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TÍTULO DEL TRABAJO

EL IMPACTO DEL COVID-19 EN LA EFICIENCIA HOTELERA EN ESPAÑA: EL CASO DE BARCELONA

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Abstract

Purpose: With this study we aim to evaluate a hotel's performance in terms of efficiency before and during COVID-19 and provide a performance knowledge of both stable and turbulent environments.

Design/methodology/approach: The sample consists of 20 Hotels: 3-star and 4-star operating in Barcelona, Spain. Data Envelopment Analysis (DEA) will be used to analyse the efficiency of those Hotels between 2012 and 2021. The analysis includes five input variables: *(X1) Current Assets; (X2) Non-Current (Fixed) Assets; (X3) Shareholders' equity; (X4) Cost of employees*; *(X5) Material Costs* and one output variable*: (Y) Operating revenue.*

Findings: The results of DEA efficiency analysis showed that hotels belonging to 3-star hotels are more inefficient than to 4-Star hotels starting from 2013. While observing each inefficient hotel's performance during the 10-year period and comparing the level of inefficiency of inefficient hotels before and during the COVID-19, it became clear that the pandemic had a negative impact on all of them. We can also notice that during COVID-19 we have more 3-star hotels being inefficient and having a high level of inefficiency than 4 stars hotels. The lambda analysis showed that during 10-year period more 3-star hotels were identified as principal models to follow than 4-star hotels. Finally, the slack analysis revealed that inefficient 3-star hotels have to make adjustments in more resources such as *Current Assets, Non-Current (Fixed) Assets* and *Shareholder's Equity* than 4-star hotels where they have to reduce resources such as *Cost of Employees* and *Material Costs*. All the hotels included in the sample have to increase their *Operating revenue.*

Research limitations/future research: This study have two main limitations: available data limitations in terms of variables and available years and limitations applicable to the method used. Regarding to future research, one direction would be to evaluate a hotel's performance in terms of efficiency and effectiveness. Another direction could be to expand the number of input and output variables and be extended for larger sample of hotels located not only in Spain but also in other popular tourism destinations for the same purposes. Finally, to analyse hotel performance after COVID-19 will help to understand the resiliency and recovery speed of hotels after pandemic.

Practical implications: The findings from the DEA analysis offer valuable information and potential strategies that could serve for hotel managers to enhance their operational efficiency. The important insights which this study reveals can also guide future investors indicating that inefficiency is more common in 3-star hotels compared to 4-star hotels and that during unexpected situations such as COVID-19 the level of inefficiency is higher in 3-star hotels than in 4-star hotels.

Originality/value: This is the first study which analyses hotel efficiency before and during COVID-19, demonstrating how hotels' performance changes over time, especially during unexpected or unpredictable situations and whether COVID-19 affected the efficiency of hotel enterprises. Furthermore, it pinpoints the origins of inefficiencies for each hotel and gives recommendations on how it can be improved at both strategic and operational management levels. The recommendations can be helpful and applicable for other Hotels with similar characteristics in different tourism destinations.

Keywords:

Efficiency, Data Envelopment Analysis (DEA), Spain, Barcelona, COVID-19, Business performance, Business performance measurement, Hotel management, Hospitality industry, Competitive strategy, Strategic management.

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GLOSSARY OF MAIN TERMS

Term	***Definition***
Performance	The efficiency and/or effectiveness of an action (Bititci et al. 2018).
Performance measure	A metric used to quantify the efficiency and/or effectiveness of an action (Neely et al., 1995).
Performance Measurement	The process where efficiency and effectiveness of action are quantified or expressed in numbers (Neely et al., 1995).
Performance Measurement System	A set of metrics used to quantify both the efficiency and effectiveness of actions (Neely et al., 1995).
Efficiency	A company's ability in producing more products (outputs) with fewer resources (inputs) and refers to "doing things right" (Singh et al., 2020).
Technical efficiency	The ability of a firm to produce "as much output as possible with a specified level of inputs, given the existing technology" or "equivalently, using minimum inputs to produce a given output" (Erena et al., 2021).
Allocative efficiency	The ability of a firm to allocate scarce resources in a way that is socially optimal and that both producer and consumer get equal benefits (Palmer and Torgerson, 1999) or the ability of an enterprise to use the inputs in the optimal way with regard to their prices and manufacturing technology (Čabinová et al., 2021, p. 201).
Effectiveness	A company's ability in accomplishing its predefined objectives and goals by designing a unique model which will encompass business opportunities and is associated with "doing the right things" (Singh et al., 2020).
Balanced Scorecard (BSC) Model	A multi-dimensional performance measurement model which integrates both financial and non-financial performance measures grouped in four important perspectives: financial perspective, customer perspective, internal business perspective, and innovation and learning perspective (Kaplan and Norton, 2005).
European Foundation for Quality Management	Self-assessment tool which helps companies to compare regularly the activities and results of the organization based on nine criteria, divided into five "Enablers" (leadership, people, policy and

(EFQM) excellence model	strategy, partnership and resources, and processes) and four "Results" (people results, customer results, society results, and business results) (Gómez Gómez et al., 2011; Wongrassamee et al., 2003).
Stochastic Frontier Approach (SFA)	Frontier model regarded as an alternative method to the Data Envelopment Analysis (Guetat et al., 2015).
Data Envelopment Analysis (DEA)	A non-parametric methodology which measures the efficiency of each single unit in the sample by assigning an efficiency value in order to compare efficient and inefficient units (a decision-making unit (DMU)) and has the concept of a frontier production function (Barros and Mascarenhas, 2005).
Decision-Making Units (DMUs)	The entity in charge of transforming inputs (resources) to outputs (products) (Yu and Lee, 2009; Manasakis, 2013).
Input	Resources which are necessary to produce a certain output, would be a good or service (Bogt, 2021).
Input-oriented model	The minimum quantities of inputs necessary to produce a given level of output (Yannick et al., 2016).
Output	Goods or services produced which are the result of an organization's production process (Bogt, 2021).
Output-oriented model	The maximum amount of outputs possible produced from a given combination of inputs (Yannick et al., 2016).
CCR model	The constant returns to scale (CRS) model, known in the literature as the CCR model (named after Charnes, Cooper, and Rhodes) assumes that all units operate at an optimal scale and when the inputs are increased, the outputs of all DMUs also increase proportionally, disregarding scale or size of the firm (Neves and Lourenço, 2009; Wöber, 2007; Barros, 2005).
BCC model	The variable returns to scale (VRS) model known as BCC model (named after Banker, Charnes and Cooper) implies that the efficiency measure of a unit is conditioned not only by its management but also by the scale at which it operates because "imperfect competition, constraints on finance, etc. may cause a tourism business or destination marketing organization to not be operating at optimal scale" (Wöber, 2007, p. 93).
Theta	A parameter that measures the efficiency of the unit analysed (Neves and Lourenço, 2009; Fuentes et al., 2016).

Lambda	A weight obtained as a solution to the program which express the weight of each DMU in the peer group of the DMU and serves as to identify the model hotel to be followed (Neves and Lourenço, 2009; Fuentes et al., 2016).
Slack	An amount of inputs that should be reduced or the additional amount of outputs that should be increased, respectively (Neves and Lourenço, 2009; Fuentes et al., 2016).
Current Assets	"An asset is a resource with economic value that an individual, corporation owns or controls with the expectation that it will provide a future benefit. Current assets are short-term economic resources that are expected to be converted into cash or consumed within one year. " (Investopedia, 2023)
Non-Current (Fixed) Assets	"Non-current assets are resources with an expected life of greater than a year, such as plants, equipment, and buildings." (Investopedia, 2023)
Shareholders' equity	"Shareholder equity is the money attributable to the owners of a business or its shareholders." (Investopedia, 2023)
Cost of Employees	"The cost of employees (cost of labor) is the sum of all wages paid to employees, as well as the cost of employee benefits and payroll taxes paid by an employer. " (Investopedia, 2023)
Material Costs	"Material cost is the cost of materials used to manufacture a product or provide a service. Excluded from the material cost is all indirect materials used in the production process." (AccountingTools, 2023)
Operating revenue	"Operating revenue is the revenue that a company generates from its primary business activities." (Investopedia, 2023)
SABI (Sistema de Análisis de Balances Ibéricos)	A database which provides information on 2.900.000 Spanish and 900.000 Portuguese companies

CHAPTER 1: INTRODUCTION..

1.1. Personal motivation……………………………………...

There are several motivations for developing this thesis. One of the main factors is that business management and performance measurement has always been great interest to me. Performance measurement is a critical aspect of organizational management as it allows organizations to evaluate how well they are meeting their goals and objectives. By doing so, organizations can identify areas of improvement and make informed decisions to enhance their operations, increase efficiency and effectiveness, and achieve better results.

Secondly, well-respected researchers have concluded that COVID-19 has created an unprecedented situation and activated multiple threats against the businesses in the hospitality industry on a large scale and a long-term basis. Columbia University professor and Nobel Prize winner, Dr. Joseph Sitglitz, expressed his opinion about the current crisis and economic resiliency stating that (2020, p. 3) “We've constructed an economy which is not resilient. It's like a car without a spare tire. We were getting more and more efficient in a very, very narrow short-term sense. And we were seeing the bigger picture vulnerability.”

Thirdly, starting my Master’s studies in Data Science Program and then doctoral journey means for me putting exploration back at the heart of this thesis, continue with this line and develop the topic. For these reasons and more, working on this topic will help me to pursue my academic interests, discover new knowledge and expand what I have already known about the topic.

1.2. Research Problem...

Organisation is a dynamic system that operates in an environment that is ever-changing, thus needs the basic components of a control system: measure, compare, analyse, correct and prevent risks. For many years, senior managers from different industries have been reconsidering the best way to measure the performance of their companies (Bititci et al., 2018; Eccles, 1991).

Business Performance Measurement (BPM) has gained increased attention and is being implemented in many industries. There is abundant research about what is performance measurement, how it is measured in different sectors by offering numerous measurement frameworks, methods, etc. and which comes from different disciplines such as accounting, economics, finance, human resource management, marketing, operations management, psychology, and sociology (Marr and Schiuma, 2003; Neely, 2002).

Performance measurement is defined as the process where efficiency and/or effectiveness of actions are quantified or expressed in numbers (Neely et al., 1995) and thus, are considered as two fundamental dimensions of performance (Bititci et al., 2018; Neely et al., 1995). Efficiency measures a company's ability in producing more products (outputs) with fewer resources (inputs) and refers to “doing things right” (Singh et al., 2020). To this point Mouzas (2006) adds that **“**efficiency is a measure of operational excellence or productivity” and “we define it as a necessary condition or hurdle” (p. 1125).

Different sectors such as banks, retail, insurance, received an attention of applying performance measurement (Sainaghi, 2010) but as different authors indicate (Barros, 2004; Pan, 2005;) the hospitality industry, especially the hotel industry has not received sufficient attention. However, Sainaghi (2010) specifies that starting from 1990s, many studies considered the application of the performance measurement in the hotel sector and this is because hotel businesses possess some characteristics, such as the presence of three distinct business units characterized by a high level of intangibility in the form of rooms, a physical asset in the form of food and beverage, and the typical attributes of a retail business in the form of stores in addition to the hotel’s strong historical growth, increasing competition and a significant spatial concentration of destinations which makes this industry a fascinating research field (Sainaghi, 2010).

The hospitality industry is regarded as one of the most significant contributors to the tourism sector and is currently facing intense global competition. Sainaghi et al.

(2019) recognize that “performance measurement is at the heart of strategic management and affects the firm’s competitive position”, thus becoming and operating more efficiently is necessary for the company to improve or maintain its market position. (Deng et al., 2019; Chen, 2007; Hwang and Chang, 2003). From the other hand, performance evaluation is a critical step in having successful and competitive hotel enterprises (Oukil et al., 2016) since, as noticed by Alotaibi and Khan (2022), the hospitality industry is among one of the most important and largest industries in the world which provides employment opportunities, directly or indirectly, to millions of people, generates financial activities for countries, etc. Consequently, measuring the performance of hotel enterprises, having an appropriate performance measurement system and capturing the performance will help hotels to achieve established goals, observe performance progress, and determine whether objectives were achieved (Maia and Costa, 2021).

Furthermore, as Bititci et al. (2018) point out, there is another emerging viewpoint which states that “the majority of the Performance Measurement and Management (PMM) knowledge has been captured from organisations operating in stable environments, and many authors argue the need for PMM knowledge in fast-changing dynamic and turbulent environments” (p. 1). Covid-19, for the first time, was detected in Wuhan, Hubei province, China in 2019. The unstoppable and unexpected expansion of this infectious disease, on March 11, 2020 made the WHO declare state of pandemic. Since there were no prior knowledge and drugs to stop and protect people from this particular virus, the governments concentrated all the efforts on preventive methods and measures such as distancing, social isolation, strong limitation on travel and even closing borders. These limitations effected all the sectors amongst which tourism sector and hospitality industry were the first and the most affected ones. For that reason, hospitality businesses made significant changes in their operations during COVID-19 (Davahli et al., 2020; Gursoy and Chi, 2020; Ntounis et al., 2022). According to Spanish Governtment and Bulletin of State (Boletín Oficial del Estado-BOE), the state of alarm thoroughout the Spanish territory was announced and approved on March 14, 2020 to stop spread of COVID-19. The initial duration was established until 00:00 on November 9, 2020 and was extended until 00:00 on May 9, 2021 (Gobierno de España, 2020; BOE, 2020).

The literature review in hospitality management reveals that the vast majority of papers have examined efficiency before COVID-19 (Tarim et al., 2000; Hwang and Chang, 2003; Barros and Alves, 2004; Barros, 2005; Chiang, 2006; Chen, 2007; Tumer, 2010 (technical efficiency); Assaf and Cvelbar, 2010 (technical efficiency); Chen, 2010;

Assaf and Barros, 2011; Assaf and Agbola, 2011 (technical efficiency); Barros et al., 2011; Huang et al., 2011; Ashrafi et al., 2013; Oukil et al., 2016 (technical efficiency).

To extend and enrich previous literature in this topic, the objective of this work is to evaluate a hotel's performance in terms of efficiency before and during COVID-19 and provide a performance knowledge of both stable and turbulent environments. It will, thus, demonstrate how hotels' performance changes over time, especially during unexpected or unpredictable situations, whether and how COVID-19 affected the efficiency of hotel enterprises. For this purpose, the case of 20 hotels in Barcelona will be studied, which may represent a valuable and original contribution in hotel management literature.

1.3. Structure of the research ....

The rest of the paper is organized as follows: Chapter 2 introduces a definition of important concepts such as performance, measurement and performance measurement. Then, presents the existing literature on the concepts of efficiency, the most common measurement approaches, methods or frameworks used for the evaluation of efficiency dimensions in the hospitality industry. Chapter 3 provides the background and rationale for the methods chosen to measure efficiency of chosen hotels. The description of variables, methods used for data collection and data analysis are presented in the continuation. The results are shown in Chapter 4. Finally, conclusions, implications, work limitations and recommendations for further research are presented in Chapter 5.

CHAPTER 2: LITERATURE REVIEW..

This chapter first briefly introduces a definition of important concepts such as business performance, business performance measurement, performance measure, etc. Then, some of the most popular business performance measurement frameworks such as *Balanced Scorecard (BSC) Model*; *European Foundation for Quality Management (EFQM) excellence model*; *Data Envelopment Analysis (DEA); Stochastic Frontier Approach (SFA)* are introduced in the continuation. Following, one of the dimensions of performance measurement are provided in the continuation explaining the general concept and measurement approaches of it. Connecting this general idea to the tourism sector, literature review is presented by summarizing the efforts in efficiency measurement in hospitality industry.

2.1. Business performance concept, definition and measurement ....

2.1.1. Business performance concept and definition

After establishing their organizational structure, companies gather and organize necessary resources to carry out their activities. Whatever type is the organization, these resources may include personnel, financial capital, raw materials, real estate, etc. which are essential to support activities and to achieve goals and objectives of the firm. The goods or services they produce or deliver need to be competitive in the relevant market and be produced with both efficiency and effectiveness (Goshu and Kitaw, 2017). But then comes one of the fundamental questions in the business: What are the reasons behind the success of some organizations and the failure of others? (Abd-Elrahman, 2019).

The concept of business performance has become an instrumental in defining the essence of a company's activities including its success in the market and has always been of great interest for both scientists and professional managers in all fields of business sciences (Cabinova et al., 2018; Yıldız and Karakaş, 2012).

Upon reviewing the literature in this field, it becomes evident that in general there is a consensus among the researchers regarding the importance of the concept of business performance and its measurement, even though Sink (1991) believed that "measurement is complex, frustrating, difficult, challenging, important, abused and misused," (as cited in Lebas, 1995, p. 1). Prominent British scientist Lord Kelvin (1824-1907), known also as William Thompson, found that "If you cannot measure it, it does not exist" (as cited in Lebas, 1995, p. 1) or “if you cannot measure it, you cannot improve it” (as cited in Kaplan, 2009, p. 3). Many authors widely acknowledged the validity of this statement about measurement by confirming that “you are what you measure!” (Hauser and Katz, 1998); “what you measure is what you get” (Kaplan and Norton, 2005, p. 1) or “what gets measure gets attention” (Cocca and Alberti, 2010; as cited in Goshu and Kitaw, 2017, p. 382). Numerous other renowned authors have also assured that ‘if you cannot measure it, you cannot manage it’ and ‘what gets measured gets done’ (Garvin, 1993; Johnson and Kaplan, 1987; Osborne and Gaebler, 1992; Peters and Waterman, 1982 as cited in Micheli and Mari, 2014).

There are many reasons that so many people developed interest in business performance measurement and came to appreciate the fact that it’s really important. According to Neely (1999), there are seven main reason for business performance measurement being so vital: (1) the changing nature of work; (2) increasing competition; (3) specific improvement initiatives; (4) national and international awards; (5) changing organisational roles; (6) changing external demands; and (7) the power of information technology. Evaluating business performance will also help to assess and compare the performance with the same companies and best practices, to motivate and encourage particular behaviours; to detect problems and resolve them (Hyland et al., 2007; Putri et al., 2017). Lebas (1995) expresses the view that it’s hard to imagine management without measurement which means translating the complex reality into a sequence of symbols that can be communicated and reproduced under the same situations. Crowther (1996) even compares performance evaluation with any audit of business activities stating that it has equal significance for the business. So, the business environment is dynamic and is constantly changing. This changing environment requires continuous measurement of business performance. Performance measurement is key because it provides very crucial information to decision-makers in an organisation and also shows the direction of the future course of business (Sink, 1991).

However, literature reveals that there is a little agreement regarding the definition and measurement of business performance, more specifically choosing the right measures, and this is where comes the debate among the researchers (Yıldız and Karakaş, 2012; Vij and Bedi, 2016; Abd-Elrahman, 2019).

For the evaluation of business performance to be successful there are 2 critical aspects: understand what business performance is and which are the right indicators or measures to use to measure it (Cabinova et al., 2018; Hyland et al., 2007).

The definition of business performance was addressed by many authors. Cabinova et al. (2018) and Cabinova et al. (2021) consider it as a market success, where enterprise is capable of succeeding in competition and identifying opportunities for its subsequent expansion in a continuously evolving and unstable business environment. According to Yıldız and Karakaş (2012), "Business performance is the evaluation of all the efforts made for the realization of business goals" (p. 1097). Prakash et al. (2017) also contribute a thought in this regard mentioning that "Business performance is an indicator which measures how well an organization accomplishes its objectives" (p. 80). Last but not least, "Business performance can be defined as the overall index of the ability of the firm to satisfy its stakeholders" (Vij and Bedi, 2016, p. 605).

Finally, it would be useful also to clarify definitions of other related concepts such as (Neely et al., 1995; Melnyk et al., 2014; Bititci et al. 2018):

- ***Performance*** is the efficiency and/or effectiveness of an action
- ***Performance measure*** is "a metric used to quantify the efficiency and/or effectiveness of an action".
- ***Performance Measurement*** is the process where efficiency and effectiveness of action are quantified or expressed in numbers
- ***Performance Measurement System*** is a set of metrics utilized to measure the efficiency and effectiveness of actions by expressing them in numbers.

2.1.2. Business performance measurement (BPM)

Performance measurement is defined as the process where efficiency and effectiveness of action are quantified or expressed in numbers (Neely et al., 1995). There is a common agreement in the literature that for performance measurement of any organisation both efficiency and effectiveness need to be measured (Singh et al., 2020) since efficiency and effectiveness are two fundamental dimensions of performance (Bititci et al., 2018; Neely et al., 1995). Singh et al. (2020) find that these two terms might sound synonymous to managers and they might use them interchangeably but each term has a totally different meaning and implication.

Efficiency measures a company's ability in producing more products (outputs) with fewer resources (inputs) but efficiency itself doesn't guarantee companies to be successful in the marketplace (Singh et al., 2020). To this point Mouzas (2006) adds that "efficiency is a measure of operational excellence or productivity" and "we define it as a necessary condition or hurdle" (p. 1125).

Effectiveness, on the other hand, measures a company's ability in accomplishing its predefined objectives and goals by designing a unique model which will encompass business opportunities (Singh et al., 2020). From this perspective, Singh et al. (2020) find that effectiveness is linked to a company's own strategy and is defined as "the extent an organisation accomplishes its objectives" (p. 411).

The process of performance measurement involves collecting information which can be used in multiple ways such as assess performance; predict future outcomes; identify appropriate rewards or punishments, and more. Additionally, performance evaluation should ensure data which can be collected, analysed, reported and used to facilitate informed and data-driven business decisions (Hyland et al., 2007; Sardana, 2009).

In the measurement process there are 2 key questions that each manager or performance evaluator should take into consideration: "Why do we want to measure?" and "What do we want to measure?", questions are inseparable and interconnected and that the answers depend on different cultures, different economic and socio-political contexts (Lebas, 1995; Crowther, 1996).

In management, for the question "Why do we want to measure?" there are 5 main reasons which help managers to understand:

- Where have we been?
- Where are we now?
- Where do we want to go?
- How are we going to get there?
- How will we know we got there?

Coming to the "What do we want to measure?" question, it changes to "What is performance?" (Lebas, 1995). According to Lebas (1995), "performance is about the future" (p. 26) and defining what is performance is very subjective and case-specific.

Neely et al. (1995) refer to performing organisations as the ones which not only achieve their goals but also act efficiently.

Adding to the previous idea, Stainer and Stainer (1998) consider that in order to be able to answer these questions, it is essential consider the three 'E's of Economy, Efficiency and Effectiveness since it will help to understand the results of the effectiveness of a chosen strategy such as "market competitiveness, financial performance, and real unit cost" and verify whether "resources have been used efficiently" and "the business process is efficient".

Next and one of the most important steps in evaluation of performance is the selection of right measures since they are the central elements of it (Hyland et al., 2007; Powell, 2004; Goshu and Kitaw, 2017). Determining which performance measure a specific business should choose and use is a complex task (Neely, 1999) and as noted by Koufteros et al. (2014) "the operations management literature is replete with discussion of metrics" (p. 313). The current process of measuring business performance is influenced by two fundamental perspectives regarding how a business should operate. The first perspective focuses on financial side where owner's financial investment is made with the expectation of obtaining a return on investment and an increase in the value of the enterprise, thus uses exclusively financial measures for the performance measurement (Dobrovic et al., 2018).

However, "revolution" in business performance measurement considers that financial measures do not provide a "true reflection of corporate performance" (Louise, 1996, p. 2). As Shad et al. (2019) described, Chakravarthy stated that "financial measures are incapable of distinguishing the differences in performance among business". Kaplan and Norton affirmed that "financial or accounting measures can give misleading results about continuous improvement and innovation of an organisation, inferring that financial measures are insufficient for measuring properly business performance" (p. 417). The same measures were also criticised for being historical in nature which means that they are not predictive measures (Kennerley and Neely, 2003). Neely (1999) provided an example where stated "Sales turnover, for example, simply reports what happened last week, last month or last year, whereas most managers want predictive measures that indicate what will happen next week, next month, or next year" (p. 206). However, even to these facts, financial measures will remain a critical aspect of corporate performance (Robinson et al., 2005).

Starting from 1980s, this dissatisfaction and growing realisation that measuring business performance using primarily financial criteria was no longer enough to manage organisations in intense competitive markets and with more demanding customers, led to the second view, according which enterprises is a socio-economic system with a complex network of internal and external relationships where balanced approach is needed, using both financial and non-financial measures (Dobrovic et al., 2018), and prompted the creation of performance measurement frameworks that were "balanced" or "multi-dimensional" (Kennerley and Neely, 2003; Najmi et al., 2005; Bourne et al., 2000) which include "nonfinancial, external and performance measures that focus on the future" (Bourne et al., 2000).

Nevertheless, Robinson et al. (2005) is concerned about the fact that organisations might not find easy to develop and integrate both financial and non-financial measures in a way that align with strategic objectives of an organisation which is a big challenge during implementation, even though a considerable number of organizations acknowledged the importance of adopting a balanced approach for performance assessment. On the top of that, as many authors believed that the focusing and using only financial measures in the past was insufficient, confusing, (Shad et al., 2019; Yaghoobi and Haddadi, 2016), today according to Powell (2004), "the nature of this measurement crisis has changed and, in many businesses, now the problem is excessive measurement. There is a desire to quantify absolutely everything" (p. 1019). Finally, evaluating organizational performance is crucial for both researchers and managers since it enables them to evaluate firms and compare them to their competitors (Yaghoobi and Haddadi, 2016).

For these reasons and more, the ideal and most appropriate approach in performance measurement would be the one where we consider also the following (Harrington and Akehurst, 1996; Robinson et al., 2005):

- select measures that will enable year-to-year performance measurement;
- select measures that will allow company-to company comparison;
- use publicly available data to produce an objective measure that can be replicated by other researchers in the field;
- don't necessarily identify what we could measure, but identify what we need to measure;

2.1.3. Business performance measurement frameworks

There was not only abundance of discussion regarding the measures but also performance measurement frameworks, models, methodologies, tools prescribing which dimensions of performance organisations should be taken into consideration while measuring it (Koufteros et al., 2014; Neely, 1999; Najmi et al., 2012).

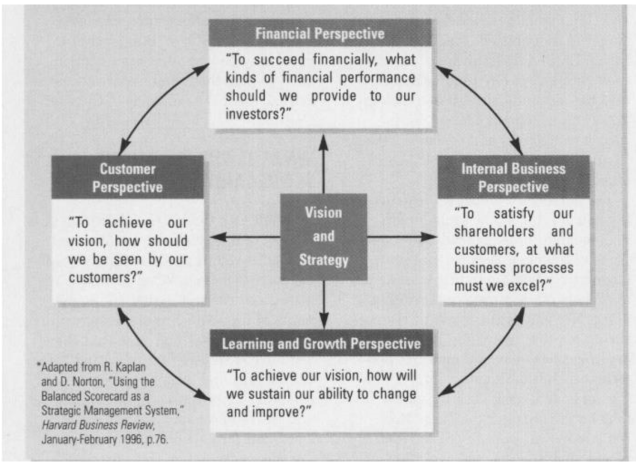
Numerous frameworks and tools have been created to assist in achieving one or more of these goals which include data envelopment analysis (Farrell, 1957); the Performance measurement matrix (Keegan et al., 1989); the Balanced Scorecard (Kaplan and Norton, 1992); the performance prism (Adams and Neely, 2000); the performance pyramid (Neely, 2002); EFQM model for business excellence (EFQM, 2003); etc. (Johnston et al., 2002; Najmi et al., 2005; Najmi et al., 2012).

This study will discuss two of them which are the most recognized and widely publicized models: Kaplan and Norton’s Balanced Scorecard and the EFQM Excellence model (Powell, 2004; Abd-Elrahman, 2019; Wongrassamee et al., 2003).

2.1.3.1. Balanced Scorecard (BSC) Model

One of the best-known and most widely used models in the world is the Balanced Scorecard which was introduced by Kaplan and Norton in 1992. It’s a multi-dimensional performance measurement model which considers business evaluation through different perspectives (Najmi et al., 2012; Brignall, 2002). It offers balanced performance measurement system which integrates both financial and non-financial performance measures grouped in four important perspectives: financial perspective, customer perspective, internal business perspective, and innovation and learning perspective which enable managers to have a fast but comprehensive view of business (Kaplan and Norton, 2005; see Figure 1). It’s recommended by the authors to use a total of 15 to 20 scorecard measures (Kaplan and Norton, 1996; Salem et al., 2012). Besides the integrated combination of financial and non-financial measures, another major strength of BSC is that this model links performance measures with business unit strategy (Wongrassamee et al., 2003). Finally, as Chow et al. (1997) p. 21 observed, another key advantage of the BSC is that in this model “the components of the scorecard are designed in an integrative fashion such that they reinforce each other in indicating both the current and future prospects of the company”.

Figure 1. Balanced Scorecard (BSC) Model



Source: Chow et al., 1997

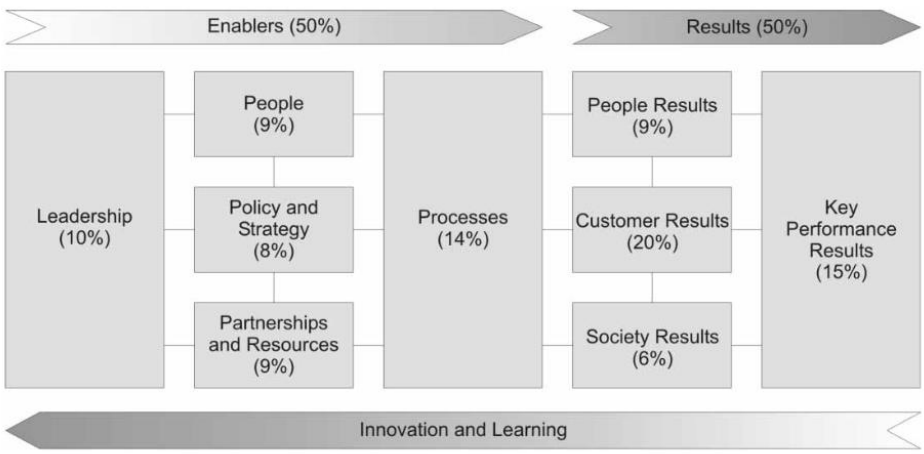
However, with all its perceived advantages, BSC also has drawbacks. Numerous researchers argue that BSC contains a large number of performance measures and using the BSC by multiple perspectives, beyond strictly financial ones, introduces complications to evaluate the performance (Lipe and Salterio, 2002; Yaghoobi and Haddadi, 2016).

It’s both complex and costly measurement model. Among the other costs, management time is one aspect of this expense which should be taken into consideration. Kaplan and Norton suggest that the development of the model could take approximately 16 weeks but others estimate that development and execution “can require a significant time investment for two years or more” (as cited in Lipe and Salterio, 2000, p. 284). Adding the fact that there is no shortage of discussion regarding BSC structure, but lack of research on how to implement the model properly, the application of this model becomes even complicated and difficult (Yaghoobi and Haddadi, 2016). Lastly, as reported by Brignall (2002), social and environmental aspects are not incorporated into BSC which hopefully may be extended as a result of the interrelationships among the four existing BSC perspectives.

2.1.3.2. European Foundation for Quality Management (EFQM) excellence model

EFQM model was initiated by 14 representatives of European multi-national companies in 1988 and was supported by the European Commission and the European Foundation for Quality Management (Nabitz et al., 2000). The essence of EFQM model is that it assists European companies in becoming competitive in international markets though self-assessment. Self-assessment assumes to compare regularly the activities and results of the organization with the EFQM excellence model based on nine criteria. (Gómez Gómez et al., 2011; Wongrassamee et al., 2003; see Figure 2). These nine criteria are divided into five "Enablers" (leadership, people, policy and strategy, partnership and resources, and processes) which makes a reference to "what an organization does" and four "Results" (people results, customer results, society results, and business results) which are "what an organization achieves" caused by "Enablers. The arrows emphasize the dynamic nature of Critical evaluation of the EFQM model 487 the model. The arrows in Figure 2 show that the model is dynamic where "Innovation and Learning" help to make better "Enablers" that in its turn result in improved "Results" (Gómez Gómez et al., 2011; Wongrassamee et al., 2003; Ehrlich, 2006).

Figure 2. The EFQM Excellence Model



Source: Ehrlich, 2006

Even though the components of the EFQM model helps the company to gain a complete understanding of their organizational position and achieve continuous improvement, however, the model doesn't not make any recommendations about what strategies or plans should be implemented in order to obtain that improvement (Wongrassamee et al., 2003). Furthermore, Abd-Elrahman (2019) highlighted that even though EFQM considers numerous performance aspects that are not taken into consideration by BSC, it's still remains as a self-assessment rather than an objective measurement framework. Lastly, the implementation of models such as Excellence Model can be challenging for larger organizations because of "complex cultural, human and organisational issues" and will require time, significant human and other resources (Robinson et al., 2005).

Nevertheless, new methods, in terms of frontier models, have been developed and came to complement the most common and classical non-frontier models. There are four frontier methods: thick frontier approach (TFA), distribution free approach (DFA), stochastic frontier approach (SFA) and data envelopment analysis (DEA) (Chen, 2007; Neves and Lourenço, 2009; Tumer, 2010) from which literature distinguishes as principal ones to analyse performance SFA and DEA (Liu and Tsai, 2021; Chen 2007; Honma and Hu, 2012). Both of them use a sample of organizations to construct Efficient Production Frontier but also have differences, advantages and disadvantages which are widely recognized.

2.1.3.3. Data Envelopment Analysis (DEA)

The idea of DEA was introduced by Farrell (1957) and following Farrell's basic concepts, Charnes, Cooper and Rhodes (1978) for the first time extended this idea by describing "what is a mathematical programming approach to the construction of production frontiers and the measurement of efficiency of developed frontiers" (Barros, 2005, p. 461; Nurmatov et al., 2021). DEA model has been successfully employed to evaluate efficiencies and has a number of advantages over the above-mentioned other frontier models which was acknowledged by many authors (Wöber, 2007; Min et al., 2009; Tumer, 2010; Huang et al., 2011; Barros et al., 2011; Fuentes et al., 2016; Higuerey et al., 2020; Nurmatov et al., 2021):

- it allows to accommodate multiple inputs and outputs

- it’s beneficial to analyse activities sectors which require multiple resources in their production process. Moreover, the inputs and outputs can be measure in different units
- it creates an efficiency frontier with efficient units, measures each of the remaining units' efficiency, identifies “reference businesses” or “efficient peers-groups” (benchmarks and best practice DMUs) for each of the inefficient units. Also, provides detailed information about how to improve the level of efficiency of those Decision-Making Units (DMUs) which are considered to be non-efficient.
- there is no requirement of functional relationship between inputs and outputs and no prior information is required about the importance of inputs and outputs.
- the results which provides DEA are objective since it’s based only on the formulations thus prevents the subjective opinion of researcher.
- for sectors which are multidimensional in their nature and require multiple resources in their production process to create different products, DEA is perfect model for analysing those activities.

However, this model has limitations too (Anderson et al., 1999; Barros and Dieke, 2008; Fuentes et al., 2016, Čabinová et al., 2021; Honma and Hu, 2012):

- there is a need of homogeneity of the DMUs, which means that analysed unit executes the same work with similar objectives; operates under the same market conditions; uses the same type of resources and produces the same types of products
- variables of the model should be chosen very carefully since there are no tests to confirm their selection and significance.
- random error term is not considered while measuring efficiency. The assumption behind this is that “there are no random fluctuations from the efficient frontier” (Anderson et al., 1999, p. 48), all deviations are considered inefficiency, thereby this inefficiency is solely attributed to the inadequate management of the DMU.

2.1.3.4. Stochastic Frontier Approach (SFA)

Stochastic frontier approach (SFA) was developed by Battese and Coelli in 1995 as an alternative approach to the Data Envelopment Analysis (Guetat et al., 2015). The major advantages and differences of the SFA from DEA is that SFA (Leal Paço and Cepeda Pérez, 2013; Guetat et al., 2015; Liu and Tsai, 2021):

- recognizes random error term and the estimation of inefficiency is done in terms of it.
- corrects the possible upward bias of inefficiency
- isolates the influence of factors to inefficient behaviour
- is less sensitive to outliers than the DEA
- it permits an analysis of the determinants of inefficiency.

But instead SFA approach requires a specific functional form or relationship between resources and products and large sample (Chen 2007).

2.2. Efficiency: Concept and Measurement ....

As we have seen, efficiency refers to a company's ability to produce expected results with minimum resources and it's considered one of the fundamental dimensions of BPM. As noticed by Bogt (2021), there are basic components of efficiency analysis and all types of efficiency deal with those elements: *inputs and outputs*. Inputs are called resources which are necessary to produce a certain output, would be a good or service. Outputs are the goods or services produced which are the result of an organization's production process. Thus, the production process converts inputs to outputs and it's described as the ratio of output to input (Bogt, 2021; Yannick et al, 2016).

Economists usually differentiate between 3 main types of efficiency: *technical efficiency, productive efficiency and allocative efficiency*, which together make up the overall economic efficiency (Palmer and Torgerson, 1999; Erena et al., 2021; Yannick et al., 2016).

2.2.1. Technical efficiency

As pointed out by Erena et al. (2021) "*technical efficiency* is the ability of a firm to produce as much output as possible with a specified level of inputs, given the existing technology" (p. 3) or "equivalently, using minimum inputs to produce a given output" (p. 5).

Technical efficiency thus focuses on the issue of making the most of available resources (Palmer and Torgerson, 1999) and "a Decision-Making Unit (DMU) is considered as technically efficient if, from the basket of inputs it holds, it produces the maximum of outputs possible or if, to produce a given quantity of outputs it uses the smaller quantities possible of inputs" (Yannick et al., 2016, p. 200)".

For the technical efficiency, Yannick et al. (2016) suggest that its expression can be done based on 2 main approaches: output-oriented (OO) technical efficiency and input-oriented (IO) technical efficiency. First approach, output-oriented (OO) technical efficiency, reflects the maximum amount of outputs possible produced from a given combination of inputs and answers to the question: "of how much can one modify quantities of output without modifying quantities of input that are being used". (p. 200).

Meanwhile, the second approach reflects the minimum quantities of inputs necessary to produce a given level of output and answers to the question: "of how much quantities of input can be proportionally reduced, without any variation in quantities of output produced" (p. 200).

Technical inefficiency would be, then, either a production below what is technically possible with a quantity of inputs and a given technology, or a use of inputs' quantities above the necessary, with a given level of output (p. 200).

2.2.2. Allocative efficiency

The concept of allocative efficiency takes into account how scarce resources are allocated in a way that is socially optimal and that both producer and consumer get equal benefits (Palmer and Torgerson, 1999). Čabinová et al. (2021) define allocative efficiency as "the ability of an enterprise to use the inputs in the optimal way with regard to their prices and manufacturing technology" (p. 201).

Thus, as pointed out by Brissimis et al. (2010) and Tumer (2010), shows the ability of a firm to utilize the inputs in optimal proportions or estimates the right combination of inputs and outputs, in terms of their price levels.

There are 2 primary reasons for the organization to perform sub-optimally. The first one is where the organization fails to allocate its resources in the most efficient way or allocative inefficiency. The second reason is the organization's inability to achieve the maximum outputs possible from a given amount of inputs, or failure to minimize an amount of inputs to produce a given level of output or technical inefficiency (Anderson et al., 1999; Yannick et al., 2016). For this reason, in this work we are going to concentrate on both technical and allocative efficiencies.

Efficiency measurement of production units is extensively employed both in public and private sectors. Measuring efficiency, particularly identifying potential inefficiencies, is a crucial step for enterprises since it helps them to enhance their competitiveness and overall performance in a competitive business environment, execute their strategic activities cost-efficiently compared to their competitors and gain a competitive advantage. Thus, measuring and continuously monitoring efficiency are important prerequisites for achieving success in business.

There are different methods for efficiency measurement such as parametric methods (Stochastic Frontier Approach, Distribution Free Approach, Thick Frontier Analysis, Corrected Ordinary Least Squares), and non-parametric methods (Data Envelopment Analysis, Free Disposal Hull, Stochastic Data Envelopment Analysis – DEA) (Čabinová et al., 2021).

2.3. Efficiency measurement in the hospitality industry ....

Altin et al. (2018) consider hospitality industry as an industry with special characteristics such as "the complexity of service business, intangibility, significant capital investment, sensitive production processes, customers being part of service and production processes, the importance of location or labour factors, high vulnerability to the external environment, e.g., the political, social, economic environment" (p. 3) which make the industry and business decisions very unique and different (Altin et al., 2018; Sainaghi, 2010).

Performance measurement makes possible to make a decision that will help detect management problems, make improvements and guarantee the best possible results which is crucial for hospitality industry as it operates in intensely competitive environment and constantly changing circumstances. Thus, fierce competition and ever-changing conditions require efficiency (Ivankovič et al., 2010; Hwang and Chang, 2003; Yu and Lee, 2009; Barros, 2004).

Efficiency measurement in hospitality industry has gained a huge attention by manager, economists and other scholars which enriched hotel management literature in studies where they have tried to precisely assess efficiency. The measurement of hotel efficiency using the DEA methodology has become a specific research line within this literature (Hwang and Chang, 2003; Chiang, 2006; Oliveira et al., 2013; Manasakis et al., 2013). Data Envelopment Analysis (DEA) is a popular technique frequently used in the efficiency literature in general and the most widely used model in the hotel industry, specifically.

For the first time DEA approach was applied by Morey and Dittman (1995) to measure the level of efficiency of 54 hotels in the US after which this model gained a wide recognition in the analysis of efficiency in the hospitality industry (Parte-Esteban and Alberca-Oliver, 2015).

Johns et al. (1997) estimated the productive efficiency of 15 hotels of a same chain over a 12-month period in UK. The sample was divided into 3 groups based on the number of rooms: type 1 with 180–350 rooms (six units), type 2 with 150–180 rooms (five units) and type 3 with 90–150 rooms (four units). The results of the study revealed that one hotel in type 1 was efficient while five were inefficient; in type 2 three hotels were efficient and two were inefficient; in type 3 two were efficient and the other two hotels were inefficient.

Tarim et al. (2000) examined the efficiency of 21 hotels in Turkey from which ten hotels belong to 5 star-hotels and 11 represent 4-star hotels operating in the Turkish Riviera -Antalya. Their main conclusion was that that 4-star hotels were more efficient than 5-star hotels.

The case of 53 international tourist hotels operating in Taiwan was studied by Tsaur (2001) where the author employed DEA approach to analyse operating efficiency from 1996 to 1998 and their findings suggested that 15 out of 53 (28.3%) were efficient having the efficiency score of 1, while 38 hotels (71.7%) were inefficient where these hotels will need to make specific input adjustments for their efficiency enhance.

Barros and Mascarenhas (2005) implemented a DEA methodology to examine the technical and allocative efficiency of 43 small hotels which belong to the Portuguese state-owned chain (Pousadas de Portugal) from 1999 to 2001 and found that the majority of the pousadas were not efficient and verified that this methodology can provide more accurate results about hotel efficiency. Taking into consideration the results of the study, at the end the authors made some suggestions that the management of pousadas need to consider.

Chiang (2006) investigated the case of 24 Taipei international tourist city hotels in Taiwan grouped in 3 operational styles: “independently owned and operated” (15 hotels); “franchise licensed” (4 hotels) and “managed by international hotel operators” (5 hotels) and found that eight out of the fifteen independently owned and operated hotels were efficient; only one of four franchise licensed hotels was efficient, and three out of five internationally managed hotels were efficient. He found also that the managed by international hotel operators were more efficient and provide better service than franchised and independent hotels.

Min et al. (2009) evaluated the financial efficiency of 31 luxury and budget hotels in Korea and the results indicated that 15 hotels were efficient. Moreover, they examined if the size of hotel can affect the efficiency of it and came to the conclusion that size of the hotel can have a significant impact on its efficiency but not for generating revenue as much as for generating income.

Tumer (2010) evaluated the technical efficiency of 28 resort hotels (4 and 5 star) in Turkey for year 2005. The main finding was that 5-star resort hotels were more inefficient than those of 4 stars. For those hotels which were considered inefficient, a peer group had been established consisting of efficient hotels so that inefficient hotels could improve their performance.

More recently Higuerey et al. (2020) presented the case of 147 hotels during 2013-2017 in Ecuador where they measure efficiency and productivity of hotels by grouping them in luxury, first, second, third and fourth classes. They concluded that the most efficient hotels belong to third class and the hotels which are located in touristic zones make better use of that resources.

With the advancement of DEA research, the application of DEA approach was used with other methods too such as the Malmquist productivity index with DEA (Hwang and Chang, 2003; Barros, 2005; Barros and Alves, 2004); Tobit regression model with DEA (Wang et al., 2006); Bootstrap approach with DEA (Assaf and Agbola, 2011; Barros et al., 2011); BSC-DEA combination (Amado et al., 2012; Kádárová et al., 2015; Dolasinski et al., 2019).

There are studies that employed other methods such as the Stochastic Frontier Approach (SFA) to measure the efficiency of hotel companies.

In their study, Anderson et al. (1999) employed SFA to investigate the managerial efficiency of 48 US hotels and motels the for the year 1994. They find that the maximum hotel efficiency score was 92.1% and the minimum efficiency score was 84.3% and that these results are high enough compared to other industries such as banking, insurance, etc. They also concluded that the results of this study are almost the same as those of Morey and Dittman (1995) stating that high efficiency score is consistent with a competitive market.

Chen (2007), using SFA, investigated the cost efficiency of 55 hotels out of which thirty hotels were independent hotels and twenty-five belonged to hotel chains in Taiwan. The results showed that the average efficiency is 80.30% with the maximum hotel efficiency score of 97.72% and the minimum efficiency score of 34.46%. Thirty-three hotels out of fifty-five have an efficiency score higher than the average efficiency.

In their study, Assaf and Barros (2013) analysed the efficiency of hotels in 37 countries where they came to the conclusion that the most efficient hotels are located in

Switzerland, the UK, Spain and the UAE and the least efficient are in Croatia, Slovakia and Kenya. When comes to regional comparison the authors stated that the hotels in the USA and Europe appear to show the highest level of efficiency, followed by the Middle East, South America and Africa. Lastly, they found that international hotel chains operate more efficiently than national hotel chains or independently owned hotels.

Guetat et al., 2015 evaluated the efficiency of 63 hotels during 2011–2012 in Tunis and revealed that the average operational efficiency of hotels in Tunisia is 65.02%.

Even though stochastic frontier approach to assess the efficiencies in the hotel industry is becoming more prevalent, DEA is still remaining popular among many scholars (Altin et al., 2018).

3.1. DEA Methodology

The literature revealed that data envelopment analysis (DEA) was the most frequently used and common approach for analysing efficiency in the hospitality industry, although other methods such as the Stochastic Frontier Analysis (SFA) have also been used (Fuentes et al., 2016; Liu and Tsai, 2021). Thus, this study will employ three stage DEA model to measure efficiency in the Spanish hospitality market.

DEA is a non-parametric methodology which measures the efficiency of each single unit in the sample by assigning an efficiency value in order to compare efficient and inefficient units (a decision-making unit (DMU)) and has the concept of a frontier production function (Barros and Mascarenhas, 2005). A DMU in the model is referred to the entity in charge of transforming inputs (resources) to outputs (products) (Yu and Lee, 2009; Manasakis, 2013) and the efficiency/inefficiency of the DMU is evaluated with respect to Efficient Production Frontier (Nurmatov et al., 2021, Anderson, 1999). And, mathematically it's expressed like the following (Neves and Lourenço, 2009; Min et al., 2008; see: Figure 3)

Figure 3. DEA model expressed mathematically.

$$\text{Max}\, P_k = \frac{\sum_{r=1}^{n} u_r \cdot Y_{rk}}{\sum_{i=1}^{m} v_i \cdot X_{ik}} \qquad \text{s.t.}\ \frac{\sum_{r=1}^{n} u_r \cdot Y_{rj}}{\sum_{i=1}^{m} v_i \cdot X_{ij}} \leq 1$$

Source: Neves and Lourenço, 2009

where:

Y_r = amount of output *r*,

X_i = amount of input *i*,

u_r = the weight of output *r*,

v_i = the weight of input *i*,

n = the number of output variables

m = the number of inputs variables

k = the DMU of interest

j = all other DMUs.

For the implementation of DEA analysis following steps are required to be taken (Parte-Esteban and Alberca-Oliver, 2015; Golany and Roll, 1989; Cook et al., 2014):

The first step in a DEA analysis is to determine DEA model orientation: Input-oriented model or Output-oriented model. As a rule, DMUs competing in competitive markets are output-oriented because they have a control over the inputs with the goal to maximize its output while adhering to the market demand, which is outside of the control of the DMU (Barros, 2005). Since hotel industry operates in a highly competitive business environment where tries to gain advantage and improve its current position, to be closer and satisfy its guests wishes (Mitrović et al., 2016), output-oriented DEA model will be used in this study.

The second step is to determine whether to use the constant returns to scale (CRS) model, known in the literature as the CCR model (named after Charnes, Cooper, and Rhodes), and variable returns to scale (VRS) model known as BCC model (named after Banker, Charnes and Cooper). The constant returns to scale model developed by Charnes, Cooper, and Rhodes (CCR) in 1978 assumes that all units operate at an optimal scale and when the inputs are increased, the outputs of all DMUs also increase proportionally, disregarding scale or size of the firm. (Neves and Lourenço, 2009; Wöber, 2007; Barros, 2005). While (BCC-VRS) model implies that the efficiency measure of a unit is conditioned not only by its management but also by the scale at which it operates because "imperfect competition, constraints on finance, etc. may cause a tourism business or destination marketing organization to not be operating at optimal scale" (Wöber, 2007, p. 93). Consequently, the impact of an increase in inputs and in outputs will differ amongst DMUs (Neves and Lourenço, 2009; Barros and Mascarenhas, 2005). Thus, both CCR and BCC models will be used in this study.

Finally, three stage DEA will be applied where if and only if all these 3 conditions are fulfilled at the same time, the DMU will be considered efficient (Neves and Lourenço, 2009; Fuentes et al., 2016):

- ϕ_0 (theta) = 1 (parameter that measures the efficiency of the unit analysed) where DMU having an efficiency score 1 is efficient and less than one is inefficient and which provides more insights for management such as efficient peers (or benchmarks for the inefficient units)

- λ_0 (lambda) (Lo) = 1 and the rest (Li) = 0 (weight obtained as a solution to the program which express the weight of each DMU in the peer group of the DMU and serves as to identify the model hotel to be followed)
- the values of Si- and Sr+ (slack variables for inputs and outputs, expressing the amount of inputs that should be reduced or the additional amount of outputs that should be increased, respectively) = 0

3.2. Input and Output Variables

As noticed by Fuentes et al. (2016), the selection of variables for DEA analysis should be made with special care due to the absence of suitable tests for their selection. and evaluation of significance. Therefore, a review of previous studies carried out in this field will be crucial. Cook et al. (2014) advise that in this process "users may also find that empirical survey papers help in identifying DEA inputs and outputs" (p. 3). Neves and Lourenço (2009) argue that since data availability limits any empirical study and especially this one because the database used has only financial data then this aspect also should be taken into consideration while selecting inputs and outputs.

Thus, above-mentioned 2 approaches would be followed in this study: the literature survey (see: Table 1) which will help to determine inputs and outputs for this study (see: Table 2) and the availability of reliable data sources which comes from annual financial reports of hotels. In this way, "the selection of inputs and outputs for the DMUs used in this study was done within the spirit of a DEA application, even though the data available was only financial" (Neves and Lourenço, 2009, p. 702).

Table 1 presents the summary of previous studies that have applied DEA model to measure efficiency in the hotel industry, including number of units analysed, the inputs and outputs variables used in each study, country and type of efficiency.

Table 1. Summary of previous studies which employed DEA model to measure efficiency in the hospitality industry.

Authors	***Methodology***	***Units***	***Inputs***	***Outputs***	***Country***	***Type of efficiency analysed***
Morey and Dittman (1995)	DEA	54 hotels	(1) Room division expenditures; (2) Energy costs; (3) Salary; (4) Advertising expenditures; (5) Non-salary expenses with property; (6) Non-salary expenses with administrative work; (7) Non-salary expenses with variable advertising; (8) Fixed expenditures.	(1) Total room revenue; (2) Level of service delivered; (3) Rate of growth; (4) Market share;	US	Hotel General Manager's Performance
Johns *et al.* (1997)	DEA	15 hotels over a 12-month period	(1) Number of room nights available; (2) Total labour hours; (3) Total food and beverage costs; (4) Total utility costs.	(1) Number of room nights sold; (2) Total covers served; (3) Total beverage revenue.	UK	Productive efficiency
Anderson et al. (2000)	DEA	48 hotels 1994	(1) Number of full-time equivalent employees; (2) Number of rooms; (3) Total gaming-related expenses; (4) Total food and beverage expenses; (5) Other expenses.	(1) Total revenues generated from rooms, gaming, food and beverage; (2) Other revenues.	US	Technical and allocative efficiency
Tarim et al. (2000)	DEA	21 hotels 1997 April-October period	(1) Hotel investment cost; (2) Number of hotel personnel employed; (3) Hotel administrative expenses.	(1) The ratio of customers staying more than once in a hotel; (2) Occupancy rate;	Turkey	

				(3) Net profit.		
Tsaur (2001)	DEA	53 hotels, from 1996 to 1998	(1) Total operating expenses; (2) Number of employees; (3) Number of guest rooms; (4) Total floor space of the catering division; (5) Number of employees in room division. (6) Number of employees in catering division; (7) Catering cost.	(1) Total operating revenues; (2) Number of rooms occupied; (3) Average daily rate; (4) Average production value per employee in the catering division; (5) Total operating revenues of the room division; (6) Total operating revenue of the catering division.	Taiwan	Operating efficiency
Brown and Ragsdale (2002)	DEA CCR	46 hotels 2001	(1) Problems; (2) Service; (3) Upkeep; (4) Hotels; (5) Rooms;	(1) Customer Satisfaction; (2) Customer value.	US	Competitive market efficiency
Hwang and Chang (2003)	DEA CCR model and the Malmquist productivity index	45 hotels, from 1994 to 1998	(1) Number of full-time employees; (2) Number of guest rooms; (3) Total area of aeal department; (4) Operating expenses.	(1) Room revenue (2) Food and beverages revenue (3) Other revenues	Taiwan	Managerial efficiency

Barros and Alves (2004)	DEA Malmquist	42 hotels, from 1999 to 2001	(1) Number of full-time equivalent workers; (2) Salary; (3) External costs; (4) Operating costs; (5) Book value of the property.	(1) Sales; (2) Number of guests; (3) Number of nights spent.	Portugal	Total factor productivity (TFP)
Barros (2005)	DEA Malmquist	43 hotels, from 1999 to 2001	(1) Number of full-time equivalent employees; (2) Cost of labour; (3) Number of rooms; (4) Surface area of the hotel; (5) The book value of the premises; (6) Operational costs; (7) External costs.	(1) Sales; (2) Number of guests; (3) Aggregated number of nights spent.	Portugal	Technical efficiency
Barros and Mascarenhas (2005)	DEA	43 hotels, from 1999 to 2001	(1) Number of full-time equivalent employees; (2) The book value of the assets; (3) Numbers of rooms.	(1) Sales; (2) Number of guests; (3) Number of nights spent.	Portugal	Technical and allocative efficiency
Chiang (2006)	DEA	24 hotels	(1) Total number of hotel rooms; (2) Total space utilized by all F&B outlets; (3) Number of employees; (4) Total operating cost.	(1) Yielding index; (2) F&B revenue; (3) Miscellaneous Revenue.	Taipei, Taiwan	
Wang et al. (2006)	DEA Tobit regression model	49 hotels, 2001	(1) Number of rooms; (2) number of full-time employees in room departments; (3) total floor area of food and beverage departments;	(1) Room revenue; (2) Food and beverage revenue; (3) Other revenues.	Taiwan	Overall efficiency (OE), Technical efficiency (TE), allocative (AE), pure technical (PTE) and scale

			(4) number of full-time employees in food and beverage departments.			efficiency measures (SE)
Yang and Luu (2006)	DEA-Window analysis	46 hotels, from 1997 to 2002	(1) Total operating expenses; (2) number of employees; (3) number of guest rooms; (4) total area of catering division.	(1) Total operating revenues; (2) average occupancy rate; (3) average room rate; (4) average production value per employee in the catering division; (5) average production value of the catering division (per 36 square feet).	Taiwan	
Haugland et al. (2007)	DEA-CCR model	101 hotels, 2005	(1) Number of hotel rooms; (2) Number of employees.	(1) Sales revenue; (2) Occupancy rate.	Norway	
Barros and Dieke (2008)	DEA (Malmquist and bootstrapped tobit model)	12 hotels, from 2000 to 2006	(1) Total cost; (2) Investment expenditures.	(1) Revenue per available room.	Luanda, Africa	Technical efficiency
Min et al. (2008)	DEA	6 hotels, from 2001 to 2003	(1) Cost of sales; (2) payroll and labour-related expenses; (3) Operating expenses (expenses for rooms, for food and beverage, expenses associated with other services);	(1) Revenue (from rooms, from food and beverage, from other services); (2) Occupancy ratio; (3) Profit margin.	Korea	Technical efficiency

			(4) Non-operating expenses (administrative and general expenses, facility maintenance cost, utility cost, and advertisement and promotional expenditure, hotel property taxes, and equipment depreciation).			
Min et al. (2009)	DEA-CCR and DEA-BCC model	31 hotels	(1) Assets (Land; building; location; other fixed asset; other current asset); (2) Expenses (Costs of goods sold; selling, general, and administrative expenses; nonoperating expenses).	(1) Revenues (room, beverage, other); (2) Income (Operating income; Non-operating income).	Korea	Financial efficiency
Neves and Lourenc¸o (2009)	DEA	83 hotels, from 2000 to 2002	(1) Current assets; (2) Net fixed assets; (3) Shareholders' equity; (4) Cost of goods and services.	(1) Total Revenues; (2) Earnings (EBITDA).	Worldwide Sample	
Assaf and Cvelbar (2010)	DEA	24 hotels, from 2005 to 2007	(1) Number of rooms; (2) Number of employees; (3) Number of restaurant seats; (4) Costs of materials; (5) Costs of services.	(1) Total room sales; (2) Total Food and Beverage sales.	Slovenia	Technical efficiency
Tumer (2010)	DEA	28 hotels	(1) Room capacity; (2) Personnel cost; (3) Energy cost; (4) F&B cost; (5) Other cost;	(1) Modified RevPAR; (2) Other revenue per room sold.	Turkey	Technical efficiency

Pulina et al. (2010)	DEA-Window analysis	150 hotels, from 2002 to 2005	(1) Labour cost; (2) Physical capital.	(1) Sales revenue; (2) Gross value added (GVA).	Italy	Technical and scale efficiencies
Barros et al. (2011)	DEA, Simar and Wilson	15 hotels, from 1998 to 2005	(1) Full-time workers; (2) Book value of property; (3) Operational costs.	(1) Sales; (2) Number of guests.	Portugal	Technical efficiency
Assaf and Agbola (2011)	DEA double bootstrap	31 hotels, from 2004 to 2007	(1) Total payroll in the room division department; (2) The total payroll in other departments; (3) The cost of food; (4) The cost of beverages; (5) The cost of maintaining rooms; (6) The number of rooms available	(1) Total room revenue; (2) Total food and beverages revenue.	Australia	Technical efficiency
Huang et al. (2011)	data envelopment window analysis (DEWA)	31 regional hotel sectors, from 2001 to 2006	(1) Total number of full- time employees in a regional hotel sector; (2) Total number of guests; rooms in a region; (3) Total fixed assets in a regional hotel sector.	(1) Total revenue generated by room occupancy, food and beverage service, and other sources such as laundry, night clubs, and service fees; (2) Average occupancy rate calculated by taking total occupied room-nights as a percentage of total available room nights.	China	Relative technical efficiency

Honma and Hu (2012)	DEA and stochastic frontier analysis (SFA)	15 hotels, from 2004 to 2008	(1) The number of employees; (2) The number of temporary staff; (3) The number of seats in restaurants and bars; (4) The number of guest rooms.	(1) Real revenue.	Japan	Operating efficiency
Ashrafi et al. (2013)	non-radial DEA Slacks-Based Measure (SBM) model	16 hotels, from 1995 to 2010	(1) Average room rate; (2) total international visitor arrivals; (3) GDP.	(1) Hotel room revenue; (2) Hotel food and beverage revenue; (3) Occupancy rate; (4) Gross lettings.	Singapore	
Manasakis et al. (2013)	DEA	50 hotels, 2008	(1) The number of employees; (1) The number of beds; (3) The total operational cost.	(1) Total room revenue; (2) Total food and beverage revenue; (3) Other sources of revenue; (4) The total number of nights spent.	Greece	
Oliveira et al. (2013)	DEA	84 hotels, from 2005 to 2007	(1) Number of rooms; (2) Number of employees, the F&B (food & beverage) capacity other costs.	(1) Total revenue.	Portugal	Efficiency
Fernández and Becerra (2015)	DEA	166 hotels, from 2000 to 2009	(1) Number of rooms; (2) Number of workers.	(1) Revenue.	Spain	Operational efficiency drivers

Oukil et al. (2016)	two-stage data envelopment analysis	58 hotels	(1) Number of beds; (2) Number of rooms; (3) Number of employees; (4) Salary of employees.	(1) Annual revenue; (2) Number of guests; (3) Number of nights; (4) Occupancy rate.	Sultanate of Oman	Technical efficiency
Zambrano and Aguilar (2017)	DEA	15 hotels, 2013	(1) Personnel expenses; (2) Inventories; (3) Property plant and equipment.	(1) Income.	Colombia	
Sellers-Rubio & Casado-Diaz (2018)	Stochastic DEA model	Hotels in 17 Spanish regions, from 2008 to 2016	(1) Number of hotels; (2) Number of available hotel beds; (3) number of full-time-equivalent employees;	(1) Average daily rate (ADR); (2) Revenue per available room (RevPAR); (3) Average occupancy rate. (4) Average length of stay; (5) Number of international tourists; (6) Dominance of the sun and sand tourist product; (7) Number of hotels distinguished with a quality distinction.	Spain	
Ang et al. (2018)	DEA	7 hotel chains and their 21 subsidiary hotels in total,	(1) Total operating costs; (2) Total number of Employees; (3) Total number of guest rooms;	(1) Room occupancy percentage; (2) Total hotel revenues.	Taiwan	

		from 2011 to 2015	(4) Food and beverage (F&B) capacity.			
Nguyen and Nguyen (2019)	DEA and Malmquist productivity index	20 hotels, from 2013 to 2017	(1) Cost of good sales; (2) Sales expense; (3) Operation expense; (4) Fixed assets; (5) Owner equity.	(1) Revenues; (2) Profit after tax.	Vietnam	
Higuerey et al. (2020)	DEA	147 hotels, from 2013 to 2017	(1) Total personnel; (2) Non-current assets; (3) Consumption.	(1) Revenue.	Ecuador	
Tan and Despotis (2021)	Network DEA	179 hotels, from 2010 to 2018	(1) Cost of goods sold; (2) Assets (the fixed assets and current assets); (3) Number of employees.	(1) Capital.	UK	
Flegl et al. (2023)	DEA	Hotels from 32 Mexican states, from 1992 to 2018	(1) Number of one-star hotel rooms; (2) Number of two-star hotel rooms; (3) Number of three-star hotel rooms; (4) Number of four-star hotels room; (5) Number of five-star hotel rooms.	(1) Tourists' nights; (2) Related revenues per available room.	Mexico	

Source: Own elaboration

Table 2. Summary of inputs and outputs used in hotel efficiency studies.

Inputs	***Outputs***
• Total cost; • Total assets; • Current assets; • Non-current assets; • Net fixed assets; • Shareholders' equity; • Room division expenditures; • Total costs; • Energy costs; • Total food and beverage costs; • Total utility costs; • Hotel investment costs; • External costs; • Catering costs; • Labour costs; • Personnel expenses; • Payroll expenses; • Costs of materials; • Costs of services; • Costs of goods; • Costs of sales; • Costs of maintaining rooms; • Total gaming-related expenses; • Hotel administrative expenses; • Total operating expenses; • Operating/operational costs; • Operating expenses (expenses for rooms, for food and beverage, expenses associated with other services) • Non-operating expenses (administrative and general expenses, facility maintenance cost, utility cost, and advertisement and promotional expenditure, hotel property taxes, and equipment depreciation)	- Total Revenues/Real revenue/Annual revenue; - Total room revenue; - Total gaming revenue, - Total food and beverage revenue; - Total operating revenues; - Total operating revenues of the room division; - Total operating revenue of the catering division; - Miscellaneous Revenue; - Revenue per available room (RevPAR); - Related revenues per available room - Sales/Sales revenue; - Other sources of revenue/ Other revenues; - Other revenue per room sold; - Total revenue generated by other sources such as laundry, night clubs, and service fees; - Level of service delivered; - Rate of growth; - Market share; - Number of room nights sold/spent; - Number of rooms occupied; - Total covers served; - Occupancy rate; - Average occupancy rate; - Average room rate; - Average daily rate (ADR); - Average production value per employee in the catering division;

• Expenses (Costs of goods sold; selling, general, and administrative expenses; nonoperating expenses) • Other expenses; • Salary; • Advertising expenditures; • Non-salary expenses with property; • Non-salary expenses with administrative work; • Non-salary expenses with variable advertising; • Fixed expenditures; • Number of room nights available; • Total labour hours; • Number of full-time equivalent employees/ Number of employees; • Number of temporary staff; • Total personnel; • Number of employees in room division; • Number of employees in catering division; • Number of hotels • Number of full-time employees in F&B departments; • Number of rooms; • Number of beds; • Number of guest rooms; • Number of restaurant seats; • Number of one-star hotel rooms; • Number of two-star hotel rooms; • Number of three-star hotel rooms; • Number of four-star hotels room; • Number of five-star hotel rooms. • Surface area of the hotel; • Total floor space of the catering division; • Total Area of Meal Department; • Total space utilized by all F&B outlets; • Total payroll in the room division department; • Total payroll in other departments;	- Average production value of the catering division (per 36 square feet); - Net profit; - Customer Satisfaction; - Customer value; - Number of guests; - Number of nights spent; - Tourists' nights; - Yielding index; - Profit margin; - Earnings (EBITDA); - Modified RevPAR; - Profit after tax; - Gross value added (GVA); - Gross lettings; - Room occupancy percentage; - The ratio of customers staying more than once in a hotel; - Income (Operating income; Non-operating income)

• Book value of the property/ book value of the premises; • The book value of the assets; • Total international visitor arrivals; • Inventories; • Investment expenditures; • Property plant and equipment; • Food and beverage (F&B) capacity; • Consumption; • Owner equity; • Average room rate; • Room capacity; • Problems; • Service; • Upkeep; • Hotels; • GDP;	

Source: Own elaboration

The selection of input and output variables is due to a theoretical approach mentioned in the literature review (integrated combination of financial and non-financial measures) but at the same time is restricted by data availability; thus, the variables in Table 3 will be used in this study.

Table 3. Summary of final Inputs and outputs for the study.

Inputs	***Outputs***
• Current Assets (X1); • Non-Current (Fixed) Assets (X2) • Shareholders' equity (X3) • Cost of Employees (X4) • Material Costs (X5)	• Operating revenue (Y);

Source: Own elaboration

3.3. Dataset

The sample for this study was chosen from a database called SABI (Sistema de Análisis de Balances Ibéricos) which provides information on 2.900.000 Spanish and 900.000 Portuguese companies. The creation of our dataset adheres to the following criteria: firstly, operating in the same Province of Spain and secondly, including hotels that fall under the same star rating. The sample of hotels was selected based on determined criteria from the overall population of active hotels in Barcelona Province during the period 2012-2021, and subsequently was divided into two groups according to their star rating: 3-star and 4-star hotels.

Above mentioned criteria were established to ensure the homogeneity of the DMUs being analyzed since based on the theory and DEA application requirement, at the time of choosing DMUs, there is a need for homogeneity of the DMUs (Wöber, 2007). This supposes that the analyzed units use the same types of resources, generate the same class of products, operate under the same market conditions and all inputs and outputs describing the performance of all units analyzed in the group are identical (Golany and Roll, 1989; Fuentes et al., 2016). And finally, to determine the size of DMUs different authors (Cook et al., 2014; Golany and Roll, 1989) suggest the "rule of thumb" which implies that the number of DMUs should be at least twice the number of inputs and outputs considered, since larger the population is, larger the probability will be to have efficient performing units which create the efficiency frontier. Thus, twelve 3-star hotels and eight 4-star hotels operating in Barcelona will be analyzed. This study will involve a smaller sample size compared to the majority of previous studies but at the same time an adequate size to apply the DEA over an extended period of time, during the period 2012-2021, to examine the efficiency of the hotel industry. Because the time period covers the COVID-19 pandemic, we will divide the sample into two periods, before the COVID-19 pandemic (2012-2019) and during the COVID-19 pandemic (2020-2021), to separately examine hotel efficiency.

Thus, this study will directly address hotel efficiency including the period which covers the COVID-19 pandemic, and will employ a Data Envelopment Analysis (DEA) output-orientation model (CCR and BCC models) for 20 hotels in Barcelona, over the period 2012 to 2021 using the following *input variables*: *(X1) Current Assets; (X2) Non-*

Current (Fixed) Assets; (X3) Shareholders' equity; (X4) Cost of employees; *(X5) Material Costs* and *output variable: (Y) Operating revenue (Table 4-Table 13).*

Table 4. Data belonging to each hotel in the selected sample, 2012

	Current Assets (X1)	***Non-Current Assets (X2)***	***Equity (X3)***	***Cost of Employees (X4)***	***Material Cost (X5)***	***Revenue (Y)***
H1	582,174	9,873,151	2,168,607	284,588	357,415	2,902,586
H2	4,568,731	6,191,709	9,884,114	626,372	156,391	2,623,997
H3	782,448	9,179,405	8,847,233	1,082,939	115,461	3,657,265
H4	1,203,238	11,664,767	12,579,528	696,622	104,552	2,968,589
H5	6,608,221	2,092,088	7,648,978	921,313	141,489	3,153,363
H6	458,286	10,089,310	2,963,485	252,555	356,692	2,070,432
H7	249,697	2,179,824	1,313,621	428,418	33,348	1,369,300
H8	646,103	1,290,157	756,899	635,833	273,811	2,526,418
H9	4,566,669	264,399	4,441,151	976,547	201,656	4,071,084
H10	2,327,024	701,517	2,900,141	452,915	62,580	2,087,144
H11	1,251,775	51,701,579	51,450,883	1,373,344	292,137	5,423,252
H12	28,066,084	217,831,384	15,328,922	14,823,681	3,140,485	57,498,693
H13	3,332,115	993,018	3,120,662	480,874	76,696	2,160,755
H14	908,350	418,940	987,546	585,467	105,325	2,122,542
H15	2,961,963	6,807,014	9,061,927	731,344	377,526	3,147,995
H16	867,893	8,063,001	8,075,881	1,111,740	226,791	3,698,242
H17	4,081,435	9,345,757	11,912,091	961,386	110,443	3,348,799
H18	439,590	6,581,578	4,568,509	1,702,721	364,675	4,052,953
H19	1,884,898	53,911,379	37,761,108	5,063,226	1,680,173	14,088,937
H20	3,871,443	5,268,840	7,268,510	3,833,507	933,535	7,767,504

Table 5. Data belonging to each hotel in the selected sample, 2013

	Current Assets (X1)	***Non-Current Assets (X2)***	***Equity (X3)***	***Cost of Employees (X4)***	***Material Cost (X5)***	***Revenue (Y)***
H1	967,026	8,808,259	2,194,146	260,068	379,631	2,825,768
H2	4,385,234	6,977,068	10,635,140	658,728	145,587	2,674,377
H3	830,019	9,597,336	9,477,488	1,075,461	117,724	3,551,742
H4	1,383,303	12,381,035	13,384,056	702,107	110,350	3,082,311
H5	6,618,220	2,004,189	7,851,289	822,355	133,786	2,914,989
H6	380,279	9,915,102	3,481,379	246,127	359,073	1,997,793
H7	186,895	2,034,016	1,327,090	453,947	31,296	1,291,307
H8	814,992	1,217,119	858,212	608,200	235,294	2,460,124
H9	4,027,369	1,018,076	4,391,181	987,489	191,856	3,780,900
H10	1,645,446	1,422,716	2,795,998	477,043	63,215	2,047,140
H11	1,051,799	53,083,006	51,003,036	1,534,073	272,034	5,532,328
H12	26,040,197	203,523,388	12,637,663	14,819,789	3,346,832	55,431,549
H13	2,772,681	1,461,747	3,166,423	514,363	76,801	2,338,379
H14	1,181,551	471,105	994,128	656,630	108,831	2,287,100
H15	8,491,649	1,462,612	9,367,369	702,675	361,446	3,005,261
H16	645,418	5,475,840	5,282,717	1,086,521	171,574	3,578,466
H17	4,321,552	9,132,368	12,281,181	941,413	112,400	3,403,052
H18	472,300	5,968,709	4,529,224	1,726,389	398,567	4,265,532
H19	2,006,903	57,246,529	46,059,887	4,990,637	1,973,633	14,366,577
H20	3,411,300	4,803,857	6,689,594	4,125,335	822,250	8,082,713

Table 6. Data belonging to each hotel in the selected sample, 2014

	Current Assets (X1)	***Non-Current Assets (X2)***	***Equity (X3)***	***Cost of Employees (X4)***	***Material Cost (X5)***	***Revenue (Y)***
H1	780,137	9,018,319	2,477,211	238,666	396,334	2,700,272
H2	5,420,830	7,193,553	11,667,318	652,960	152,728	2,748,772
H3	1,620,651	9,384,183	10,192,490	999,541	138,294	3,537,230
H4	1,698,134	17,760,740	14,069,313	745,137	115,419	3,281,970
H5	5,396,899	1,894,969	6,645,286	801,108	134,663	2,973,668
H6	563,391	9,794,242	4,095,823	259,092	320,258	1,982,048
H7	161,416	1,875,341	1,323,028	449,298	25,720	1,343,621
H8	932,754	1,121,420	963,305	675,536	244,009	2,503,527
H9	3,912,598	1,172,950	4,482,306	1,028,290	200,782	4,148,942
H10	1,449,228	1,754,879	2,716,675	473,438	63,046	2,104,800
H11	919,830	58,097,324	52,273,757	1,522,701	277,754	5,250,818
H12	20,008,263	199,306,010	14,173,977	15,262,054	3,440,934	58,383,676
H13	2,698,313	1,306,748	3,217,584	506,568	76,346	2,316,923
H14	1,363,558	441,790	1,054,553	746,277	139,331	2,504,210
H15	2,195,096	1,066,445	2,647,935	675,328	357,469	2,999,496
H16	755,459	6,116,035	6,087,607	1,045,615	142,391	3,382,789
H17	4,066,073	7,173,640	10,301,260	848,680	104,982	3,302,210
H18	377,809	5,647,348	4,416,972	1,714,570	407,006	4,083,568
H19	3,584,068	57,311,633	48,904,718	4,894,012	1,927,381	14,799,161
H20	3,530,009	4,603,010	6,601,572	4,162,032	1,044,178	8,287,777

Table 7. Data belonging to each hotel in the selected sample, 2015

	Current Assets (X1)	***Non-Current Assets (X2)***	***Equity (X3)***	***Cost of Employees (X4)***	***Material Cost (X5)***	***Revenue (Y)***
H1	507,220	8,780,047	3,003,328	235,821	422,039	2,907,075
H2	5,537,905	8,214,607	12,832,640	677,249	166,517	2,850,293
H3	645,173	11,477,019	10,944,842	1,081,458	128,928	3,479,872
H4	2,115,579	17,361,820	14,670,565	862,482	132,332	4,386,888
H5	5,856,271	1,890,241	7,028,030	793,869	136,384	3,154,352
H6	479,012	9,617,447	4,807,085	265,803	366,322	2,216,527
H7	152,645	1,725,221	1,369,694	408,574	25,108	1,406,683
H8	924,690	1,380,869	872,991	683,221	235,456	2,307,134
H9	4,324,045	1,155,728	4,754,777	1,106,658	196,612	4,657,430
H10	1,813,136	1,237,868	2,799,498	483,504	58,486	2,379,287
H11	918,899	57,569,471	54,397,682	1,542,955	276,535	5,441,450
H12	26,601,247	189,210,763	25,122,701	16,677,122	3,745,625	71,936,870
H13	2,929,399	689,754	3,355,913	498,669	74,241	2,409,166
H14	1,507,495	410,401	1,136,127	825,157	168,297	2,776,770
H15	2,544,131	756,886	2,380,766	693,506	372,932	3,210,998
H16	632,659	8,218,389	6,796,385	872,532	147,943	3,161,985
H17	3,998,820	7,388,167	10,699,353	918,162	123,154	3,540,082
H18	972,444	5,246,174	4,525,600	1,801,522	380,169	4,216,972
H19	4,133,148	58,838,137	52,044,889	5,057,669	2,006,365	15,568,895
H20	2,208,173	5,837,034	6,280,952	4,345,738	959,229	8,618,279

Table 8. Data belonging to each hotel in the selected sample, 2016

	Current Assets (X1)	*Non-Current Assets (X2)*	*Equity (X3)*	*Cost of Employees (X4)*	*Material Cost (X5)*	*Revenue (Y)*
H1	389,963	9,745,346	4,611,916	279,961	388,719	3,015,714
H2	2,040,948	12,501,542	13,779,075	720,275	171,249	3,037,052
H3	4,700,778	11,975,253	11,883,344	1,029,136	154,921	4,005,530
H4	4,028,855	16,790,911	16,430,585	913,226	188,165	4,713,779
H5	6,648,854	2,012,606	7,664,249	941,717	146,289	3,705,029
H6	564,166	9,440,651	5,619,944	283,434	91,194	2,464,158
H7	209,664	1,597,464	1,470,972	443,166	40,884	1,513,149
H8	1,055,030	1,396,988	982,363	697,481	194,682	2,497,403
H9	4,824,358	1,258,839	5,434,629	1,131,543	200,844	5,311,023
H10	2,105,606	1,131,311	3,000,488	498,138	63,284	2,638,938
H11	1,243,392	58,216,012	56,872,217	1,527,925	304,915	5,735,481
H12	29,334,668	190,386,737	34,714,717	17,129,757	3,967,537	76,298,173
H13	3,290,569	582,375	3,586,421	520,203	78,545	2,571,977
H14	1,853,154	498,000	1,426,209	683,196	180,065	3,070,121
H15	2,657,081	709,593	2,562,831	746,310	383,310	3,659,392
H16	355,219	9,902,319	7,727,149	944,439	131,046	3,551,186
H17	3,973,180	8,058,082	11,116,205	1,195,944	118,815	3,903,374
H18	4,919,001	1,620,008	4,724,569	1,845,712	407,999	4,599,125
H19	4,432,092	58,520,897	55,933,585	5,205,193	2,071,683	16,964,807
H20	1,578,256	6,247,698	6,184,184	4,557,328	945,907	8,977,327

Table 9. Data belonging to each hotel in the selected sample, 2017

	Current Assets (X1)	*Non-Current Assets (X2)*	*Equity (X3)*	*Cost of Employees (X4)*	*Material Cost (X5)*	*Revenue (Y)*
H1	232,875	10,047,980	5,781,119	318,485	376,897	3,255,914
H2	2,511,616	13,136,918	14,795,604	718,057	191,073	3,109,592
H3	3,247,799	11,471,522	12,947,921	1,137,232	180,426	4,331,797
H4	4,209,878	16,869,754	17,337,657	967,492	164,469	4,730,970
H5	7,824,726	2,217,879	8,684,676	1,013,179	152,331	3,763,549
H6	823,500	9,263,856	6,093,912	289,258	95,922	2,695,129
H7	343,985	1,617,882	1,638,031	340,626	46,464	1,489,724
H8	1,110,499	1,206,735	1,058,881	602,160	148,472	2,372,148
H9	5,410,157	1,285,704	6,067,334	1,155,454	206,337	5,206,522
H10	2,275,316	1,104,629	3,079,613	513,823	57,884	2,447,498
H11	894,881	56,535,440	54,886,432	1,616,544	287,267	6,240,999
H12	43,031,799	181,602,957	51,205,685	19,109,438	4,016,569	79,091,174
H13	3,526,802	558,564	3,809,450	553,731	79,544	2,511,278
H14	1,670,187	628,102	1,404,259	584,442	163,896	3,219,313
H15	3,137,440	355,072	2,649,715	760,944	397,791	4,103,765
H16	545,670	10,019,127	8,871,258	1,046,337	131,721	4,183,258
H17	8,714,479	8,643,617	15,998,090	1,229,987	108,839	4,331,095
H18	1,893,097	5,235,645	4,859,152	1,939,003	436,203	4,629,388
H19	3,621,446	59,132,845	55,963,128	5,460,838	2,208,506	17,626,319
H20	1,458,853	6,619,256	6,402,982	4,517,748	1,007,246	9,393,975

Table 10. Data belonging to each hotel in the selected sample, 2018

	Current Assets (X1)	***Non-Current Assets (X2)***	***Equity (X3)***	***Cost of Employees (X4)***	***Material Cost (X5)***	***Revenue (Y)***
H1	641,011	10,090,373	6,669,582	394,339	434,241	3,220,489
H2	2,791,418	13,730,169	15,753,703	703,167	171,490	3,122,001
H3	1,196,811	13,599,170	13,639,543	1,225,426	169,207	4,095,563
H4	4,670,108	15,913,343	17,529,007	962,360	203,919	4,687,216
H5	16,385,892	2,067,253	8,777,189	1,049,944	152,155	3,405,015
H6	788,317	9,101,172	6,255,842	310,684	98,756	2,626,232
H7	242,757	1,751,491	1,666,344	358,740	36,955	1,370,928
H8	1,386,371	947,978	1,118,073	405,057	68,431	1,902,302
H9	5,727,316	1,277,731	6,363,384	1,185,493	211,577	4,939,403
H10	2,159,961	1,291,051	2,973,776	528,501	58,215	2,349,960
H11	5,557,900	56,131,527	56,776,408	1,648,687	273,267	5,846,004
H12	47,437,178	190,524,215	59,814,953	19,985,912	4,290,169	74,616,454
H13	3,316,692	669,498	3,752,814	579,712	80,520	2,320,199
H14	1,597,435	681,953	1,501,648	582,987	148,839	2,921,797
H15	3,067,287	347,635	2,757,990	844,108	434,573	3,919,550
H16	1,012,116	10,015,053	10,022,868	1,078,115	148,204	4,324,250
H17	9,058,562	8,235,664	16,295,592	1,160,054	115,832	4,017,147
H18	1,865,960	5,192,212	4,598,611	1,940,334	471,308	4,264,775
H19	2,838,872	59,151,035	55,865,877	5,634,311	2,347,425	18,028,587
H20	1,344,787	7,098,430	6,605,023	4,495,838	1,093,068	9,764,468

Table 11. Data belonging to each hotel in the selected sample, 2019

	Current Assets (X1)	***Non-Current Assets (X2)***	***Equity (X3)***	***Cost of Employees (X4)***	***Material Cost (X5)***	***Revenue (Y)***
H1	1,043,609	9,939,588	7,299,153	419,084	429,278	3,468,391
H2	3,589,275	14,006,576	16,661,699	728,411	174,094	3,266,078
H3	1,971,241	11,556,422	12,573,461	1,261,467	160,237	4,678,903
H4	5,010,629	15,114,360	18,016,593	995,343	316,225	4,857,906
H5	15,786,206	2,044,201	9,122,394	1,128,262	131,653	3,823,109
H6	1,104,683	8,922,877	6,576,511	337,068	106,120	2,920,245
H7	72,799	1,862,840	1,708,799	424,545	37,365	1,741,894
H8	1,509,258	587,470	1,132,064	343,564	102,873	2,114,814
H9	5,476,572	1,844,169	6,762,193	1,315,269	227,378	5,342,355
H10	1,270,363	2,062,909	2,955,703	554,085	61,940	2,480,435
H11	4,795,813	57,490,368	57,796,778	1,620,753	231,157	5,857,962
H12	67,132,480	169,079,157	41,651,908	21,450,266	4,325,412	74,992,770
H13	3,196,425	955,330	3,838,285	669,172	101,258	2,685,191
H14	1,954,793	895,217	1,925,012	620,011	148,781	3,279,541
H15	3,235,263	372,950	2,851,075	871,558	464,306	4,226,196
H16	1,322,040	10,006,467	10,323,947	1,115,303	145,233	4,574,540
H17	10,100,307	4,794,283	13,923,437	1,258,209	113,318	4,539,394
H18	2,887,216	5,787,788	4,612,797	1,944,350	433,405	4,667,028
H19	3,614,114	58,554,436	56,056,739	5,889,339	2,447,578	19,221,039
H20	1,057,155	7,208,332	6,989,350	4,827,527	1,416,454	10,660,444

Table 12. Data belonging to each hotel in the selected sample, 2020

	Current Assets (X1)	***Non-Current Assets (X2)***	***Equity (X3)***	***Cost of Employees (X4)***	***Material Cost (X5)***	***Revenue (Y)***
H1	1,602,103	9,841,672	7,115,220	290,102	161,536	1,007,677
H2	2,790,756	14,027,235	16,505,204	375,772	34,474	502,514
H3	1,345,481	11,106,210	12,063,144	554,637	34,067	1,027,738
H4	3,422,269	14,641,377	16,777,702	477,705	55,630	834,461
H5	13,870,555	1,854,981	8,147,066	500,916	28,319	774,009
H6	403,227	8,744,581	6,136,385	191,483	22,757	666,974
H7	36,298	1,724,567	1,402,399	140,866	6,988	284,472
H8	1,356,613	369,445	736,244	134,615	56,100	536,099
H9	4,532,005	1,389,723	5,803,850	554,374	47,746	691,951
H10	958,061	2,375,152	2,348,887	290,219	11,180	295,933
H11	357,257	61,430,269	59,789,246	665,916	34,724	612,103
H12	31,427,809	180,245,416	5,867,643	12,227,343	996,414	23,034,064
H13	2,495,598	811,375	3,257,838	262,151	13,902	285,139
H14	1,823,964	833,439	1,210,673	244,299	59,878	506,083
H15	1,632,741	971,132	2,445,413	455,402	93,778	779,208
H16	809,187	9,501,835	9,993,101	503,876	36,619	1,025,660
H17	8,360,013	4,917,454	12,847,162	510,503	23,758	805,464
H18	376,889	6,965,581	3,609,942	1,059,909	172,455	1,214,135
H19	1,970,856	57,276,244	53,885,278	2,752,379	535,935	3,806,342
H20	386,480	7,184,595	4,604,918	2,436,580	275,554	2,116,208

Table 13. Data belonging to each hotel in the selected sample, 2021

	Current Assets (X1)	*Non-Current Assets (X2)*	*Equity (X3)*	*Cost of Employees (X4)*	*Material Cost (X5)*	*Revenue (Y)*
H1	1,636,021	9,475,774	6,948,564	294,117	235,075	1,636,549
H2	3,039,493	14,569,645	17,100,995	490,017	92,261	1,512,926
H3	840,571	11,587,230	11,946,851	728,725	59,949	1,865,036
H4	3,348,366	14,210,459	16,559,808	713,839	83,155	2,149,972
H5	13,464,808	1,663,904	7,828,732	533,016	16,083	1,464,649
H6	804,480	8,566,286	6,369,655	149,940	31,638	1,295,322
H7	464,469	1,543,742	1,434,347	241,663	17,800	845,963
H8	1,232,304	274,791	664,381	157,456	29,192	729,342
H9	3,589,436	2,044,901	5,225,813	140,719	9,028	371,156
H10	572,823	2,328,066	1,927,419	179,344	3,200	131,682
H11	360,991	62,942,961	59,452,931	372,473	266	529,896
H12	40,171,292	178,075,368	6,053,795	13,165,763	1,733,950	34,269,600
H13	2,127,627	706,071	2,790,191	160,749	2,716	102,924
H14	1,985,547	708,128	793,235	198,094	50,554	918,512
H15	1,916,012	2,148,489	2,211,423	397,966	104,087	1,187,890
H16	1,515,789	9,039,140	10,070,924	703,161	67,671	1,925,124
H17	8,718,607	4,436,482	12,749,018	606,550	34,780	2,027,603
H18	502,938	6,568,346	3,140,090	1,184,587	255,013	2,501,560
H19	4,185,300	55,776,820	53,499,247	3,098,434	928,759	7,117,117
H20	437,223	7,292,873	2,599,298	3,215,724	364,336	3,452,511

The descriptive statistics for all the variables in the model is presented (Table 14) since, as mentioned by Vetter (2017), "descriptive statistics are specific methods basically used to calculate, describe, and summarize collected research data in a logical, meaningful, and efficient way" (p. 1) which helps to identify some elements for our variables such as:

- For X1 (Current Asstes): *the mean value* is 4341539.835000; its *minimum value* is at 36298.000000 and its *maximum value* at 67132480.000000; *the value of its standard deviation* would be 8274129.231229.

Table 14. Summary of Descriptive Statistics on inputs and outputs, 2012-2021

Input/Output	***Mean***	***Std. Dev.***	***Minimum***	***Maximum***
(X1) Current Assets	4341539.835000	8274129.231229	36298.000000	67132480.000000
(X2) Non-Current (Fixed) Assets	19963600.420000	42420616.688692	264399.000000	217831384.000000
(X3) Shareholders' equity	12171371.065000	15754885.308466	664381.000000	59814953.000000
(X4) Cost of employees	1906624.585000	3615245.124921	134615.000000	21450266.000000
(X5) Material Costs	442232.565000	818408.539253	266.000000	4325412.000000
(Y) Operating revenue	6559340.160000	13439342.177502	102924.000000	79091174.000000

Source: Own elaboration

CHAPTER 4: RESULTS AND DISCUSSION..

4.1. Results

4.1.1. Efficiency Results and Analysis

Table 15 represents efficiency scores of each hotel included in the sample. The sample was divided into two groups: 3-star hotels and 4-star hotels and the Hotels having a score equal to 1 meet the first condition and therefore can be said that they are potentially efficient hotels at the moment. The hotels that have a value other than 1 (in our case greater than 1 because we have the output orientation) are inefficient. The results indicate that, if we analyze by years, in 2012 we have more inefficient hotels belonging to 4-star hotels but starting from 2013, we have more inefficient hotels belonging to 3-star hotels than to 4-Star hotels. While observing each inefficient hotel's performance during the 10-year period and comparing the level of inefficiency of inefficient hotels (Table 16 - Table 25) before and during the COVID-19 pandemic, it becomes clear that the COVID-19 pandemic had a negative impact on all of them. For example, for Hotel 2 during a 10-year period, the highest inefficiency levels were recorded during 2020 and 2021 with 89.93% and 42.56% respectively. In the case of Hotel 4, we have the same situation where it recorded the highest levels of inefficiency with 45% in 2020 and 12.88% in 2021. Or, Hotel 11 had the highest level of inefficiency during a 10-year period in 2020 with 14.31%. We can also notice that during COVID-19 we have more 3-star hotels being inefficient and having a high level of inefficiency than 4 stars hotels (from 12 hotels 33% of hotels are inefficient and from 8 hotels 12% are inefficient).

Table 15. DEA Efficiency Scores of Hotels in Barcelona, 2012-2021

Category	***Hotel***	***Year***									
		2012	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***
***	H1	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
***	H2	*1.145864*	*1.136578*	*1.110854*	*1.250829*	*1.375001*	*1.428309*	*1.267710*	*1.276160*	*1.898395*	*1.425630*
***	H3	**1.000000**	**1.000000**	**1.000000**	**1.000000**	*1.114657*	*1.155027*	*1.130078*	*1.036494*	**1.000000**	**1.000000**
***	H4	**1.000000**	**1.000000**	**1.000000**	**1.000000**	*1.007525*	**1.000000**	**1.000000**	*1.077835*	*1.450730*	*1.128808*
***	H5	*1.067885*	*1.069368*	*1.088795*	*1.132817*	*1.153306*	*1.149934*	*1.178984*	**1.000000**	**1.000000**	**1.000000**
***	H6	**1.000000**	**1.000000**	**1.000000**	1.229856	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
***	H7	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
***	H8	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
***	H9	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
***	H10	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	*1.309499*	**1.000000**
***	H11	**1.000000**	**1.000000**	**1.000000**	**1.000000**	*1.030755*	**1.000000**	*1.102657*	*1.047605*	*1.143135*	**1.000000**
***	H12	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
****	H13	*1.029260*	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
****	H14	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	*1.203213*	**1.000000**
****	H15	*1.234760*	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	*1.073033*
****	H16	*1.011721*	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
****	H17	*1.021278*	**1.000000**	**1.000000**	*1.058770*	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
****	H18	**1.000000**	**1.000000**	**1.000000**	*1.021428*	*1.140729*	*1.259838*	*1.334215*	*1.265881*	**1.000000**	**1.000000**
****	H19	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**
****	H20	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**	**1.000000**

Source. Own elaboration

Table 16. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2012

2012						
	Hotel 2 * **	**Hotel 5*****	**Hotel 13******	**Hotel 15******	**Hotel 16******	**Hotel 17******
Inefficiency score	1.145864	1.067885	1.029260	1.234760	1.011721	1.021278
Level of Inefficiency* (%)	14.59%	6.8%	2.93%	23.48%	1.17%	2.13%

Source. Own elaboration

Table 17. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2013

2013		
	Hotel 2 * **	**Hotel 5*****
Inefficiency score	1.136578	1.069368
Level of Inefficiency* (%)	13.66%	6.94%

Source. Own elaboration

Table 18. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2014

2014		
	Hotel 2 * **	**Hotel 5*****
Inefficiency score	1.110854	1.088795
Level of Inefficiency* (%)	11%	8.89%

Source. Own elaboration

Table 19. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2015

2015					
	Hotel 2 * **	**Hotel 5*** **	**Hotel 6*** **	**Hotel 17******	**Hotel 18******
Inefficiency score	1.250829	1.132817	1.229856	1.058770	1.021428
Level of Inefficiency* (%)	25%	13.28%	23%	5.88%	2.14%

Source. Own elaboration

Table 20. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2016

2016						
	Hotel 2 * **	**Hotel 3*** **	**Hotel 4*** **	**Hotel 5*** **	**Hotel 11*** **	**Hotel 18******
Inefficiency score	1.375001	1.114657	1.007525	1.153306	1.030755	1.140729
Level of Inefficiency* (%)	37.5%	11.47%	0.75%	15.33%	3.08%	14.07%

Source. Own elaboration

Table 21. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2017

2017				
	Hotel 2 * **	**Hotel 3*** **	**Hotel 5*** **	**Hotel 18******
Inefficiency score	1.428309	1.155027	1.149934	1.259838
Level of Inefficiency* (%)	42.83%	15.50%	14.99%	25.98%

Source. Own elaboration

Table 22. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2018

2018					
	Hotel 2 * **	**Hotel 3*** **	**Hotel 5*** **	**Hotel 11*** **	**Hotel 18**** **
Inefficiency score	1.267710	1.130078	1.178984	1.102657	1.334215
Level of Inefficiency* (%)	26.77%	13%	17.90%	10.27%	33.42%

Source. Own elaboration

Table 23. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2019

2019					
	Hotel 2 * **	**Hotel 3*** **	**Hotel 4*** **	**Hotel 11*** **	**Hotel 18**** **
Inefficiency score	1.276160	1.036494	1.077835	1.047605	1.265881
Level of Inefficiency* (%)	27.61%	3.65%	7.78%	4.76%	26.59%

Source. Own elaboration

Table 24. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2020

2020					
	Hotel 2 * **	**Hotel 4*** **	**Hotel 10*** **	**Hotel 11*** **	**Hotel 14**** **
Inefficiency score	1.898395	1.450730	1.309499	1.143135	1.203213
Level of Inefficiency* (%)	**89.83%**	**45%**	**30.95%**	**14.31%**	**20.32%**

Source. Own elaboration

Table 25. DEA Inefficiency Scores and Level of Inefficiency of Hotels in Barcelona, 2021

2021			
	Hotel 2 * **	**Hotel 4*** **	**Hotel 15**** **
Inefficiency score	1.425630	1.128808	1.073033
Level of Inefficiency* (%)	**42.56%**	**12.88%**	7.30%

Source. Own elaboration

4.1.2. Lambda Results and Analysis

Lambda values express the weight of each DMU in the peer group of the DMUs, the elements of the Lambdas Matrix indicate the hotel that is part of the comparison group and identify a hotel that would be the model to follow to improve the efficiency (Neves and Lourenço, 2009; Fuentes et al., 2016). During the 10-year period, we have more 3-star hotels identified as principal models to follow than 4-star hotels (Table 26).

Table 26. Model Hotel to follow to improve efficiency

2012	***2013***	***2014***	***2015***	***2016***
*Hotel 12****	*Hotel 13*****	*Hotel 13*****	*Hotel 10****	*Hotel 9****
2017	***2018***	***2019***	***2020***	***2021***
*Hotel 6****	*Hotel 16*****	*Hotel 16*****	*Hotel 6****	*Hotel 6****

Own elaboration

4.1.3. Slack Results and Analysis

Slack values of DEA offer valuable insights by providing specific recommendations for inefficient Hotels in order to become efficient. As Barros states (2005), “adjustments for the inefficient hotels can be identified for outputs and inputs in order for them to join the efficient frontier” (p. 470). Slack Results represent the change in resources and products that a Hotel has to make to be efficient beyond what the efficiency parameter indicates. The change of resources implies that Hotels always have to reduce resources according to what the Slack indicates and the change of products implies that Hotels always have to increase products, first according to what the efficiency parameter indicates, and then according to what the Slack indicates in order to become efficient (Manasakis et al., 2013). And this information will help to hotel managers in their decision-making process, especially for unexpected situations such s COIVD-19.

The analysis of input and output slacks, in Table 27 – Table 36, provides the input and output slacks where if we consider the case of Hotel 2 in 2012, for the interpretation, it should make different adjustments in inputs such as Current Assets, Non-Current Assets, and Shareholder’s Equity and in output such as Revenue, in order to operate efficiently. First, it would have to reduce its Current Assets by 2,178,191.50 (from 4,568,731 to 2,390,539.5), Non-Current Assets by 863,374 (from 6,191,709 to 5,328,335), and Equity by 6,934,293 (from 9,884,114 to 2,949,821) while in case of its

Revenue it would have to make an effort to increase its by 382,747 (from 2,623,997 to 3,006,744). In the case of 3-star Hotels, the majority of them are required make adjustments in resources X1, X2, X3 while 4-star hotels should focus their attention on reducing resources such as X4 and X5.

Table 27. Slack values of Hotels in Barcelona, 2012

Original values of inputs and outputs

2012						
	Hotel 2 ***	**Hotel 5*****	**Hotel 13******	**Hotel 15******	**Hotel 16******	**Hotel 17******
Amount of products each hotel has to produce to be efficient	Y 2,623,997	Y 3,153,363	Y 2,160,755	Y 3,147,995	Y 3,698,242	Y 3,348,799
Amount of resources each hotel has to reduce to be efficient	X1: 4,568,731 X2: 6,191,709 X3: 9,884,114	X1: 6,608,221 X3: 7,648,978 X4: 921,313	X1: 3,332,115 X3: 3,120,662	X1: 2,961,963 X3: 9,061,927 X5: 377,526	X3: 8,075,881	X1: 4,081,435 X3: 11,912,091

Recommended changes in inputs and outputs

2012						
	Hotel 2 ***	**Hotel 5*****	**Hotel 13******	**Hotel 15******	**Hotel 16******	**Hotel 17******
Amount of products each hotel has to produce to be efficient	Y 3,006,744	Y 3,367,430	Y 2,223,979	Y 3,887,020	Y 3,741,591	Y 3,420,053
Amount of resources each hotel has to reduce to be efficient	X1: 2,390,539.5 X2: 5,328,335 X3: 2,949,821	X1: 3,143,536.5 X3: 4,790,745 X4: 831,699.7	X1: 2,405,527.8 X3: 2,961,053	X1: 2,724,200.5 X3: 3,371,051 X5: 3,032,11.4	X3: 6,244,433	X1: 961,818.8 X3: 9,419,156

Own Elaboration

Table 28. Slack values of Hotels in Barcelona, 2013

Original values of inputs and outputs

2013		
	Hotel 2 ***	**Hotel 5*****
Amount of products each hotel has to produce to be efficient	Y 2,674,377	Y 2,914,989
Amount of resources each hotel has to reduce to be efficient	X1: 4,385,234 X3: 10,635,140	X1: 6,618,220 X3: 7,851,289 X4: 822,355 X5: 133,786

Recommended changes in inputs and outputs

2013		
	Hotel 2 ***	**Hotel 5*****
Amount of products each hotel has to produce to be efficient	Y 3,039,637	Y 3,117,196
Amount of resources each hotel has to reduce to be efficient	X1: 2,385,366 X3: 5,999,507	X1: 3,174,560 X3: 4,312,996 X4: 784,796 X5: 141,489

Own Elaboration

Table 29. Slack values of Hotels in Barcelona, 2014

Original values of inputs and outputs

2014		
	Hotel 2 ***	**Hotel 5*****
Amount of products each hotel has to produce to be efficient	Y 2,748,772	Y 2,973,668
Amount of resources each hotel has to reduce to be efficient	X1: 5,420,830	X1: 5,396,899

	X3: 11,667,318	X3: 6,645,286 X4: 801,108

Recommended changes in inputs and outputs

2014		
	Hotel 2 ***	**Hotel 5*****
Amount of products each hotel has to produce to be efficient	Y 3,053,484	Y 3,237,714
Amount of resources each hotel has to reduce to be efficient	X1: 2,429,461 X3: 5,321,987	X1: 3,387,506 X3: 4,559,997 X4: 775,580.9

Own Elaboration

Table 30. Slack values of Hotels in Barcelona, 2015

Original values of inputs and outputs

2015					
	Hotel 2 * **	**Hotel 5*** **	**Hotel 6*** **	**Hotel 17***** **	**Hotel 18***** **
Amount of products each hotel has to produce to be efficient	Y 2,850,293	Y 3,154,352	Y 2,216,527	Y 3,540,082	Y 4,216,972
Amount of resources each hotel has to reduce to be efficient	X1: 5,537,905 X3: 12,832,640	X1: 5,856,271 X3: 7,028,030	X2: 9,617,447 X3: 4,807,085	X1: 3,998,820 X3: 10,699,353 X4: 918,162	X2: 5,246,174

Recommended changes in inputs and outputs

2015					
	Hotel 2 * **	**Hotel 5*** **	**Hotel 6*** **	**Hotel 17***** **	**Hotel 18***** **
Amount of products each hotel has to produce to be efficient	Y 3,565,228	Y 3,573,304	Y 2,726,008	Y 3,748,131	Y 4,307,334
Amount of resources each hotel has to reduce to be efficient	X1: 1,888,972 X3: 6,117,201	X1: 2,943,376 X3: 3,713,885	X2: 7,946,524 X3: 2,921,148	X1: 2,590,620 X3: 7,858,805 X4: 792,793	X2: 5,231,613

Own Elaboration

Table 31. Slack values of Hotels in Barcelona, 2016

Original values of inputs and outputs

2016						
	Hotel 2 * **	**Hotel 3*** **	**Hotel 4*** **	**Hotel 5*** **	**Hotel 11*** **	**Hotel 18**** **
Amount of products each hotel has to produce to be efficient	Y 3,037,052	Y 4,005,530	Y 4,713,779	Y 3,705,029	Y 5,735,481	Y 4,599,125
Amount of resources each hotel has to reduce to be efficient	X1: 2,040,948 X2: 12,501,542 X3: 13,779,075	X1: 4,700,778 X2: 11,975,253 X3: 11,883,344	X1: 4,028,855 X2: 16,790,911 X3: 16,430,585	X1: 6,648,854 X3: 7,664,249 X4: 941,717	X2: 58,216,012 X3: 56,872,217	X1: 4,919,001 X4: 1,845,712 X5: 407,999

Own Elaboration

Recommended changes in inputs and outputs

2016						
	Hotel 2 ***	**Hotel 3*****	**Hotel 4*****	**Hotel 5*****	**Hotel 11*****	**Hotel 18******
Amount of products each hotel has to produce to be efficient	Y 4,175,950	Y 4,464,792	Y 4,749,251	Y 4,273,031	Y 5,911,877	Y 5,246,354
Amount of resources each hotel has to reduce to be efficient	X1: 1,621,132 X2: 11,323,201 X3: 5,582,978	X1: 4,106,668 X2: 2,912,094 X3: 6,381,432	X1: 2,368,243 X2: 9,622,277 X3: 4,853,289	X1: 3,836,215 X3: 5,303,775 X4: 932,063.1	X2: 16,281,981 X3: 10,248,503	X1: 3,909,009 X4: 1,394,099.4 X5: 273,007

Own Elaboration

Table 32. Slack values of Hotels in Barcelona, 2017

Original values of inputs and outputs

2017				
	Hotel 2 ***	**Hotel 3*****	**Hotel 5*****	**Hotel 18******
Amount of products each hotel has to produce to be efficient	Y 3,109,592	Y 4,331,797	Y 3,763,549	Y 4,629,388
Amount of resources each hotel has to reduce to be efficient	X1: 2,511,616 X3:	X3: 12,947,921	X1: 7,824,726 X3:	X3: 4,859,152 X4:

	14,795,604		8,684,676 X4: 1,013,179	1,939,003

Own Elaboration

Recommended changes in inputs and outputs

2017				
	Hotel 2 * **	**Hotel 3*** **	**Hotel 5*** **	**Hotel 18***** **
Amount of products each hotel has to produce to be efficient	Y 4,441,459	Y 5,003,343	Y 4,327,832	Y 5,832,279
Amount of resources each hotel has to reduce to be efficient	X1: 1,781,392 X3: 7,104,640	X3: 11,618,647	X1: 4,985,631 X3: 6,567,964 X4: 988,233.3	X3: 4,190,315 X4: 1,932,087.4

Own Elaboration

Table 33. Slack values of Hotels in Barcelona, 2018

Original values of inputs and outputs

2018					
	Hotel 2 * **	**Hotel 3*** **	**Hotel 5*** **	**Hotel 11*** **	**Hotel 18**** **
Amount of products each hotel has to produce to be efficient	Y 3,122,001	Y 4,095,563	Y 3,405,015	Y 5,846,004	Y 4,264,775
Amount of resources each hotel has to reduce to be efficient	X1: 2,791,418 X2: 13,730,169 X3: 15,753,703	X2: 13,599,170 X3: 13,639,543 X4: 1,225,426	X1: 16,385,892 X3: 8,777,189 X4: 1,049,944	X1: 5,557,900 X2: 56,131,527 X3: 56,776,408	X3: 4,598,611

Own Elaboration

Recommended changes in inputs and outputs

2018					
	Hotel 2 * **	**Hotel 3*** **	**Hotel 5*** **	**Hotel 11*** **	**Hotel 18**** **
Amount of products each hotel has to produce to be efficient	Y 3,957,792	Y 4,628,304	Y 4,014,459	Y 6,446,138	Y 5,690,127
Amount of resources each hotel has to reduce to be efficient	X1: 2,473,858 X2: 12,979,707 X3: 10,393,422	X2: 10,712,366 X3: 10,202,296 X4: 1,169,565	X1: 4,972,440 X3: 6,409,864 X4: 974,355	X1: 2,416,604 X2: 15,468,485 X3: 11,532,435	X3: 4,475,640

Own Elaboration

Table 34. Slack values of Hotels in Barcelona, 2019

Original values of inputs and outputs

2019					
	Hotel 2 * **	**Hotel 3*** **	**Hotel 4*** **	**Hotel 11*** **	**Hotel 18***** **
Amount of products each hotel has to produce to be efficient	Y 3,266,078	Y 4,678,903	Y 4,857,906	Y 5,857,962	Y 4,667,028
Amount of resources each hotel has to reduce to be efficient	X1: 3,589,275 X2: 14,006,576 X3: 16,661,699	X2: 11,556,422 X3: 12,573,461 X4: 1,261,467	X1: 5,010,629 X2: 15,114,360 X3: 18,016,593	X2: 57,490,368 X3: 57,796,778 X4: 1,620,753	X4: 1,944,350

Own Elaboration

Recommended changes in inputs and outputs

2019					
	Hotel 2 ***	**Hotel 3*****	**Hotel 4*****	**Hotel 11*****	**Hotel 18******
Amount of products each hotel has to produce to be efficient	Y 4,168,040	Y 4,849,654	Y 5,236,020	Y 6,136,833	Y 5,907,903
Amount of resources each hotel has to reduce to be efficient	X1: 2,133,713 X2: 11,467,787 X3: 7,442,406	X2: 10,399,535 X3: 10,607,212 X4: 1,201,560	X1: 3,082,003 X2: 14,017,326 X3: 7,820,262	X2: 12,362,583 X3: 11,845,194 X4: 1,601,432	X4: 1,752,680

Own Elaboration

Table 35. Slack values of Hotels in Barcelona, 2020

Original values of inputs and outputs

2020					
	Hotel 2 ***	**Hotel 4*****	**Hotel 10*****	**Hotel 11*****	**Hotel 14******
Amount of products each hotel has to produce to be efficient	Y 502,514	Y 834,461	Y 295,933	Y 612,103	Y 506,083
Amount of resources each hotel has to reduce to be efficient	X1: 2,790,756 X2:	X1: 3,422,269 X2:	X3: 2,348,887 X4:	X2: 61,430,269 X3:	X4: 244,299

	14,027,235 X3: 16,505,204	14,641,377 X3: 16,777,702	290,219	59,789,246 X4: 665,916	

Own Elaboration

Recommended changes in inputs and outputs

2020					
	Hotel 2 ***	**Hotel 4*****	**Hotel 10*****	**Hotel 11*****	**Hotel 14******
Amount of products each hotel has to produce to be efficient	Y 953,970.2	Y 1,210,578	Y 387,524.1	Y 699,716.2	Y 608,925.6
Amount of resources each hotel has to reduce to be efficient	X1: 879,352.8 X2: 10,873,684 X3: 7,180,541	X1: 1,211,205.4 X2: 12,800,107 X3: 6,202,886	X3: 2,187,339 X4: 203,272.1	X2: 7,796,919 X3: 5,470,954 X4: 308,741.6	X4: 204,641.7

Own Elaboration

Table 36. Slack values of Hotels in Barcelona, 2021

Original values of inputs and outputs

2021			
	Hotel 2 ***	**Hotel 4*****	**Hotel 15******
Amount of products each hotel has to produce to be efficient	Y 1,512,926	Y 2,149,972	Y 1,187,890
\Amount of resources each hotel has to reduce to be efficient	X1: 3,039,493 X2: 14,569,645 X3: 17,100,995 X5: 92,261	X2: 14,210,459 X3: 16,559,808	X3: 2,211,423 X5: 104,087

Recommended changes in inputs and outputs

2021			
	Hotel 2 ***	**Hotel 4*****	**Hotel 15******
Amount of products each hotel has to produce to be efficient	Y 2,156,873	Y 2,426,905	Y 1,274,645

Amount of resources each hotel has to reduce to be efficient	X1: 1,833,055 X2: 12,995,214 X3: 6,361,402 X5: 76,115.95	X2: 12,894,080 X3: 8,924,805	X3: 1,350,658 X5: 88,315.32

Own Elaboration

CHAPTER 5: CONCLUSION..

5.1. Implication of the study...

The main objective of this thesis was to attempt to evaluate a hotel's performance in terms of efficiency before and during COVID-19 and provide a performance measurement knowledge of both stable and turbulent environments demonstrating how hotels' performance changes over time, especially during unexpected or unpredictable situations.

The general conclusion based on the efficiency score is that hotels belonging to 3-star hotels are more inefficient than to 4-Star hotels and that during COVID-19 we have more 3-star hotels being inefficient and having a high level of inefficiency than 4 stars hotels. The lambda analysis showed that during 10-year period more 3-star hotels were identified as principal models to follow than 4-star hotels. Finally, the slack analysis revealed that inefficient 3-star hotels have to make adjustments in more resources such as Current Assets, Non-Current (Fixed) Assets and Shareholder's Equity than 4-star hotels where they have to reduce resources such as Cost of Employees and Material Costs.

As mentioned earlier the main goal of the study was to evaluate the impact of COVID-19 on hotel's efficiency by analysing the efficiency of 20 hotels (twelve 3-star hotels and eight 4-star hotels) located in Barcelona province but the results obtained through DEA took us further then we were expecting. The results not only measured the the impact of COVID-19 on efficiency of hotels in the sample but also offered comprehensive, evidence-based insights and hands-on information for the businesses involved in the hospitality industry. The results provided suggestions to hotel owners and managers that could be adopted in order to improve the efficiency of their business and operations by identifying the sources of inefficiencies. Moreover. this type of business-specific information and insights can also be included in their annual reports.

The important insights which this study reveals can also guide future investors indicating that inefficiency is more common in 3-star hotels compared to 4-star hotels and that during unexpected situations such as COVID-19 the level of inefficiency is higher in 3-star hotels than in 4-star hotels.

5.2. Limitations of the Study ....

There are two main limitations of this study:

- Available data limitations in terms of variables and available years. In this study the SABI database was used and because of the unavailability of all possible inputs and outputs which were chosen initially to be used, were reduced according to the available data in SABI. It should be taken into consideration that if we employ more inputs and outputs with more hotels these results might change. Moreover, the data was available till 2021, for that reason the period of analysis was limited by before and during COVID-19.

- Limitations applicable to the method used. In general DEA methodology requires variables with positive values to be included in the sample. This requirement of DEA positivity limited the selection of input and outputs variables and left aside variables with negative values which could provide very useful information. Fortunately, there are different models such as additive models that can be used to positivize the variables without influencing the results (Sarkis, 2007).

5.3. Recommendation for further research ....

Mouzas (2006) reveals, both efficiency and effectiveness are key for overall business performance and a balanced approach is required. Putting too much emphasis on efficiency and ignoring effectiveness will bring temporary benefits. Putting too much emphasis on effectiveness and ignoring efficiency could lead to “unprofitable growth”. Taking into account this recommendation and the fact that there is a common agreement in the literature that for performance measurement of any organisation both efficiency and effectiveness need to be measured (Singh et al., 2020), one direction for future research would be to evaluate a hotel’s performance in terms of efficiency and effectiveness since this study assesses hotels' performance in terms of their efficiency. Capturing performance from efficiency’s and effectiveness’s point of view will help hotels to achieve established goals, observe performance progress, and determine whether objectives were achieved (Maia and Costa, 2021).

Another direction could be to expand the number of input and output variables. For example, for inputs the following variables can be considered: Cost of goods sold (COGS); Selling, general, and administrative expenses (SGA); Total expenses, Non-operating expenses and for the output the following ones could be used: EBIDTA; Net income; Added value.

With this study we attempted to capture hotels’ performance measurement both stable and unexpected environments such as before and during COVID-19, so it could be extended for larger sample of hotels located not only in Spain but also in other popular tourism destinations for the same purposes.

Last but not least, another direction of future research would be to analyse hotel performance after COVID-19 which will help to understand the resiliency and recovery speed of hotels after pandemic.

Taking into account all the above-mentioned recommendations, the findings could be compared with those of other studies.

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