Santo Domingo de los Tsáchilas		8	11	29	64	1	113	273	342	615
Santa Elena	2	28	92	181	36	7	346	1037	823	1860
TOTAL	53	560	1604	2398	439	123	5177	18,053	16,253	34,306

Source: General Coordination of Statistics and Research of the [1]. Tourism Statistics Report 2012–2016.

In Ecuador, this theme is scarce. In this respect, Dencker, 2002, as cited by Herrera Rivas and Espinoza [30], states: “The scientific study of tourism is new, multidisciplinary and interdisciplinary in essence. It is immersed in an environment influenced by paradigms and studied by some disciplines, with theoretical references of almost all of the social sciences (. . .) for studying tourists’ motivation, preferences and attitude, their social and economic status, their cultural level and creating the need for traveling and knowing” (p. 37).

This situation is evidenced in Ecuador since the studies conducted in the sector are focused on the main cities and tourist destinations of the country. To a certain extent, this research does not allow us to observe an integral approach of the sector that indicates multi and interdisciplinary research, as Decker points out.

To finish this analysis of the hotel industry, it is important to consider that this sector has currently implemented several strategies regarding innovation and technology for the trading, sale, and loyalty process. In addition, there are important online platforms that help businesses generate an important demand for them. Scott (as cited by [31], in the study “Consumer Research Uncover Travelers’ Online Search and Booking Behaviors” (conducted in the United States for the company TrustYou), mentions that 91% of travelers use Google as the main search engine to find a hotel. In addition, 77% of travelers look for “accommodation” and “location” as keywords on the search engine, and 57% of the searches are done with the word “hotel”. Likewise, Brandwatch (as cited by [31]), published interesting data about the use of social networks as their sales channels, indicating that in the year 2016, social networks had 2.4 billion active users. Additionally, 91% of the retail companies use social networks as their sales channels. On average, users had 5.54 social networks accounts. These events happen due to the technological era we live in. Moreover, in current production processes, we must incorporate innovation and technology as differentiating factors of the industry. This increases productivity of resources with the purpose of generating quality supply in the tourist destination [31,32].

Although Ecuador has won several awards, in context of the World Travel Awards, there is no prior empirical evidence for the hotel industry, where cities with characteristics of tourism vocation, and greater development, have clear predominance in the promotion of luxury hotels and first class. However, this condition (in some cities) does not represent this development. On the other hand, in various cities, there is also growth of companies of reduced sizes and categories, without proper planning. These considerations are valid when studying the Ecuadorian hotel industry. It is timely and important because Ecuador, in a few years, must bet on proper growth of the tourism sector. In a broad sense, we only find the recent works of Serrano and Pucha [33], Meléndez [34], and Veloz y Vasco [35], although they only focus on the hotel industry in specific places.

The National Tourism Plan 2030, proposed by the Ministry of Tourism, sets out the main strategies for development and investment in the tourism sector, in which, with the correct intervention of the public and private sectors and society in general, they could expect a growth in the medium and long term. Currently, tourism has become the third source of non-oil revenues, after bananas and shrimp—importance that is recognized by the extraordinary biodiversity that creates a natural and cultural heritage for current and future generations (proposed in two words as unique places). To this is added that, at present, for the development of tourist products in different destinations, the new tourist, or hiker, who is willing to pay more for the incorporation of true intangible value to their travel experience, should be considered.

4. Materials and Methods

The financial data utilized for determining the efficiency of the hotel companies in Ecuador were obtained from the Superintendence of Companies, Securities and Insurance (SUPERCIAS), while data related to categorization and personnel were supplied by the Ecuadorian Ministry of Tourism.

As for the categorization, the fostering of tourism in Ecuador has caused an increase in hotels with the purpose of meeting the needs of demanding users. In this respect, these hotels have been classified into luxury, first, second, third, and fourth class.

By the year 2017, 4144 hotels were registered in the Ministry of Tourism in the form of companies. Most of these hotels are in the highlands and are categorized as third class. In addition, most of these companies do not provide information to the SUPERCIA. The code CIUU “I5510.01” reports 303 companies by the year 2012, 368 companies by 2016, and 320 by 2017.

Only the hotels that had provided financial information to the SUPERCÍA for all the years of studies were selected. We obtained data from all types of hotels and from the provinces in which tourism plays an important role in the economy. With the information obtained, we made a balanced panel data based on 735 observations from 147 hotels for the period 2013–2017. The distribution by geographic zone of the hotels can be seen in Table 2; most of them are in the highlands. The category that prevails is first class; this can be caused by the fact that the financial data were obtained from SUPERCIA, and, therefore, this information must have been supplied by the companies registered.

Table 2. Distribution of hotels in Ecuador by region and class.

Region	Class				Total
	Luxury	First	Second	Third	
Coast	8	27	14	10	59
Highlands	6	45	13	5	69
Orient	0	2	4	2	8
Islands	0	8	3	0	11
Total	14	82	34	17	147

It is important to consider the distribution of the sample by province since, despite the aforementioned regional distribution, it would be interesting to observe the results in the provinces. Ecuador has 24 provinces, and, as seen in Table 3, 12 provinces are part of the sample, including Guayas and Pichincha, which are the most important in Ecuador’s economy. In this sample, we can observe that many hotels are in the provinces with the most economic development in Ecuador. Nevertheless, the province of Pichincha exhibits a major difference as to first-class hotels. It is worth mentioning that luxury hotels are present in provinces with the highest economic growth, while first-class hotels constitute more than 50% of the sample. This situation is closer to the actual situation of the country.

Table 3. Distribution of hotels in Ecuador by province and class.

Province	Luxury	First	Second	Third	Total
Azuay	2	4	1	0	7
Chimborazo	0	3	0	0	3
El Oro	1	3	0	1	5
Esmeraldas	0	2	0	1	3
Galápagos	0	8	3	0	11
Guayas	5	16	10	6	37
Imbabura	0	5	1	0	6
Manabí	1	3	3	1	8
Pichincha	4	27	11	5	47
Santa Elena	1	3	1	1	6
Sucumbíos	0	2	4	2	8
Tungurahua	0	6	0	0	6
Total	14	82	34	17	147

In the determination of efficiency, there has not been an agreement related to the variables to be used in order to measure inputs and outputs. Some authors have suggested the use of variables that can be physically measured, Bucklin [36], while others recommend the use of variables quantified in monetary units, with the purpose of determining economic efficiency and profitability, Duhan [37].

Because the hotel industry is based on service companies, the demand has to be met by using a series of inputs. For this purpose, this sector relies on appropriate infrastructure and specialized personnel. The infrastructure will be more important in high-quality hotels, while specialized labor will play a major role in low-quality hotels.

As output, the variable selected in the present study has been revenue, in order to measure the efficiency of the Ecuadorian hotel sector, which represents all the resources obtained by the hotel companies as a result of providing their services expressed in American dollars. A similar variable has been employed by Barros et al. and Yu [38–40].

The inputs used are total personnel (Total_personnel), the non-current assets (Act_no_corri) and Consumption. The total personnel (Total_personnel) represents the total number of people who work in the hotel, including administrative and service personnel (Higuerey, Trujillo and González [41] and De Jorge and Suárez [39]). The non-current assets (Act_no_corri) refers to the money invested in properties, buildings, and equipment, as well as other non-current assets necessary for the hotel to provide services expressed in American dollars. The Consumption represents the necessary expenses incurred by the hotel, excluding personnel costs, in order to provide services. These expenses were determined by adding operating costs and subtracting the total of personnel costs. As for revenue, it consists of adding revenue from activities and other types of revenue.

The descriptive statistics of the sample under study is presented in Table 4. It is noteworthy that there is a major difference as to the revenue to be raised (revenue) since the sample includes luxury and first-class hotels, which generates large amounts of revenue. On the other hand, third-class hotels are within the category of small businesses, so their revenue is much lower. This situation is also observed in the amount of personnel. Whereas small hotels are owned by the same people or families who work there, big hotels require the presence of more personnel, and in many cases, specialized personnel.

Table 4. Descriptive statistics of the sample.

Variable	Observations	Mean	Standard Deviation	Min	Max
Revenue	735	1,442,053.13	2,985,100.26	4853.88	22,215,242.00
Total_personnel	735	41.26	95.43	2.00	947.00
Act_no_corri	735	2,291,406.17	6,044,310.53	136.44	41,533,676.00
Consumption	735	453,888.14	904,318.79	0.00	6,798,999.00

Act_no_corri represents the variable of capital in the present study. We can also see a major difference. Likewise, we have Consumption, which is the variable that absorbs the rest of the necessary expenses that the hotels incur to provide services.

Table 5 shows the correlation that exists between the variables, observing that there is a high correlation between the variables used in this study—the highest being that of Revenue with Act_no_corri, since the income of this type of company depends directly on the non-current assets they own.

Table 5. Correlation matrix of the sample.

Variable	Revenue	Total_personnel	Act_no_corri	Consumption
Revenue	1			
Total_personnel	0.8812	1		
Act_no_corri	0.9262	0.8508	1	
Consumption	0.9893	0.882	0.9148	1

It is necessary to point out that the method applied for determining efficiency is the Data Envelopment Analysis (DEA). This technique, whose precursor was Boles [42], uses linear programming algorithms for frontier estimation. In its implementation, we must consider that a business is efficient

if there is not another one, or a combination that provides more than some product, given the inputs; or uses less of some input, given the outputs. The advantage is that this technique does not impose an a priori functional form on the data, which can accommodate multiple inputs and outputs, and generate information about “reference businesses” for each of the inefficient businesses. In other words, the businesses have the following aspects that are similar to an efficient business: output mix, input mix, and scale operations. As mentioned in the literature review, several studies on the efficiency of the hotel industry have used this method with some variations ([11–16,18]).

Recently, the DEA model has been used in other sectors, with some modifications, but maintaining the principles of the methodology. In the energy sector, Chai, Fan, and Han [43] use the DEA with some novelties to determine the efficiency in this sector, justifying its use in that you have great advantages in avoiding subjective factors, simplifying algorithms, and reducing errors; it gradually developed into one of the most commonly used tools for evaluation efficiency in many fields. This same DEA model has also been used in the environmental sector, by Łozowicka [44] to measure the efficiency of European community countries. In the water industry, Sun, Yang, Zhang, and Chen [45] evaluated the efficiency of the use of this product in the municipalities of China, using the traditional DEA model, but modifying the indices used. In the hotel sector, Lee, Kuo, Jiang, and Li [46] evaluate the efficiency of this sector in Taiwan. To do this, they used the DEA and added a mega frontier, modifying the directional distance function in the meta-frontier model in order to consider expanding outputs, contracting inputs, and fixed quasi-fixed inputs in the short-run.

Traditionally, there are two DEA models, constant returns to scale (CCR) and variable returns to scale (BCC). In this work, the CRS model is used with an input orientation. Being the first work carried out on the efficiency of the tourism sector in Ecuador, it has been considered convenient to use this model, so that it is easy to understand and useful for tourism regulators and planning agencies in Ecuador. The formulation is as follows:

$$\text{Min } ef, \lambda \text{ efi} \quad (1)$$

Subject to:

$$-yi + Y\lambda \geq 0 \quad (2)$$

$$ef \, xi - X\lambda \geq 0 \quad (3)$$

$$\lambda \geq 0 \quad (4)$$

where: ef is efficiency, λ is a constant vector, X is a matrix with all the inputs of all the companies, Y is a matrix of all the outputs of the companies, xi is a vector of the inputs of the company, i , yi is a vector of the outputs of the company, i and i represents the company i -th.

On the other hand, the total factor productivity (TPF) is defined as the result of dividing an output index by an input index, in which M products and K inputs can be used, thus adapting to multiproductive companies (Coelli et al. 2003) [47]. Both indices are generally defined as a weighted sum of all outputs or inputs, respectively. The formulation is as follows:

$$TPF = \frac{\sum_{m=1}^M a_m Y_m}{\sum_{k=1}^K b_k X_k} \quad (5)$$

where a and b are weights that depend on the importance of each input or output in the industry. On the other hand, the measures of change in TPF (CTPF) can be divided into three components: change in technical efficiency (CET), technological change (CT), and change in efficiency of scale (CEE) [47]; all of them being multiplicative, expressing themselves as follows:

$$CTPF = CET * CT * CEE \quad (6)$$

5. Results

In this section, we will present the results related to efficiency and productivity. For the former, we will show the change that each one of the provinces has had in the years under study. Afterwards, we will present the results of productivity by province and by class in order to observe which hotels are the most productive.

5.1. Results Related to Efficiency

Table 6 displays the results of efficiency in the provinces and years under study in Ecuador by using the approach by Banker, Charnes, and Cooper [10]. Likewise, the average efficiency by year and province is presented.

Table 6. Average efficiency by province and years.

Province	Years					Total
	2013	2014	2015	2016	2017	
Azuay	0.808	0.688	0.663	0.67	0.661	0.698
Chimborazo	0.81	0.668	0.681	0.754	0.763	0.735
El Oro	0.628	0.497	0.555	0.543	0.519	0.548
Esmeraldas	0.602	0.594	0.484	0.422	0.526	0.525
Galápagos	0.716	0.767	0.712	0.752	0.754	0.740
Guayas	0.713	0.624	0.591	0.58	0.562	0.614
Imbabura	0.663	0.572	0.608	0.576	0.596	0.603
Manabí	0.646	0.495	0.508	0.462	0.471	0.516
Pichincha	0.725	0.717	0.711	0.72	0.682	0.711
Santa Elena	0.629	0.596	0.547	0.561	0.491	0.565
Sucumbíos	0.755	0.791	0.781	0.726	0.73	0.756
Tungurahua	0.671	0.608	0.613	0.661	0.604	0.631
Average	0.71	0.662	0.646	0.645	0.626	0.658

It is important to remark that the average efficiency in the years under study has declined from the year 2013 to 2017. This decrease was stronger in 2014, dropping approximately 4 percentage points.

On the other hand, it can be seen that by the year 2013, the three most efficient provinces were Chimborazo, Azuay, and Sucumbíos, which hold first, second, and third place, respectively. It is interesting to observe in Figure 1 that the tendency of the lines indicates that the businesses in the first positions of efficiency change positions over the years. Some businesses are in positions below average, while others move down and up again in position over the years.

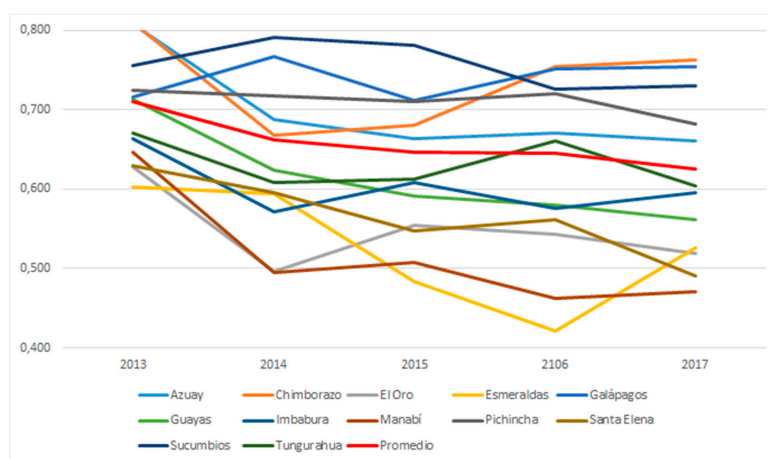


Figure 1. Tendency of the average efficiency by province and years.

In the case of the hotel businesses in Chimborazo, this province occupied the first position in the first year under study, disappeared from the three first positions in the years 2014 and 2015, and reappeared to occupy the first position in the last years of the study.

As for the province of Sucumbíos, it was in the third position in the initial year, moved up to the first position in the years 2014 and 2015, and returned to the third position in the last years of the study.

The Galapagos Islands, which are one the most important tourist attractions in Ecuador, occupied the fifth position in the year 2013, and then kept the second position in the rest of the years of the study, while the lowest positions were occupied by the provinces of Esmeraldas, El Oro, and Santa Elena. It can be noticed that, in the years under study, in average (see Figure 1), the hotels of the provinces of Galapagos and Sucumbíos are the most efficient ones. They have a large visitor flow, especially Galapagos, although the oil-based economy of Sucumbíos needs a better hotel infrastructure.

Regarding the efficiency by hotel category (luxury, first, second, and third), it can be seen in Table 7, that in many of the provinces the first and third categories are present. In this sense, luxury hotels do not stand out as those of greater efficiency, in the years in studies. It is noted that the third category hotels, on average, are the most efficient in most of the provinces of the sample studied.

Table 7. Average efficiency by province, class, and years.

Province	Class	2013	2014	2015	2016	2017	Average
Azuay	Luxury	0.748	0.631	0.547	0.536	0.515	0.5954
	First	0.885	0.821	0.820	0.835	0.797	0.8316
	Second	0.619	0.274	0.271	0.282	0.414	0.372
Chimborazo	First	0.810	0.668	0.681	0.754	0.763	0.7352
El Oro	Luxury	0.663	0.558	0.542	0.561	0.554	0.5756
	First	0.635	0.457	0.572	0.517	0.486	0.5334
	Third	0.573	0.554	0.517	0.603	0.583	0.566
Esmeraldas	First	0.680	0.624	0.497	0.553	0.545	0.5798
	Third	0.447	0.534	0.459	0.161	0.488	0.4178
Galápagos	First	0.718	0.790	0.738	0.738	0.769	0.7506
	Second	0.710	0.705	0.643	0.789	0.714	0.7122
Guayas	Luxury	0.662	0.618	0.601	0.608	0.625	0.6228
	First	0.694	0.611	0.555	0.559	0.560	0.5958
	Second	0.747	0.597	0.615	0.594	0.516	0.6138
	Third	0.747	0.711	0.636	0.592	0.595	0.6562
Imbabura	First	0.632	0.549	0.579	0.559	0.564	0.5766
	Second	0.815	0.688	0.753	0.658	0.757	0.7342
Manabí	Luxury	0.699	0.637	0.658	0.609	0.588	0.6382
	First	0.536	0.285	0.373	0.370	0.422	0.3972
	Second	0.620	0.489	0.427	0.326	0.304	0.4332
	Third	1	1	1	1	1	1
Pichincha	Luxury	0.798	0.781	0.772	0.761	0.693	0.761
	First	0.679	0.692	0.674	0.684	0.659	0.6776
	Second	0.758	0.733	0.748	0.756	0.698	0.7386
	Third	0.838	0.768	0.776	0.808	0.763	0.7906
Santa Elena	Luxury	0.562	0.572	0.532	0.500	0.530	0.5392
	First	0.679	0.523	0.521	0.629	0.560	0.5824
	Second	0.633	0.565	0.448	0.480	0.558	0.5368
	Third	0.540	0.869	0.741	0.497	0.179	0.5652
Sucumbíos	First	0.634	0.631	0.748	0.725	0.719	0.6914
	Second	0.811	0.828	0.781	0.714	0.718	0.7704
	Third	0.764	0.880	0.815	0.750	0.765	0.7948
Tungurahua	First	0.671	0.608	0.613	0.661	0.604	0.6314

In the province of Manabí, which was struck by an earthquake in 2016, we can see that from that year, the average efficiency of all the categories of hotels has dropped. This decrease affects the general average efficiency of hotels in Ecuador.

5.2. Results Related to Productivity

It is also important to highlight the change in total factor productivity (TPF); which consists of technical efficiency changes (CET), technological change (CT), change in pure technical efficiency (CETP), and change of efficiency in scale (CEE). It can be observed that the most important change in TPF was present in the province of Galapagos, which relies on a better tourist infrastructure, and it is considered as one of the first options to visit. Table 8 shows that this province has experienced the most important change in technical efficiency and CETP. The province of Galapagos is followed by the provinces of Chimborazo (whose main tourist attraction is the Cotopaxi) and Santa Elena, which have 3 and 6 hotel businesses respectively.

Table 8. Change in the Total Factor Productivity (TPF).

Province	CET	CT	CETP	CEE	TPF	# of Businesses	Ranking
Azuay	0.946	1.037	0.955	0.991	0.981	7	10
Chimborazo	0.981	1.048	0.988	0.992	1.027	3	2
El Oro	0.955	1.069	0.948	1.007	1.020	5	4
Esmeraldas	0.971	1.019	0.976	0.994	0.990	3	9
Galápagos	1.010	1.025	1.009	1.002	1.035	11	1
Guayas	0.934	1.049	0.964	0.969	0.980	37	11
Imbabura	0.948	1.071	0.988	0.955	1.004	6	7
Manabí	0.918	1.049	0.945	0.966	0.963	8	12
Pichincha	0.987	1.022	0.990	0.997	1.009	47	6
Santa Elena	0.926	1.117	0.984	0.941	1.021	6	3
Sucumbíos	0.993	1.018	0.989	1.005	1.012	8	5
Tungurahua	0.975	1.019	0.988	0.988	0.993	6	8
Average	0.962	1.045	0.977	0.984	1.003	147	

On the other hand, the provinces of Manabí and Guayas occupy the last positions in this study regarding the change in total factor productivity. These positions are influenced by a low CTE since they have one of the most relevant technological changes. In other words, even though these businesses have experienced the most important technological changes, this technology has not been fully exploited, which affects their technical efficiency.

With respect to the province of Pichincha, it is in the sixth position, and it is represented by 47 businesses. In this province, we can find major tourist attractions, its emblem the historic center. Moreover, the main buildings of the central government are located in there, which contributes to a high visitor flow.

It is necessary to mention that, the hotels that operate in the regions and zones of Ecuador with the tourist attractions in higher demand are the ones that use their inputs [11,31] in a better way; thus, contributing to improve the efficiency indexes.

In summary, it can be seen that the companies of the hotel industry in Ecuador have a low efficiency on average, with a high level of hotels, which, due to their influx of customers and the areas in which they are located, make the high influx of customers, shown through income, allowing them to improve their use of resources. On the other hand, the best change in factor productivity is owned by hotels that are in the tourist areas of Ecuador, such as the provinces of Galapagos and Chimborazo.

6. Discussion and Conclusions

The average provincial efficiency is interesting since it demonstrates the behavior of the hotel industry in Ecuador. It is appreciated that the hotels that have obtained the greatest efficiency are those

located in the provinces with the greatest tourist development, coinciding with Sellers and Casado [12], in which the hotels located in the tourist areas of Spain were the most efficient. However, authors such as Alberca and Parte [48] found that hotels located in the provinces with the greatest economic movement were more efficient.

On the other hand, in terms of those factors that have influenced the efficiency of Ecuador's hotels, it is appreciated that size is not an important characteristic when measuring efficiency, but the location, in tourist areas, affects in a better way the efficiency. Not coinciding with Alberca and Parte [49], which shows that the determinants of efficiency in the hotel industry in Spain is significantly influenced by regional and corporate factors, such as the tourist flow driven by each region, the location of the hotel, and the hotel size.

The tourist situation in Ecuador does not show a marked seasonality as in European countries, but its attractions are maintained in most months of the year; this is not limiting for the service provided by the hotel industry. As in Italy, where the mostly inefficient hotels were those that were located in areas with strong seasonality [15].

On the other hand, in terms of total factor productivity, it can be seen that, in Ecuador, on average, this change is highly influenced by technological change (TC), followed by the change in efficiency of scale (CEE), which favors hotels, since on average the TPF has increased by 0.03%. A favorable situation, which was not appreciated in hotels in Spain; Alberca and Parte [48] mentioned that the change in TPF was influenced by technical efficiency, but that the national average of that country suffered a decrease in TPF.

The present study measures the technical efficiency and the change in productivity of the businesses in the hotel industry of Ecuador from 2013 to 2017. This is the first work presented in the efficacy literature about the Ecuadorian hotel industry, presenting technical efficiency and the change in total factor productivity (TPF). It can be observed that the hotel infrastructure of Ecuador has more presence in hotels of lower class. Most of the hotels are in the provinces with more economic and political development.

In order to measure the technical efficiency, the output used was the revenue while the inputs were total personnel (Total_personnel), the non-current assets (the variable of capital) (Act_no_corri), and the Consumption, (the variable that absorbs the rest of the necessary expenses of the hotel in order to provide services). The DEA model, constant returns to scale (CCR), was used with orientation to the inputs, due to its better adaptation to the tourism sector. That is a methodology of easy interpretation (before people who did not have great knowledge of the interpretation of this and its results); thus, facilitating the use of tourism planning and control agency members in Ecuador.

We can say that that average technical efficiency of the hotels from the sample of Ecuador was stable, if we consider that its variation in the years studied is similar (with a tendency to decrease). Because this drop is strong in some provinces, despite an increase in other provinces, the general average tends to decrease.

The results indicate that, when evaluating technical efficiency, third class hotels in Ecuador are the most efficient ones, according to Oliveira et al. [19]. These results differ from studies conducted in developed countries, where big hotel chains stood out in terms of technical efficiency.

It is worth mentioning that Ecuador has experienced many changes in its economic policies. The strategy of developing the hotel industry is an attempt to improve the Ecuadorian economy. In this respect, there has been funding for lodging services, and "lower class" hotels are the ones who have received these resources. However, there is no improvement in the technical efficiency since, on average, it decreased in the years under study.

It can also be noticed that hotels have more presence in zones with tourist attractions in high demand. These hotels use their resources in a better way and contribute to improve efficiency indexes.

Furthermore, we have the dispersion of data oriented to the dimensions in hotels. Their locations are limitations that hinder a better comparability of the sample under study, since there is no information from all the hotels in Ecuador.

The management of hotels located in provinces with results of inefficiency must enhance their procedures in order to provide incentives to increase technical efficiency. It would be interesting to change strategies in order to take advantage of production factors in a better way and adapt them to a specific region and market size.

The contribution of this research, in addition to the use of the DEA methodology to the Ecuadorian hotel industry, lies in the inputs that clearly show the different factors that these companies use to provide their services. In addition to this are the different theories that have been developed in the matter of selecting the inputs for measuring efficiency.

It is important that these results be considered in matters of public policies. Despite the effort and investment in some provinces in Ecuador, the efficiency of hotels in the country has not increased. For this reason, there should be public policies that foster the efficient management of the production factors in the Ecuadorian hotel industry.

Based on these results, we can highlight the importance of further studies related to efficiency of the hotel industry. Other interesting variables can be included, such as service quality, which was not available as of conducting the present study.

Likewise, it would be important to incorporate some control variables, such as market size, tourist attractions, and the gross domestic product of the province. In addition, we suggest the use of different techniques for measuring the efficiency, such as the stochastic frontier analysis and the distance function, which have some advantages in comparison with DEA. Moreover, techniques and variables that have been used in other sectors, such as the water industry, should also be implemented.

This work is not exempt of limitations, which have to be contemplated in future works that can be carried out, due to the scarce information that is presented to the SUPERCIA. There may be some variables that are very important, and that have not been taken into account (e.g., the number of rooms and physical units—variables that, in other studies, have referenced their importance in efficiency studies). On the other hand, the financing they receive, as well as other economic variables, could be used to visualize the Ecuadorian hotel industry, and these results can be used by the government agency that governs Ecuador's tourism and hotel policy.

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