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Article

Analysis of the Effects of the COVID-19 Pandemic in the Hotel Sector Spanish: An Efficiency Study by Regions

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Abstract: In this paper, the non-parametric frontier methodology (DEA) with input orientation, variable returns to scale, and the Malmquist productivity indices are used to study the level of national and regional efficiency and know the productive change of Spanish hotels in the period 2014–2021, after the health crisis caused by COVID-19. The main objective of this paper is to know if the national and regional efficiency and total productivity of this sector have changed due to this pandemic. The data were extracted from the Iberian Balance Sheet Analysis System (SABI) and the Spanish National Statistics Institute (INE). The results obtained make it possible to determine which regions are the most efficient (Asturias, Castilla-León, and Cantabria) and to know that changes in productivity have their origin in efficiency. Furthermore, in 2021, after eliminating the restrictions imposed to fight COVID-19, investments made by hotel companies led to great technical progress. Thus, contrary to what one might think, the pandemic did positively affect the productivity of these companies, thanks to great technical progress and better adjustment of their scale. Besides, it is possible that COVID-19 has shifted tourism from regions with large cities to those with more natural areas, so the most efficient regions are those where natural tourism stands out.

Keywords: DEA methodology; Malmquist productivity indices; efficiency; productivity; hotel companies; COVID-19 pandemic; natural tourism



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1. Introduction

Some events such as the health crisis caused by COVID-19 or the conflicts in Ukraine and Gaza demonstrate that organizations operate in a highly volatile, uncertain, complex, and ambiguous environment (Giménez-Espín et al., 2023; Wang et al., 2022). Global and national service industries experienced significant disruptions, particularly in the supply chain (Zackery et al., 2022; Zhu & Xie, 2022). The service sector was heavily impacted due to lockdowns and supply chain interruptions, with the degree of loss varying across different industries and within the service sector itself (Skare & Riberio Soriano, 2022; Jiang et al., 2019).

Additionally, the COVID-19 pandemic had a devastating impact on the tourism sector, as the crisis affected perceptions of tourism risk, leading to a sharp and sudden drop in demand with significant socio-economic consequences (Carrillo-Hidalgo et al., 2023). Tourism is one of Spain's key productive sectors, accounting for around 12% of its gross domestic product (GDP). During the pandemic, its activity fell to minimal levels (less than 5% of GDP in 2020), with a 77% decrease in international arrivals in 2020 and 63% in 2021

(Gil-Alana & Poza, 2022). Understanding the COVID-19 shockwave mechanism is crucial to explaining why some economies and industries suffered significant damage. Despite the extensive literature on the pandemic's impact on the service industry, there is still a need for a detailed analysis of its effects on specific sectors (Cambra-Fierro et al., 2022). This study focuses on the Spanish hotel sector. We pay attention to this sector because the tourism, accommodation, and hospitality industries were the ones that were most severely affected.

In the tourism sector, Spain is one of the top three tourist destinations globally, primarily due to its unique natural environment, cultural heritage, and hotel industry. As a result, tourism is the most significant economic sector in the Spanish economy. In fact, the contribution of tourism reached 154.487 million euros, which represented 12.4% of the country's GDP in 2019, the year before the health crisis. Besides, the branches of tourism generated 2.72 million jobs, 12.9% of total employment (Canalis, 2019).

However, in 2020 we suffered one of the worst environmental crises in history (Zhu & Xie, 2022). In this situation, knowing the degree of exploitation of the resources is essential, both for the private and public sectors (Alberca & Parte, 2013). This has sparked interest in the analysis and assessment of efficiency across all economic sectors.

The analysis of efficiency and productivity in hotel companies, along with the impact of the COVID-19 pandemic, is a topic of significant interest for both academics and professionals. The hotel sector is a fundamental sector of the tourism industry, which constitutes a crucial part of the global economy. The COVID-19 pandemic severely affected demand, leading to temporary closures, restrictions, and shifts in consumption habits, posing one of the greatest challenges in the history of the hotel industry.

As a result, researchers from various fields focused on the impact of COVID-19 on different economic sectors, aiming to provide a knowledge base to address the epidemic, particularly through theoretical studies and practical case analyses (Zhu & Xie, 2022). Moreover, the analysis of business efficiency aligns with the Sustainable Development Goals (Goal 12, responsible production and consumption). Using fewer resources with a sustainable perspective is essential for future business models in the tourism industry. Thus, the services sector is no exception, even though its unique characteristics (such as the intangibility or heterogeneity of its outputs) make it difficult to assess and quantify its efficiency (Fuentes, 2011; Jiang et al., 2019). In this context, studies have been conducted for various countries (Färe et al., 1997; Barros et al., 2011) and by regions (Alberca & Parte, 2013; Davutyan, 2007).

But the service sector encompasses a broad branch of economic activities, some of which have been little studied theoretically and empirically. Such is the case in the hotel sector (Barros et al., 2011). This subsector stands out as it represents approximately 35% of the added value and 25% of the business volume of all tourism companies. According to data from the CNAE-2009, in Spain, there were approximately 12,600 companies in the hotel and similar accommodation sector at the beginning of 2020. Since 2017, Spain has been the second most visited country in the world and, since 2015, the most competitive on a tourist level due, in part, to the hotel infrastructure it offers.

In relation to hotel demand, in 2019 the record was reached with more than 343 million overnight stays, and the degree of occupancy, since 2016, has remained at around 60%. Approximately 65 of every 100 tourists who visit our country stay in hotels and hotel establishments (INE, 2021), becoming a key part of the Spanish economy, which has stimulated the interest of researchers regarding the evaluation of the measure of their efficiency, to know if to achieve their productive objective they adequately always apply their economic resources.

However, the global health crisis caused by the COVID-19 pandemic reduced the number of travelers who stayed in Spain by 68.41%, overnight stays by 73.28%, the number of employees by 60.56% and revenue per available room (RevPar) by 48.6% (INE, 2021). It would be very interesting for the managers of these companies to know if this crisis assumed changes in their efficiency levels, but there is little theoretical and empirical research on the hotel sector in Spain which also uses this methodology, data envelopment analysis (DEA) and Malmquist productivity indices (MI) (Barros et al., 2011; González-Rodríguez et al., 2015; Alimohammadlou & Mohammadi, 2016; Alberca & Parte, 2020). These facts justify carrying out this paper.

Data Envelopment Analysis (DEA) is a non-parametric method used to assess productivity changes in a Decision Making Unit (DMU) with multiple inputs and outputs. Caves et al. (1982a, 1982b) introduced the Malmquist Index (MI), based on the work of Malmquist (1953), to measure relative performance changes of DMUs over different time periods (Wang & Lan, 2011). The MI's popularity stems from two key reasons: first, it only requires input and output data, and second, it can be broken down into components like efficiency change (EFFch) and technical change (TECHch) to better understand the reasons for performance variations (Färe et al., 1997; Camanho & Dyson, 2006; Alberca-Oliver et al., 2011; Alberca & Parte, 2013; Alberca-Oliver, 2014; O'Donnell, 2012; González-Rodríguez et al., 2015). According to Emrouznejad and Yang (2018), DEA is widely recognized as a modern tool for performance evaluation. Consequently, a substantial number of articles have been published on the topic, contributing both theoretical advancements and practical applications of DEA in the public and private sectors to assess the efficiency and productivity of their operations. For example, Färe et al. (1994b) used DEA to study productivity growth in industrialized nations, Grifell-Tatje and Lovell (1996) examined the impact of deregulation on Spanish savings banks, and Liu and Wang (2008) analyzed productivity changes in Taiwanese semiconductor companies from 2000 to 2003. Lin et al. (2011) investigated the economic performance of local governments in China, while Benito et al. (2014) focused on the provision of key municipal services. Halkos and Petrou (2019) researched the handling of undesirable outcomes, and Dobos and Vörösmarty (2024) explored input and output data transformation for efficiency analysis using DEA. Cai et al. (2023) assessed healthcare efficiency in 31 Chinese provinces, considering two environmental factors.

DEA was first suggested by Charnes et al. (1978), building on Farrell's (1957) work on technical efficiency estimation and efficient frontiers. Since then, it has become a crucial tool for measuring the relative efficiency of DMUs performing similar tasks within a production system that uses multiple inputs to generate multiple outputs (Wang & Lan, 2011). DEA has a wide range of applications in interpreting the productivity of complex economic and engineering systems (O'Donnell, 2012; Mardani et al., 2017, 2018; Walheer, 2018; Emrouznejad & Yang, 2018).

In the case of the Spanish hotel sector, could be highlighted the studies by Alberca and Parte (2013, 2020) and Alberca-Oliver et al. (2011). According to Alberca and Parte (2013), the total factor productivity (TFP) of Spanish hotel companies during the period 2001–2008 decreased due to TECHch and not due to efficiency. This TECHch, in turn, had its origin in the increase in hotel capacity, caused by higher investments in infrastructure and equipment, which was not offset by demand. In addition, the fall was joined by the increase in various costs of production factors, such as personnel costs and intermediate consumption. However, there is a gap in the literature, since it is unknown how the TFP of hotel companies in our country has evolved due to the pandemic caused by COVID-19 and if its changes are due to factors similar or different to those that occurred in the period 2008–2014.

From an academic perspective, studying health crises and their effects on efficiency and productivity can provide valuable insights for designing resilient business models in extreme scenarios. Such analyses enable a deeper understanding of resource management and contribute to achieving the Sustainable Development Goals (SDGs) outlined in the United Nations 2030 Agenda. Examining how companies have navigated the crisis and optimized their resources offers important lessons for addressing future global challenges.

For professionals, this research provides valuable insights to support decision-making and the development of business models tailored to the new tourist profile. Studying hotel efficiency and productivity before and after COVID-19 not only enhances our understanding of the pandemic's impact but also offers strategies and frameworks for designing resilient business models capable of addressing future challenges.

In this study, we aim to address the research gap focusing on the hotel sector in Spain, where we assess the impact of the COVID-19 pandemic on operational performance. Specifically, in this paper, we analyze the following research questions (RQ) that have not been addressed in previous literature on hotel efficiency in the context of the COVID-19 pandemic and Spanish companies:

RQ(1): What were the main changes in efficiency at the national and regional level for hotel companies due to the impact of the COVID-19 pandemic?

RQ(2): Was there a pattern of variation in efficiency during the period from 2014 to 2021?

RQ(3): What were the main changes in total factor productivity at the national and regional level for hotel companies during the 2014 to 2021 period after the health crisis caused by COVID-19?

RQ(4): What were the main changes in pure efficiency, scale efficiency, and technical progress due to the impact of the COVID-19 pandemic?

Thus, the main objective of this paper is to analyze whether the national and regional efficiency and total factor productivity of the Spanish hotel sector changed due to the COVID-19 pandemic. For this, the non-parametric frontier DEA methodology has been used to assess the levels of efficiency of the hotel firms and MI to estimate the change in productivity in the period 2014–2021. The segmentation of the sample by autonomous communities made it possible to know the efficiency indices and the variation in productivity by region. To do this, data was taken from the period 2014–2021, which includes the two years in which hotel activity was most affected (2020 and 2021). To carry out the proposed analysis, which is obtained by means of mathematical optimization models the so-called frontier efficiency or “good practices”, are formed by those economic DMUs that present a better optimization of their resources as well as the scale of operations. It decided to use this methodology because it has great advantages.

From the calculation of the DEA efficiency indices, the variations in productive change were also studied by calculating the TFP, as well as its decomposition in EFFch and TECHch. In turn, the EFFch has been disaggregated into two components: pure efficiency change (PEch) and scale efficiency change (SEch) (Färe et al., 1994a; González-Rodríguez et al., 2015; Alberca-Oliver et al., 2011; Alberca & Parte, 2013; Alberca-Oliver, 2014).

This paper aims to fill the gap in prior literature since the possible effects of the health crisis on productivity in this period are unknown, and it is unknown whether there have been variations in efficiency and/or technical progress. All of this will make it possible to establish policies that improve the management of tourism companies and facilitate their action in future waves of this crisis or similar crises.

For this purpose, this article has been structured as follows: the following two sections include the the Spanish hotel sector and review of the literature carried out. The fourth section is dedicated to data analysis, the description of the variables, and the DEA

methodology used. In the fifth section, the results obtained by using the MI are analyzed, which allows us to decompose the changes experienced by productivity into: TECHch, Pech, and SEch. The next section has been devoted to the conclusions and includes the main recommendations, limitations, and future research that can be developed from this one. Finally, the seventh section presents the discussion.

2. The Hotel Sector in the Spanish Economy

In Spain, tourism has traditionally been considered the engine of economic growth due to its large contribution to the national GDP and its capacity to generate income and create employment (Alberca-Oliver, 2014). Besides, historically, crises and disasters have always been considered serious challenges for the tourism industry. In fact, the tourism sector is highly exposed to numerous changes, and this is one of the economic activities most affected by uncertain conditions (Senbeto & Hon, 2020).

In the tourism sector, the hotel industry is essential to both the Spanish and global economies, due to the high percentage it represents within the total of tourism-related companies. Activities related to hospitality have a significant impact on factors such as added value, personnel costs, and turnover within the tourism sector (INE, 2024).

When checking the contribution of the four main sectors of activity to the Spanish economy, it is observed that, already in 2018, tourism was the sector that contributed the most wealth, 14.6% of GDP (176,000 million euros), followed very closely the one of the construction with 14% (Canalís, 2019) and, according to Rico et al. (2020) tourism has become the sector that brings more wealth to the Spanish economy, representing 14.6% of GDP in addition to 14.7% of total employment.

The following graph (Figure 1) shows how the weight of tourism in GDP and employment levels in the Spanish economy evolved during the analyzed period (2014–2021). As can be seen, the contribution of tourism to GDP remained on an upward trend throughout the period, with the share of tourism in GDP increasing from 10.9% in 2014 to 12.4% in 2019. In 2020, because of the COVID-19 pandemic, there was an unprecedented drop in tourism activities, which in the Spanish economy fell to 4.3% in terms of tourism's contribution to GDP. After the health crisis caused by the pandemic, in 2021, the recovery of economic activity and the increase in the weight of tourism in GDP began. Furthermore, regarding tourism's contribution to employment levels, as shown in Figure 1, it was steadily increasing, especially from 2015 to 2019. In 2015, employment in tourism activities accounted for 12.1%, and it rose by almost one point, reaching 12.9% in 2019. Employment was also greatly affected by this shock. However, 55% of the people who could have lost their jobs were included in an ERTE (proceedings of employment regulation) carried out by the Spanish government. This fact tells us that companies in the hotel sector adjust their scale when shocks occur to remain efficient. This aspect will be discussed in the results, conclusions, and discussion.

Within the tourism sector, in Spain, the hotel industry represents one of the most relevant economic activities. Hospitality is understood as the *“economic activity consisting of the provision of services related to accommodation and/or food for a certain period of time, generally associated with tourist activity”* (Marrero Hernández, 2016).

In 2019, the year before the COVID-19 crisis, the hotel industry was the tourist activity that most contributed to the GDP, with 12.2%, surpassed only by other activities or components not directly related to tourism such as commerce (13.0%) and manufacturing industry (12.4%). By countries, Spain is the country in the world in which the hotel industry has the most weight in its GDP, followed by other close ones with common characteristics such as Portugal (5.9% contribution to GDP), Italy (4.3%) and France (4.0%). For this reason, hotel industry research has gained importance (Hoskins & Leick, 2019). Its good evolution until

the health crisis caused by COVID-19 has contributed to this. For example, the number of tourists increased by 26.06% from 2014 to 2017 (see Tables 1 and 2). As a result, the analysis of hotel management and its implications for performance has become an urgent issue considering the current global health crisis caused by the COVID-19 pandemic. The uncertainty brought on by this crisis has severely impacted the global hotel industry and has sparked extensive academic discussion (Zenker & Kock, 2020).

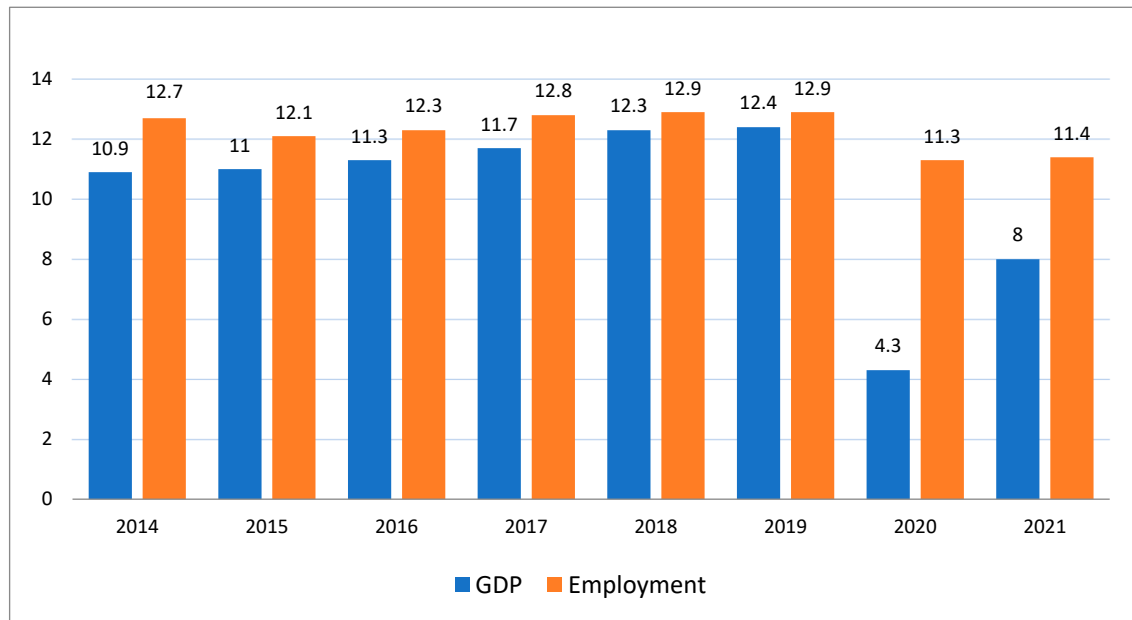


Figure 1. Evolution of the weight of tourism in Spanish economy (2014–2021). Source: authors' own construction based on INE (2021).

Table 1. Evolution of the Spanish hotel supply and demand.

Period	Number of Hotel Establishments	Number of Hotel Beds	Growth of the Number of Hotel Beds (%)	Arrival of Tourists	Growth of the Arrival of Tourists (%)
2014	14,728	1,437,300	-	64,938,945	-
2017	14,659	1,478,000	2.83	81,868,522	26.06
2020	12,333	1,044,308	−29.34	18,957,856	−76.84
2021	11,482	1,068,086	2.22	31,180,802	164.47

Source: authors' own construction based on the INE Hotel Occupancy Survey (INE, 2021).

However, since the outbreak of the COVID-19 health crisis, activity in the Spanish tourism sector has come to a halt, as evidenced by various indicators. For instance, overnight stays in hotel establishments, which had increased by 2.9% and 6.8% in January and February 2019, respectively, on a year-over-year basis, dropped by more than 60% in March and were nonexistent in April 2020. This trend was observed for both resident and non-resident travelers. Similarly, foreign tourist arrivals and spending by non-resident tourists also plummeted in March and completely disappeared in April, which meant an abrupt break in the dynamics that these variables had been following in the preceding months.

In terms of employment, the adjustment that occurred in the national tourism sector was equally intense. At the end of May 7.8% of employees in the hospitality industry, one of the branches of activity most linked to tourism, had been affected by the drop in Social Security affiliation observed since the beginning of the crisis, and 55% of the total were subject to ERTE. In addition, according to data from the end of April 2020, 15% of workers

in the sector were receiving the benefit for cessation of activity. Therefore, the intensity with which this sector recovers will have a significant influence on the rate of recovery of the economy. Furthermore, to the extent that exposure sectoral and regional tourism is very heterogeneous, the degree of dynamism shown by this industry in the coming quarters will also condition in a way remarkable economic prospects for certain branches of activity and regions (INE, 2020).

Table 2. Evolution of the magnitudes in current values.

	2014	2019	2021
Turnover *	15,928,910	28,558,378	16,464,728
Production value *	15,740,121	16,669,559	28,149,820
Value added *	8,486,901	8,860,015	14,929,390
Purchases and expenses *	7,939,424	14,487,304	9,380,453
Personal expenses *	5,662,761	9,140,828	5,756,398
Investment material goods *	1,133,652	2,626,520	2,519,308
Busy staff **	210,193	338,753	274,520
Salaried staff **	203,007	317,273	255,285

Source: authors' own construction based on information from INE (2020). * Data in thousands of euros; ** Average number of employees.

3. Literature Review

The pioneering study on the performance of hotel companies that used a frontier model was that of Morey and Dittman (1995). In it, the authors make a comparison of the efficiency of the general managers of hotels, to identify the most efficient operations and allow the less efficient managers to achieve the established standards. Subsequently, this methodology has been used to analyze the performance of hotels (Barros et al., 2011; Hu et al., 2010), since it facilitates the comparison of the results of the selected companies. However, these studies have been characterized by using small samples, thus obtaining conclusions that cannot be generalized.

In the case of our country, there are few studies that use a large sample of organizations. Among them, those of (Parte-Esteban & Alberca-Oliver, 2015; Alberca & Parte, 2013, 2020; Alberca-Oliver, 2014) stand out, in which the productivity and efficiency of the hotel sector are analyzed by regions and at the national level. According to them, in general, as the years have passed, the hotel sector has been more efficient and productivity declines have been mainly due to technical changes, caused by differences between hotel capacity and demand.

Furthermore, studies that use microdata for specific sectors are even rarer. Among others, that of Haugland et al. (2007) about the Norwegian hotel industry, that of Rubio and Román (2006) about Andalusian companies during the 2002–2004 period, and that of Alberca-Oliver et al. (2011) for a panel of 302 audited Spanish hotel companies and a period between 2000 and 2005.

At an international level, the works stand out of Walheer (2018), Pulina et al. (2010), Brida et al. (2012), and Barros et al. (2011) for the USA and the Italian and French regions respectively.

On the other hand, investigations into specific hotel segments have been more common, in which the sample is usually small, not exceeding 50 or 60 companies.

According to Alberca-Oliver (2014) and Parte-Esteban and Alberca-Oliver (2015) longitudinal and dynamic studies have been less common than cross-sectional and static ones. From the point of view of the origin of the samples, most of the analyses refer to hotels and hotel chains in Taiwan, the US, France, and Portugal, with fewer being those carried out in countries such as Spain, the United Kingdom, Italy, or China, among others.

Furthermore, it is important to note that studies tend to consider different inputs and outputs, as well as different samples and periods, which makes it more difficult to compare them. Table 3 shows some of these works.

Table 3. Investigations in hotel companies with DEA that consider different inputs and outputs.

Authors	Description
Hwang and Chang (2003)	They study the performance of Taiwan's hotel companies based on 45 international hotels. They conclude that there are differences in the efficiency of hotel companies depending on the management style.
Barros and Alves (2004)	They analyze the efficiency and productivity of a Portuguese hotel chain from 1999 to 2001. The evidence is mixed, as only some hotels increased their productivity.
Chiang et al. (2004)	They consider a sample of 25 hotels in Taipei according to the type of property. They conclude that hotels that operate under franchises and hotels managed by international operators are more efficient than independent hotels.
Barros (2005)	In this study the author evaluates total factor productivity (TPF), disaggregated into technical efficiency and technological change. The main findings indicate that very few hotels achieved improvements in total productivity.
Rubio and Román (2006)	They study the efficiency indices for hotel companies in Andalusia and its provinces for the period 2002–2004. They conclude that most Andalusian hotels, regardless of the hotel typology, present increasing returns to scale.
Shang et al. (2010)	They consider a sample of Taiwan's international hotels. They study the incidence of some organizational factors: location, seniority, and managerial style. They conclude that the factor with the greatest explanatory power is the location of the hotel.
Alberca-Oliver et al. (2011)	They study the effect of new technologies and productive change in the appraised hotel companies by approximating the Malmquist indices in the period 2000–2005. They find that TFP decreases due to the unfavorable behavior of technical change.
Huang et al. (2012)	They analyze the incidence of tourist resources and some macroeconomic variables on hotel efficiency in China. They find that educational level, employee compensation, etc., have a positive effect on efficiency.
Oliveira et al. (2013)	They carry out their study with a sample of hotels in the Algarve. They find that efficiency does not depend on the number of stars, although it appears that efficiency is higher in hotels that have golf courses.
González-Rodríguez et al. (2015)	The authors estimate the Total Factor Productivity in a hotel chain using the Malmquist Index in the period 2007 to 2010 in the context of the Spanish financial crisis. The results of this study indicate that the recession period influenced performance and competitiveness.
Chiu and Lin (2018)	This study focusses on managerial performance in the empirical context of international tourist hotels in Taiwan with Network DEA model. The main results indicate the worse performance of the service stage compared to the production stage.
Karakitsiou et al. (2020)	In this paper the authors analyze the efficiency of hotel and restaurant sector across all the thirteen regions in Greece for the years 2002–2013. They apply this frontier method to calculate efficiency scores based on a series of inputs (number of local units, number of employees and investments) and output (turnover).

Source: authors' own construction.

Also, it is important to note that some papers have studied the stability/volatility of efficiency indices and the effect that the experience of workers, the size of the organization (economies of scale), and seniority (experience effect) may have on this variable.

In the case of the personal experience of hotel workers, in the research of [Pulina et al. \(2010\)](#) for an Italian sample and [Huang et al. \(2012\)](#) for China the training of employees is positively related to efficiency indices.

Regarding size, the results of the investigations are different depending on the country considered ([Lundvall & Battese, 2000](#)). Thus, [Alberca-Oliver \(2014\)](#) finds that the smallest Spanish hotels are the most efficient and that efficiency is stable in the short term, but for [Sanjeev \(2007\)](#) the most efficient companies are the largest and the smallest. In this study, the author uses the DEA model to assign efficiency scores to each of the hotel and restaurant companies taken in the sample of 68 Indian companies for the year 2004–2005.

[Fernández and Becerra \(2015\)](#) examined the operational efficiency of 166 Spanish hotels, categorized into medium and upper-chain scale groups, from 2000 to 2009. Their analysis revealed a strong relationship between quality levels and efficiency across the entire sample. Additionally, resort hotels were found to be more efficient than other types of properties, and larger hotels were more efficient than smaller ones.

On the other hand, [Neves and Lourenço \(2009\)](#), using a sample of international hotels, found that efficiency is inversely related to the size of the companies. However, [Barros and Dieke \(2007\)](#) suggest that the largest African hotels are the most efficient. [Pulina et al. \(2010\)](#), along with [Biggs et al. \(1996\)](#), concluded that medium-sized companies are the most efficient.

In addition, to develop this paper, understanding hotel companies' reactions to the pandemic was crucial. While some studies analyze tourism recovery after COVID-19, few focus solely on Spanish hotels using the DEA methodology. Thus, this study is essential for better understanding the recovery of Spain's hotel industry.

Among the studies that have dealt with this topic, we can highlight the one carried out by [Anguera-Torrell et al. \(2020\)](#) whose sample was the 20 largest listed hotel companies in the world for the period between 24 February and 24 April 2020. According to these authors, the recovery of these companies after COVID-19 depended on their ability to control the pandemic and the macroeconomic efficiency of the public policies adopted to boost the general economic recovery. Specifically, on economic policies with a direct impact on the public budget, while measures with a non-direct impact, such as liquidity provisions or financial assistance, did not seem to support this industry.

Besides, [Chiawo et al. \(2023\)](#) examined the impact of COVID-19 on conservation, local communities, and tourism businesses in Kenya's Maasai Mara. Their authors highlighted significant negative effects and proposed integrated government interventions, financial support for small tourism enterprises, community livelihood programs, and public-private conservation partnerships. These measures were aimed at fostering economic recovery, promoting sustainability, and enhancing resilience in the tourism sector.

According to [Gursoy and Chi \(2020\)](#), the hospitality industry's recovery from the COVID-19 pandemic requires a strategic reassessment of business models, consumer expectations, and technological advancements. Adapting to new customer preferences, especially regarding health and safety, is crucial through enhanced hygiene protocols and greater transparency in sanitation measures. Additionally, adjusting pricing strategies and diversifying service offerings, such as long-stay accommodation or remote work-friendly options, can help mitigate future disruptions. Digital transformation also plays a key role, with contactless technologies improving operational efficiency and meeting evolving consumer expectations. Marketing strategies must also be revised to emphasize safety and trust-building, leveraging social media and targeted digital campaigns to engage domestic travelers while awaiting the full return of international tourism. By integrating these adaptive strategies, hospitality firms can strengthen their resilience and position themselves competitively in the post-pandemic landscape.

[Masroor and Shiva \(2024\)](#) also pointed out the importance of smart tourism technologies (STT) in reducing the impact of the pandemic on tourists' perceptions and the importance of technologies for the effective recovery of tourism businesses after the pandemic. [Gössling et al. \(2020\)](#) suggested that the pandemic should prompt a critical reassessment of the mass tourism-driven growth model, as it entails significant risks and contributes to climate change. Therefore, the authors advocated rethinking the concept of "normality" and viewed the crisis as an opportunity to transform this tourism model into more sustainable practices, which would facilitate a more resilient recovery for tourism businesses.

Moreover, [Ntounis et al. \(2021\)](#) examined the resilience of tourism-dependent businesses in English towns during COVID-19. Through surveys, they analyzed businesses' perceptions and responses, highlighting resilience's temporal dimensions and key influencing factors. Their findings showed that tourism and hospitality businesses faced severe disruptions due to closures and delayed reopenings. To cope, businesses implemented operational adjustments, diversified services, and enhanced health and safety measures to meet changing consumer expectations. Despite these efforts, the study highlighted that the resilience of these industries was influenced by multiple factors, such as the nature of the business, location, and available resources, suggesting that a one-size-fits-all approach may not be effective for all tourism-dependent enterprises.

Another study that highlighted the importance of technology, innovation, and sustainable tourism practices in overcoming the effects of the pandemic is that of [Zhang et al. \(2023\)](#). These authors examined the impact of COVID-19 on tourists' risk perceptions and highlighted the role of tourism policies in fostering a sustainable and resilient recovery. They emphasized the need for governments to implement policies that reduce perceived risks and enhance health and safety measures to restore traveler confidence. For the authors, the crisis was seen as an opportunity to transition from mass tourism to more sustainable models that prioritize environmental conservation and community well-being. Additionally, technological innovation was essential for improving visitor experiences, streamlining operations, and strengthening health security. To ensure long-term resilience, destinations should also focus on diversifying tourism markets, reducing dependence on international travelers, and promoting domestic and regional tourism. These strategies collectively aim to create a more adaptable and sustainable tourism industry in the post-pandemic era.

Finally, the study of [Arold-Lario \(2021\)](#) emphasized the importance of health and safety protocols, urging businesses to implement strict hygiene measures to restore consumer confidence. Additionally, digital transformation was identified as a critical factor, encouraging companies to integrate contactless technologies for bookings, payments, and customer service. Moreover, the article highlighted the need for product diversification, suggesting that businesses should develop innovative tourism offerings such as rural, ecological, or personalized experiences to meet changing market demands. Workforce training and upskilling are also considered essential, particularly in digital customer service and crisis management. Lastly, the study underscored the role of public-private collaboration, advocating for partnerships between businesses and government entities to create coordinated recovery strategies, and carrying out reforms in coastal areas, where mass tourism was common, to cushion the economic effects of the drop in foreign tourism. In the case of cultural tourism, linked to urban environments or inland areas, structural changes in its management can be effective measures. These measures aim to enhance the resilience of the Spanish tourism industry, ensuring its adaptation to post-pandemic challenges.

Therefore, the literature has identified various actions that businesses have undertaken to recover from this crisis, with their effectiveness influenced by factors such as firm size, location, and industry. Nevertheless, these actions can generally be categorized into three main areas: technological advancements, the reorientation of tourism activities toward more sustainable and virus-safe alternatives, and the implementation of effective economic policy measures.

4. Methodology

4.1. Research Design and General Description of Method

In the empirical part of this work, following the previous literature, the efficiency of Spanish companies in the tourist accommodation sector is analyzed during the 2014–2021 period, in order to know how the TFP of the hotel companies in our country has

been able to change due to the pandemic caused by COVID-19 and if its changes are due to factors similar or different from those that occurred in the economic crisis of the period (2008–2014). To do this, company data has been obtained according to the region of Spain, without differentiating the sample according to the size of the organizations and using the non-parametric methodology of DEA and MI, capable of determining a synthetic indicator of relative efficiency, which provides a ranking of efficiency scores from the production data provided by the sample under study, without the need for a priori knowledge of the functional form of the production function, since that it will be generated from the information of the productive units evaluated (Min et al., 2008; Tohidi & Razavyan, 2013; Shahverdi & Ebrahimnejad, 2014; Walheer, 2018). The unnecessary knowledge of the functional form of the production function, together with the extensive information provided by the DEA technique in multiple aspects, such as the ranking of DMUs ordered by levels of efficiency, indication of referents or seed groups to follow (peer groups) (Min et al., 2008; Shahverdi & Ebrahimnejad, 2014; Walheer, 2018), make this methodology a valuable tool for the management of the entities analyzed, resulting, therefore, very interesting for the study of the performance measurement of the hotel sector, since this sector presents market imperfections, seasonality of demand and important differences in the size of the companies that comprise it (Banker et al., 1984; Alberca & Parte, 2020). To achieve this objective, free software has been used, such as Efficiency Measurement software and Data Envelopment Analysis software developed by authors Coelli (1996) and Scheel (2000). Other free software that performs similar calculations is the FEAR package developed by Wilson (2008) in the context of the “R” programming language (Version 4.4.3).

4.2. Efficiency Analysis and Data Envelopment Analysis (DEA)

The term efficiency is widely used in the economic literature, thus being exposed to multiple interpretations and different definitions, which however, in its broadest sense, agree that efficiency is *“the ability to achieve an end through the desirable relationship between the factors and productive results, that is, maximizing production with the minimum of resources or minimizing resources given a level of production to be achieved”* (Álvarez, 2014). Besides, the efficiency of a DMU is used to identify the level of performance that can be achieved by this with respect to a set of production possibilities in accordance with existing technology, which roughly consists of determining the optimal values with those obtained (Chiang et al., 2004; Guzmán et al., 2006; Mardani et al., 2017, 2018; Walheer, 2018).

The efficiency calculation can be carried out considering two different types of approximations (Maniadakis & Thanassoulis, 2004; O'Donnell, 2012; Mardani et al., 2017, 2018; Walheer, 2018): the parametric approximation, which a priori assumes the specification of the functional form of the production function, using techniques econometric for the estimation of its parameters according to the data offered by the evaluated DMUs (Coelli et al., 2005); and the non-parametric approach, which evaluates the properties that the set of production possibilities must satisfy, from which the efficiency frontier formed by the DMUs that apply the *“best practices”* and are classified as efficient (Alberca-Oliver, 2010).

A comparison of both methodological proposals shows that the main advantage of the non-parametric approach is its high degree of flexibility, which allows it to easily adapt to multi-product and non-price environments, the main drawbacks of the technique are the need for homogeneity of the units analyzed (Fuentes, 2011; Alberca & Parte, 2020). Besides, the deterministic nature of the method makes any deviation in relation to the frontier of good practices or efficiency is interpreted as an inefficient behavior of the evaluated DMU, not existing the possibility of incorporating inefficiency provoked by random causes (Coelli et al., 2005; Cooper et al., 2007; Emrouznejad et al., 2008; Yang et al., 2017). These facts have

been able to favor that empirical studies on the hotel sector use non-parametric frontier techniques (Chen, 2009; Perrigot et al., 2009).

The DEA model was initially developed by Charnes et al. (1978), building on the seminal work of Farrell (1957). DEA is a non-parametric methodology that utilizes mathematical programming to define the production frontier based on the set of production possibilities. It serves as an excellent tool for measuring the relative efficiency of production units (Alberca-Oliver, 2014; Yang et al., 2017). In this model, the efficiency of productive units is evaluated in relation to best practices and is obtained from the information of the evaluated productive units and does not have a specific functional form (Parte-Esteban & Alberca-Oliver, 2015; Mardani et al., 2017, 2018; Walheer, 2018).

The fundamental decisions related to the DEA methodology are related to the type of performance and the type of orientation. For Alberca-Oliver (2010), efficiency can be analyzed according to various orientations, depending on the variables that the company controls. Thus, when managers control inputs, the most appropriate model would be the input-oriented DEA, while, if they can control the results of the production process, then it is more appropriate to use the output-oriented DEA model (Ramanathan, 2003). In our case, given that the sample is made up of hotel companies, it is convenient to use the input-oriented DEA model that considers the existence of variable returns, due to the seasonality of demand, the different sizes of the organizations, the restrictions imposed by short-term hotel capacity, etc., (Yu & Lee, 2009; Alberca & Parte, 2013) which allows obtaining the pure efficiency separated from scale effects (DEA BCC, in honor of its authors, Banker et al., 1984).

To define the mathematical formulation of the method, the existence of n DMUs is typically assumed. The productive unit or DMU uses different quantities of m distinct inputs to generate y outputs. Specifically, DMU _{j} consumes input amounts $x_j = (x_{1j}, x_{2j}, \dots, x_{mj})^t$ of inputs and produces output quantities $y_j = (y_{1j}, y_{2j}, \dots, y_{sj})^t$. In addition, it is established that λ is the intensity vector of size nx_1 , which determines the minimum number of factors necessary to achieve the established production. This vector allows calculating an inefficiency index, through the proportional reduction that can be done simultaneously in all inputs without reducing production. The expression of the dual model, which has fewer restrictions and is widely used, is the following (Coelli et al., 2005):

$$\text{Min}_{\alpha, \lambda} \delta$$

Subject to:

$$Y\lambda \geq y_0$$

$$\delta x_0 \geq X\lambda$$

$$\sum_i \lambda_i = 1 \quad i = 1, \dots, n$$

$$\lambda \geq 0$$

4.3. Malmquist Productivity Index

The change in TFP can be obtained using MI (Malmquist, 1953; Moorsteen, 1961; Caves et al., 1982a, 1982b; Tohidi & Razavyan, 2013; Parte-Esteban & Alberca-Oliver, 2015). This methodological approach only requires having information on the quantities of inputs and outputs, and one of its main advantages is that it allows us to decompose the change in productivity into its determining elements, changes experienced in EFFch (Pech and/or SEch) (catching up) and the changes due to TECHch that produce a displacement of the frontier. The shifts in the frontier are caused by advancements in available technology, while the movement of the firms towards the efficient frontier and the catching-up effect

represent the portion of the change in overall productivity that cannot be directly attributed to technological progress. This variation is driven by factors such as the learning effect, knowledge diffusion in technology application, organizational improvements, and more (Grifell-Tatje & Lovell, 1996; González-Rodríguez et al., 2015; Alberca-Oliver et al., 2011; Karakitsiou et al., 2020).

Obtaining the MI requires calculating the distance of observation with respect to the contemporary technological frontier, but also in relation to the existing frontier at another moment in time (see Appendix A, Malmquist Productivity index, for more details).

4.4. Data and Variables

To define the production frontier, we use a balanced panel, sourced from the database Iberian Balance Sheet Analysis System (SABI), which provides financial information on 480,000 Spanish firms. Additionally, we include tourism flow data from the Spanish National Statistics Institute (INE), covering the period from 2014 to 2021. The sample comprises Spanish hotel firms listed in SABI, specifically those classified under activity code 551 of the CNAE-2009, which for the selected period is made up of a panel of 1608 companies.

The data has been segmented by region. This has made it possible to calculate the efficiency and productivity indices at the regional level. In addition, the sample has been divided into two sub-periods to be able to know the changes in these variables when going from one period of economic growth (2014–2019) to another of global crisis due to COVID-19 (2019–2021). This period provides an opportunity to examine how tourism firms have responded to the shift from highly favorable conditions to a recessionary environment like the one experienced then. The data from this period were generated using consistent criteria, making them homogeneous and comparable. The timeframe considered was the widest possible according to the database, with the most recent data for most of the selected businesses being from 2021.

As indicated above, the DEA methodology requires that the researcher select the inputs (factors and costs) and the outputs (goods or services) (Perrigot et al., 2009). According to Hwang and Chang (2003), the data used in this type of study fundamentally depends on the experience of the researcher and their availability. However, the variables used in this study are based on previous literature. Net sales have been considered as a measure of output, while the inputs have been used the number of workers (labor factor), non-current or fixed assets (capital factor) and consumption made (Picazo-Tadeo & Quirós-Romero, 2001; Alberca-Oliver, 2010; Alberca-Oliver et al., 2011; Alberca & Parte, 2013, 2020; Alberca-Oliver, 2014; González-Rodríguez et al., 2015; Karakitsiou et al., 2020). The information on net sales, non-current assets, and consumption has been obtained from the financial information of the companies (balance sheet and income statement) and has been valued in constant euros so that they have been deflated with the price index hoteliers (Blasco & Moya, 2005). Instead, the number of workers has been expressed in physical units (Shang et al., 2010).

The following tables show a comparative analysis of the sample with the total population and the descriptive statistics of the variables used (Tables 4 and 5 respectively).

Table 4 presents a comparison between the analyzed sample and the total number of companies in the Spanish hotel industry for the variables production value and personnel expenses for the years 2014, 2019, and 2021. For example, in 2014, the companies analyzed achieved a production value of 14,653,433, representing 93.09% of the sector's total production value, while personnel expenses amounted to 5,121,129, approximately 90.43% of the total personnel expenses in the hotel sector for that year.

Table 4. Comparison of the sample with its population.

Period	Variable	INE Data	Sample Data	% of the Total
2014	Production value	15,740,121	14,653,433	93.09
	Personal expenses	5,662,761	5,121,129	90.43
2019	Production value	28,149,820	22,386,271	79.53
	Personal expenses	9,140,828	7,231,567	79.11
2021	Production value	16,669,559	10,196,153	61.16
	Personal expenses	5,756,398	4,162,955	72.31

Source: Personal compilation based on information from [INE \(2020\)](#) and SABI.

Table 5. Descriptive statistics.

Period	Variable	Mean	Deviation	Maximum	Minimum
2014	Production	2708.330	6435.83	422,332	52
	Capital	3786.56	10,954.89	302,867	2
	Employees	38.85	105.62	4503	2
	Consumptions	655.67	1234.56	1535.87	2
2019	Production	3008.5	13,353.70	623,651.62	0.05
	Capital	3681.40	13,624.48	468,719.33	0
	Employees	32.97	134.57	5557	0
	Consumptions	509.45	1733.54	43,953.85	0
2021	Production	1669.03	7322.26	259,614	0
	Capital	5871.05	42,514.33	2,095,658	0
	Employees	24.88	113.61	5025	1
	Consumptions	292.28	1032.40	32,645.55	0

Source: Personal compilation based on information from [INE \(2020\)](#) and SABI.

Furthermore, the descriptive statistics of the analyzed variables are presented in Table 5 for the years 2014, 2019, and 2021. During the pre-pandemic period (2014–2019), as shown in Table 5, the average production increased from 2708.330 to 3008.5. However, because of the health crisis caused by the COVID-19 pandemic and the associated restrictions, the average production decreased significantly in 2021 to 1669.03.

5. Results: Measurement and Analysis of Total Factorial Productivity

Tables 6 and 7 are constructed mainly following the methodology of [Banker et al. \(1984\)](#), although other previous works also perform a similar analysis ([Liu et al., 2018](#)). The first of them shows the evolution that the IM and its main determinants have experienced globally and for each of the periods analyzed. In the first period, the IM experiences a large drop (−30.5%) mainly due to the negative evolution of technical progress (−34.2%). However, in the second period, the index grew by 39.9% and the main driving force is also technical progress (36.5%).

Table 6. Evolution of productive change by periods.

Period	EFFch	TECHch	PEch	SEch	IM
2014–2019	1.056	0.658	1.091	0.968	0.695
2020–2021	1.025	1.365	0.976	1.050	1.399
Mean	1.040	0.948	1.032	1.008	0.986

Source: Own based on [Alberca-Oliver et al. \(2011\)](#).

Table 7. Evolution of productive change by periods and region.

Regions 2014–2021	EFF 2014	EFF 2019	EFF 2021	EFFch 2014–2021	TECHch 2014–2021	PEch 2014–2021	SEch 2014–2021	IM	Ranking
Andalusia	1.0000	0.6370	0.9030	1.040	0.959	1.000	1.040	0.998	9
Aragón	0.7430	0.6260	0.7640	1.066	0.967	1.069	0.997	1.031	5
Asturias	0.6910	0.6210	0.8390	1.153	0.969	1.159	0.995	1.118	1
Balearic Islands	1.0000	0.8240	1.0000	1.001	0.994	1.000	1.001	0.995	11
Cantabria	0.9470	0.6710	0.8710	1.086	0.955	1.028	1.056	1.036	3
Canary Islands	0.9920	0.6580	0.7680	0.909	0.968	0.917	0.992	0.880	19
Castilla- León	0.7130	0.5680	0.9500	1.204	0.896	1.185	1.017	1.079	2
Castilla Mancha	0.8900	0.5690	0.9330	1.129	0.904	1.057	1.067	1.020	7
Catalonia	1.0000	0.6300	0.8480	0.960	0.961	1.000	0.960	0.922	16
Valencia	1.0000	0.5540	0.8440	0.995	0.944	0.991	1.004	0.939	14
Extremadura	0.7460	0.4890	0.7100	1.064	0.937	1.036	1.026	0.996	10
Galicia	0.8260	0.6170	0.8190	1.090	0.949	1.070	1.018	1.034	4
Rioja	0.7650	0.6700	0.7760	1.078	0.945	1.075	1.003	1.019	8
Madrid	1.0000	0.9750	1.0000	1.000	0.992	1.000	1.000	0.992	12
Murcia	0.7720	0.5880	0.8020	1.096	0.940	1.055	1.039	1.030	6
Navarra	1.0000	0.6810	0.9040	0.998	0.939	1.000	0.998	0.937	15
Basque Country	1.0000	0.6220	1.0000	1.012	0.960	1.000	1.012	0.971	13
Melilla	1.0000	0.7730	0.9310	1.000	0.885	1.000	1.000	0.885	18
Ceuta	1.0000	1.0000	1.0000	0.937	0.952	1.000	0.937	0.892	17
Mean	0.8992	0.6723	0.8160	1.040	0.948	1.032	1.008	0.986	

Source: Own based on [Alberca and Parte \(2013\)](#).

If we consider the entire period, the index suffers a fall of 1.4%, which is only produced by technical progress, which overall drops by 5.2%, since average efficiency experiences an improvement of 4%. Therefore, the contribution of technical progress to the decrease in average productivity has been 100%, which represents a negative displacement of the production possibility frontier equal to 5.2%.

Regarding the change in Total Factor Productivity (TFP), measured through the Malmquist Index (MI), this study has similarities with previous literature, particularly with [Alberca-Oliver et al. \(2011\)](#), [Alberca and Parte \(2013\)](#), [Barros \(2005\)](#), [Barros and Alves \(2004\)](#), and [González-Rodríguez et al. \(2015\)](#). For example, [Barros and Alves \(2004\)](#) and [Barros \(2005\)](#), in the empirical context of a public hotel chain in Portugal, found mixed evidence. Additionally, the results of our study in Total Factor Productivity align with those of [González-Rodríguez et al. \(2015\)](#) for the period 2007–2010 in the context of a hotel chain in Spain, and with those of [Alberca-Oliver et al. \(2011\)](#) and [Alberca and Parte \(2013\)](#), in Spanish hotel companies (periods 2000–2005 and 2001–2008, respectively). These works concluded with negative Total Factor Productivity results in terms of averages, driven by the unfavorable technical change.

If the variables that make up efficiency are considered, both have positive behavior. Specifically, pure efficiency grows by 3.2%, and efficiency scales by 0.8% on average over the entire period. These results present certain nuances although broadly speaking they are similar to those of several previous studies at the national and even international level ([Wang et al., 2006](#); [Alberca-Oliver et al., 2011](#); [Alberca & Parte, 2013](#)) and indicate that the precursor variables of productivity improvement in this period (2014–2021) are more related to learning, knowledge dissemination, and organizational improvements than to the approximation of the size of the hotels to its optimal scale or to technical progress. In this sense, [Wang et al. \(2006\)](#) demonstrate that the international tourist hotel industry in Taiwan is inefficient, with most efficiency losses attributable to technical inefficiencies. Furthermore, the COVID-19 pandemic did positively affect the productivity of companies in the hotel sector, since only the PEch was reduced by 2.5%. But this decrease was offset

by the 5% increase in the SECh and 36.5% in the TECHch. Therefore, although the value of production decreased from 2021 to 2019 (−40.78%), these organizations reduced their consumption (−42.62%), personnel expenses (−37%), the number of employees (−24.53%, a drop that would have been greater if the ERTes had not existed), so they adjusted their size to the new economic reality imposed by the pandemic in a very efficient way.

The first peculiarity is the behavior of technical progress, which experiences a sharp drop in the first period and great growth in the second, respectively. This drop during the 2014–2019 period is due to the increase in production costs (personnel costs and intermediate consumption), as well as the greater increase in the capacity of the companies compared to the increase in demand. Thus, while the value of production has increased by 16.93%, personnel expenses have grown by 61.41%, which represents a significant reduction in the operating margin. But after 2020 and once the restrictions imposed to deal with COVID-19 were eliminated, technical progress experienced strong growth (39.9%). This was contributed to by the large investment in tangible assets (capital) made by hotel establishments, whose growth was 59.47%, and the arrival of tourists increased by 164.47% compared to the 2.22% growth of the hotel beds. In this way, during 2021 the usual excess capacity of hotel establishments was considerably reduced.

Table 7 includes the national average efficiency at an initial moment, in an intermediate year, and at the end of the period considered. In addition, Table 7 shows the evolution that the IM and its main determinants have experienced for each region and for the period analyzed.

As can be seen in the last row, the national average productivity has reduced by 1.4% from 2014 to 2021. On the one hand, companies that present the most favorable behavior in terms of their productivity are located in Asturias, Castilla-León, and Cantabria, with positive growth in their TPF of 11.8, 7.9, and 3.6%, respectively, which appear in the ranking with position 1, 2 and 3. In addition, hotel companies from the Galicia, Aragón, Murcia, Castilla Mancha, and Rioja regions also present positive growth in their TPF of 3.4, 3.1, 3, 2, and 1.9%, respectively, their positions in the ranking being 4, 5, 6, 7 and 8.

On the other hand, in the rest of the regions, the TPF decreases, and in some, it is quite pronounced. The hotel organizations that present the most unfavorable evolution of their productivity are those of Ceuta, Melilla, and Canary Islands, with a decrease of 10.8, 11.5, and 12% respectively. In the case of companies from the Canary Islands, the result is like that obtained by Alberca and Parte (2013). It may have its origin in the increase in unprofitable accommodation capacity due to lower growth in demand. In this sense, Impactur Canarias (2022) indicates that investment in new equipment by hotel companies has grown throughout 2021, despite the high debt accumulated in the months of COVID-19, the uncertainty, and high energy prices.

The other two less productive regions, the autonomous cities of Ceuta and Melilla, are characterized by the fact that they traditionally receive the smallest number of tourists. This is mainly due to their location, which makes it necessary to cross the sea to visit them. Besides, according to the Hotel Occupancy Survey (INE, 2021), these two cities have been losing tourists for years, although this trend has changed in Ceuta, as it has increased its visitors in 2021 and 2022. Therefore, its low productivity is associated with the excess capacity of hotel firms, which has not been compensated for by the decrease in demand for accommodation.

The region with the best TFP performance is Asturias. Asturias' main asset lies in its natural environment, highlighting its nature tourism, since 33% of its territory is protected under some form of protection: natural and national parks, reserves, and monuments... Its greater efficiency is due to the great increase in the number of tourists who visit it. For this reason, Asturias closed 2022 with a new tourism record: more than 2.4 million visitors and

6.1 overnight stays. Last year, this community received 2,413,956 tourists which generated 6,114,619 stays. These data represent increases of 2.4% and 6%, respectively, compared to 2019, a year in which the historical maximums had been recorded until now. Compared to 2021, the increases stand at 29.5% and 22.8% (INE, 2021).

Also in Cantabria, nature tourism stands out, linked mainly to the Cabarceno Natural Park. While gastronomic tourism is what predominates in Castilla-León. Both regions also have high productivity thanks to the increase in the number of tourists who visit them.

In the rest of the regions with positive evolution of their TFP, in the case of Galicia, its high TPF performance may be because it receives many tourists, thanks to the Camino de Santiago and cultural and rural tourism, although the volume of business and the added value that this first generate is low. In Aragon cultural and mountain tourism stands out, in Murcia beach and sun tourism and, in Castilla Mancha and La Rioja, wine and rural tourism are the most important. In all of them, the added value exceeds that generated by tourists who visit Galicia to complete the Camino de Santiago.

Regarding previous studies, the ranking is changing. This indicates that efficiency is dynamic, and companies can improve and even worsen. Thus, in the study by Alberca and Parte (2013) for the period 2001–2008, the most efficient regions were Basque Country, Catalonia, Aragón, and Madrid, which now occupy positions 13, 16, 5, and 12 respectively. This tells us that COVID-19 has led to an increase in the number of tourists who choose regions with natural spaces, which allow nature, rural tourism, outdoor activities, etc. This tells us that COVID-19 has led to an increase in the number of tourists who choose regions with natural spaces, which allow nature, rural tourism, and outdoor activities. This fact has allowed Asturias, Cantabria, and Castilla-León to gain efficiency, to the detriment of other regions with large cities, such as Madrid and Barcelona, where cultural tourism predominated (Alberca & Parte, 2013).

6. Conclusions, Limitations, and Future Developments

This study addressed efficiency and productivity analysis in the empirical context of Spanish hotel companies and the effects of the COVID-19 pandemic focusing on a regional perspective. Specifically, in this study we analyze the main changes in efficiency and productivity at the national and regional level for hotel companies due to the impact of the COVID-19 pandemic, as well as the pattern of variation in total factor productivity during the period from 2014 to 2021.

Methodologically we use a non-parametric frontier model as DEA to estimate efficiency indicators, and Malmquist indices to evaluate the productivity of Spanish hotel companies. By utilizing the disaggregated Malmquist index (IM), which includes scale efficiency, pure technical efficiency, overall technical efficiency, and technological change, this study allows for a more comprehensive and precise analysis of the current state of the Spanish hotel industry. Additionally, this research builds on the model proposed by Färe et al. (1994b), contributing valuable insights to the existing literature in this area.

These methodologies employed to estimate efficiency and productivity (DEA models and Malmquist indices) offer significant advantages, such as flexibility by not assuming a functional form, suitability for contexts involving multiple inputs and outputs, and the ability to identify reference units, thereby enhancing decision-making processes and benchmarking (El Alaoui et al., 2023; Wybawa et al., 2023). However, these methodologies also have certain limitations, including the requirement for homogeneity among the analyzed DMUs, the potential subjectivity in selecting inputs and outputs, and the high likelihood of classifying a large number of units as efficient when sample sizes are small (Alberca-Oliver, 2014; Alberca & Parte, 2020).

In this study, the main methodological limitations have been addressed in two ways. First, by using a database that includes companies engaged in the same hotel activity and providing a homogeneous service. Second, incorporating a large number of observations increases the discriminatory power and degrees of freedom of the models, thereby improving efficiency estimates. Finally, given that the DEA methodology is sensitive to variable selection, this choice has been based on previous literature.

Regarding the evolution of total productivity, it is evident an unfavorable behavior by decreasing its average value by 1.4% (a 30.5% decrease in the IM during the first period and a 39.9% growth in the second period). The 5.2% decline in TECHch throughout the entire period is the primary explanatory factor for the drop in productivity, while the efficiency index shows a growth of 4%. When considering the efficiency components, both exhibit positive behavior. Specifically, pure efficiency change (PEch) increased by 3.2%, and scale efficiency change (SEch) grew by an average of 0.8% over the entire period.

Furthermore, the results show that the health crisis of the COVID-19 pandemic had an overall positive effect on the productivity index of hotel companies. Considering its main components, only PEch decreased by 2.5%, while SEch and TECHch increased by 5% and 36.5%, respectively.

Specifically, technical change experienced a sharp decline in the first period (2014–2019) and significant growth starting in 2020, as the restrictions imposed to address the COVID-19 pandemic were lifted. This was supported by substantial investments in tangible assets (capital) made by hotel establishments and a strong increase in tourist arrivals. Consequently, in 2021, the usual excess capacity of hotel establishments was considerably reduced.

Moreover, the Malmquist index by region shows that hotel companies located in Asturias, Castilla-León, and Cantabria regions are more competitive by obtaining higher productivity rates, 11.8, 7.9 and 3.6%, respectively. In contrast, the regions with less competitive companies that show a lower performance, in terms of productivity, are the Canary Islands, Melilla, and Ceuta.

It is worth noting some limitations of this study. Firstly, only the subsector whose activity code is 551 of the CNAE-2009 has been used, that is, hotels and similar accommodations. Therefore, more complete studies could also be carried out considering subsectors 552 (tourist accommodation and other short-stay accommodation), 553 (camping sites and caravan parks), and 559 (other accommodations).

Alternatively, comparable research could be conducted using different methodologies, such as double frontiers DEA the parametric frontier models, the Free Disposal Hull methodology (FDH), the Point-wise Minimization DEA, and the artificial neural networks, among others (Cai et al., 2023; Wang & Lan, 2011). In addition, it would be useful to replicate this research in other countries. All this with the purpose of comparing the results and drawing more general conclusions.

It should also be noted that the variables used in the study, the inputs and outputs selected to measure efficiency, are based on the previous literature, but it would be convenient to use more economic-financial information, as well as obtain data from surveys carried out with managers of the hotel sector.

Finally, it would be convenient to include control variables, such as the firm size (economies of scale), the age of the companies (experience effect), and the training of their employees, among others.

7. Discussion

The aim of this study is to assess the efficiency and productivity indicators, at the national and regional level, in the empirical context of Spanish hotel companies, because it

is a relevant sector in the tourism industry. Spain is one of the main tourist destinations worldwide, and the tourism sector has a significant impact on its economy, accounting for around 12% of its GDP. In the tourism industry, the hotel sector is key, playing an important role in relevant variables such as added value (35%) and turnover (25%).

On the other hand, because of the COVID-19 pandemic, companies faced significant challenges: there was a disruption in the trend of tourism businesses due to an unprecedented drop in the number of travelers, and hotel companies had to deal with major challenges due to loss of revenue because of the decline in the number of stays. In the uncertain environment caused by the COVID-19 pandemic, hotel companies were forced to optimize resources, reduce costs, and improve their processes to ensure survival.

Thus, understanding the degree of utilization of productive resources with indicators of efficiency and productivity in the context of a health crisis could improve the decision-making process. Moreover, the lack of empirical research applied to the hotel sector in the context of the COVID-19 pandemic motivates this study. The findings of this study can support decision-making processes and guide tourism policies.

This paper addresses the research gap in previous literature by analyzing the impact of the COVID-19 pandemic on the efficiency and productivity index of hotel companies in Spain; analyzing a broad period (2014 to 2021) that covers a phase of activity growth, as well as the impact of an unprecedented crisis in 2020 due to the pandemic, and the beginning of recovery in 2021.

Specifically, in this paper, we answered the research question (RQs) formulated in the design study. In response to the first and second research questions (RQ1) and (RQ2) referring to the main changes in efficiency and the pattern of variation in efficiency during the period from 2014 to 2021 at the national and regional level for hotel companies, the efficiency results at the national level indicate positive behavior: pure efficiency grows by 3.2% and efficiency scales by 0.8% on average over the entire period. These positive results in efficiency indicators may be related to knowledge diffusion, the experience effect, and organizational improvements. Some previous studies found similar results in other periods and sample contexts (Wang et al., 2006; Alberca-Oliver et al., 2011; Alberca & Parte, 2013). If we consider a regional perspective, the efficiency results by regions show that companies located in Asturias, Cantabria, and Castilla-Leon present the most favorable behavior in terms of efficiency change in the entire period. Compared to previous studies, the regional ranking is changing in the context of the COVID-19 pandemic, and the number of tourists choosing regions linked to nature tourism, rural tourism, and outdoor activities is increasing.

Furthermore, research question 3 (RQ3) referred to the main changes in Total Factor Productivity at the national and regional level for hotel companies during the 2014 to 2021 period after the health crisis caused by COVID-19. In the first subperiod (2014–2019), the productivity results at the national level indicate that TPF (Total Factor Productivity), measured by Malmquist Index (MI), has a negative performance with a decrease of -30.5%; however, the second subperiod (2020–2021), during and after the COVID pandemic, the TPF index grows by 39.9% and the main driving force is also technical progress (36.5%). If we consider the entire period (2014–2021), the results showed a negative Total Factor Productivity index, in terms of averages, driven by unfavorable technical change.

In this study, we also analyze the main changes in pure efficiency, scale efficiency, and technical progress due to the impact of the COVID-19 pandemic (RQ4). To answer this question, we analyze the Total Factor Productivity (TFP) indicator measured by the Malmquist index (MI), generally broken down into two key components: changes in efficiency and technical change. This decomposition is fundamental in analyzing productive

change to understand what drives improvements or deteriorations in the productivity of hotel companies.

As we indicated previously, in the analyzed period, the main results have shown that there is a particularly noteworthy decrease in total factor productivity (TFP) of 1.4% on average. If we analyze the behavior of the two key components, the results indicate that while the average efficiency of hotel companies increased by 4% during the period due to better utilization of resources or factors of production (such as capital and labor), this improvement has not compensated for the decrease in technical change, which overall decreased by 5.2% during the analyzed period.

The main results of the regional efficiency and productivity analysis reveal shifts in regional competitiveness compared to previous studies. After the health crisis, tourist behavior patterns changed significantly, with greater emphasis on safety, a preference for private accommodations, longer stays, and increased interest in nature tourism, among other trends. Examining how these behavioral changes impact regional efficiency and productivity can help companies better adapt to evolving demands. Comparatively, with prior literature, there is a similarity with studies focusing on Spanish empirical contexts ([Alberca-Oliver et al., 2011](#); [Alberca & Parte, 2013](#); [González-Rodríguez et al., 2015](#)) and Portuguese empirical contexts ([Barros & Alves, 2004](#); [Barros, 2005](#)). These studies also concluded with negative Total Factor Productivity, because of unfavorable technical change, although efficiency change was found to be positive. Furthermore, the general results obtained during the period contrast with those obtained by other previous studies that considered that the most favorable evolution of productivity occurs in periods of economic growth ([Chen, 2009](#); [Miró, 2021](#)).

Although the period from 2014 to 2019 is economic recovery the IM was reduced due to the absence of technical progress. But starting in the first quarter of 2021, when the restrictions imposed to fight COVID-19 were eliminated, the hotel sector had to make large investments so that its facilities operated as before the pandemic. These investments, together with the increasing arrival of tourists and the resulting increase in sales, meant a considerable improvement in productivity ([Skare & Riberio Soriano, 2022](#)). Thus, contrary to what one might think, the COVID-19 pandemic that began in 2020 made companies in the hotel sector more efficient in the period 2020–2021, since the IM increased by 39.9%, thanks mainly to the great growth of TECHch (36.5%) and the advance of SEch (5%). Therefore, these firms adjusted their consumption and, above all, their size very efficiently, using, among other measures, ERTE.

Recent studies analyzing the impact of the COVID-19 pandemic in the context of international tourism firms have found mixed evidence comparatively regarding the conclusions of our study. [Arbula Blecich et al. \(2025\)](#), examining Mediterranean and European Union countries concluded that productivity declined between 2014 and 2021. Due to the COVID-19 pandemic in 2020, pure technical efficiency experienced a significant drop, influenced by management, technology, and external factors. However, the analysis of overall efficiency indicated that, prior to the health crisis, the primary cause of inefficiency in the sector was the difficulty of operating at an optimal scale. Between 2019 and 2020, productivity declined across all countries, mainly due to technological regression.

In the context of Croatian hotel enterprises, [Arbula Blecich \(2024\)](#) also found a slight decrease in relative efficiency in 2020 due to the impact of the COVID-19 pandemic and a decline in productivity between 2019 and 2020 in two segments (coastal and inland hotels), primarily driven by technological stagnation. Similarly, [Wybawa et al. \(2023\)](#), analyzing Indonesian tourism firms, demonstrated a significant drop in efficiency scores as a result of the health crisis caused by the pandemic, with decreases of approximately 20.42% in 2020

compared to efficiency levels in 2019. However, they also found a slight increase in the overall average efficiency of these firms in 2021 compared to 2020 (2.39%).

In other international contexts, recent studies have also focused on analyzing tourism efficiency and the impact of the health crisis. For example, [Nurmatov et al. \(2025\)](#), examining Russia, Kazakhstan, and Azerbaijan, identified significant regional differences in business performance due to both the pandemic and the war in Ukraine. [Kamel et al. \(2022\)](#), in their study of Egyptian tourism enterprises, concluded that operational expenses and labor costs negatively affected business efficiency. However, their findings regarding the impact of the COVID-19 pandemic on firm efficiency indicated that the pandemic did not affect either of the two types of efficiency analyzed: operational and financial. To assess the evolution of hotel efficiency following the pandemic outbreak, they compared the two years preceding COVID-19 (2018–2019) with the two years during the pandemic (2020–2021).

In the context of U.S. tourism enterprises, [Schalk-Nador and Rašovská \(2024\)](#) reported a slight decline in efficiency, which fell to 74% in 2020 (compared to 79% in 2018 and 77% in 2019). Their results also indicated a significant increase in efficiency in 2021, reaching 81%, possibly driven by the high demand for domestic travel following international travel restrictions.

Finally, our study addresses a regional perspective, due to the impact of geographical variables on tourism-related industries, such as the hotel sector. Analyzing efficiency and productivity within a regional context helps identify which regions perform better and highlights the main changes in tourist profiles following the COVID-19 pandemic. The main regional results indicate that hotel companies showing very favorable productivity growth during the analyzed period are located in Asturias, Castilla-León, and Cantabria.

The key results of the regional efficiency and productivity analysis reveal shifts in regional competitiveness compared to previous studies. After the health crisis, tourist behavior patterns changed significantly, with greater emphasis on safety, a preference for private accommodations, longer stays, and increased interest in nature tourism, among other trends. Examining how these behavioral changes impact regional efficiency and productivity can help companies better adapt to evolving demands. These results obtained may be useful for improving the efficiency of the companies located in the regions with the most deficit and can be useful for the management to establish policies adapted to the tourist demand of each region.

The IM results could generate reflection on the need to review management strategies, evaluate investments in technology and human resources, as well as analyze the competitive environment and market conditions to identify areas for improvement.

Based on these results, several recommendations can be established for managers and politicians responsible for the decisions made in the Spanish hotel sector. The first of them is the appropriate slowdown in the growth of the Spanish hotel plant, to not increase excess capacity, since it generates negative returns. Secondly, policies should be aimed at modernizing hotel companies with the aim of increasing competitiveness: investments in technologies that can streamline operations and improve customer experiences (advanced property management systems, automated check-in/check-out processes, smart room systems, and mobile apps); as well as environmentally friendly practices and technologies to reduce energy consumption and waste. Thirdly, measures must be adopted to allow de-seasonalize demand and direct tourism towards other segments, such as nature, culture, and business. In this way, tourism activity would not depend so much on the sun and the beach. Finally, it would be important for the managers of hotel firms and responsible politicians to establish strategies to differentiate the tourist offer, since tourists have increasingly

differentiated needs and expectations (Pulido & Sánchez-Rivero, 2010; Cambra-Fierro et al., 2022; Carrillo-Hidalgo et al., 2023).

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Appendix A. Malmquist Productivity Index

The Malmquist Index (*MI*) is a method used to measure productivity changes over time, specifically focusing on changes in Total Factor Productivity (*TFP*). *TFP* measures the efficiency with which inputs (factors of production like labor, capital, technology, etc.) are used to produce outputs.

The distance in inputs of the observation at $t + 1$ represented by (x^{t+1}, y^{t+1}) with respect to the existing technology in period t (x^t, y^t) can be observed in the following Figure (Alberca-Oliver, 2010):

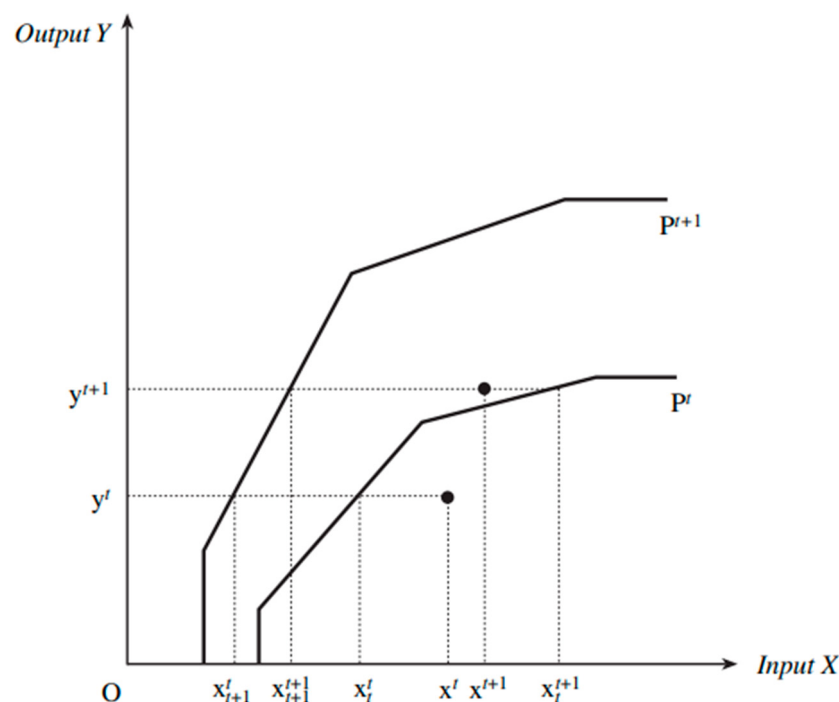


Figure A1. Efficiency frontiers (t and $t + 1$ period). Source: Own based on Alberca-Oliver (2010).

The distance functions allow the calculation of the input-oriented *MI* which, based on the technology of period t , is formulated as:

$$M_I^t(x^t, y^t; x^{t+1}, y^{t+1}) = \frac{D_I^t(x^t, y^t)}{D_I^t(x^{t+1}, y^{t+1})}$$

This index will take a value greater than one if there has been an increase in productivity between periods t and $t + 1$ since the deflation of the input vector x^t is necessary to place the observation (x^t, y^t) at the technological frontier of the moment t , it is higher than the deflation to which the input vector x^{t+1} would have to be subjected to place the production plan (x^{t+1}, y^{t+1}) on that same frontier. The opposite would happen if the expression reached a value less than unity.

The *MI* can also be obtained based on the existing technology at time $t + 1$ as follows:

$$M_I^{t+1}(x^t, y^t; x^{t+1}, y^{t+1}) = \frac{D_I^{t+1}(x^t, y^t)}{D_I^{t+1}(x^{t+1}, y^{t+1})}$$

Färe et al. (1994a) set the calculation of the *MI* input-oriented with a fixed technology such as the geometric mean of the previous index for periods t and $t + 1$. Besides, these authors decompose the variation in productivity as the product of 2 factors: *EFFch* and *TECHch*.

$$M' = \frac{D^t(x^t, y^t)}{D^{t+1}(x^{t+1}, y^{t+1})} \times \left[\frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^t(x^{t+1}, y^{t+1})} \times \frac{D^{t+1}(x^t, y^t)}{D^t(x^t, y^t)} \right]^{1/2}$$

The *MI* or M' and its decomposition can be obtained, in principle, in relation to any type of return to scale. However, Färe et al. (1994b) incorporate the specification of variable returns to scale (*Vrts* from here on, for simplicity, the letter v is used in the formulation), which allows obtaining the change experienced by *PEch*, *SEch*, and *TECHch* as follows (Banker et al., 1984):

$$M'' = \left[\frac{D^t(x^t, y^t)_v}{D^{t+1}(x^{t+1}, y^{t+1})_v} \times \frac{D^t(x^t, y^t)_c / D^t(x^t, y^t)_v}{D^{t+1}(x^{t+1}, y^{t+1})_c / D^{t+1}(x^{t+1}, y^{t+1})_v} \right] \times \left[\frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^t(x^{t+1}, y^{t+1})} \times \frac{D^{t+1}(x^t, y^t)}{D^t(x^t, y^t)} \right]^{1/2}$$

Thus, the *MI* can be written as:

$$MI = TFP = EFFch \times TECHch$$

And how *EFFch* can be further divided into two sub-components: *PEch* and *SEch*, as follows:

$$EFFch = PEch \times SEch$$

Therefore:

$$MI = TFP = PEch \times SEch \times TECHch$$

Figure A2 represents the technology under the assumptions of constant and variable returns to scale, again for a technology characterized by the production of an output from a single input.

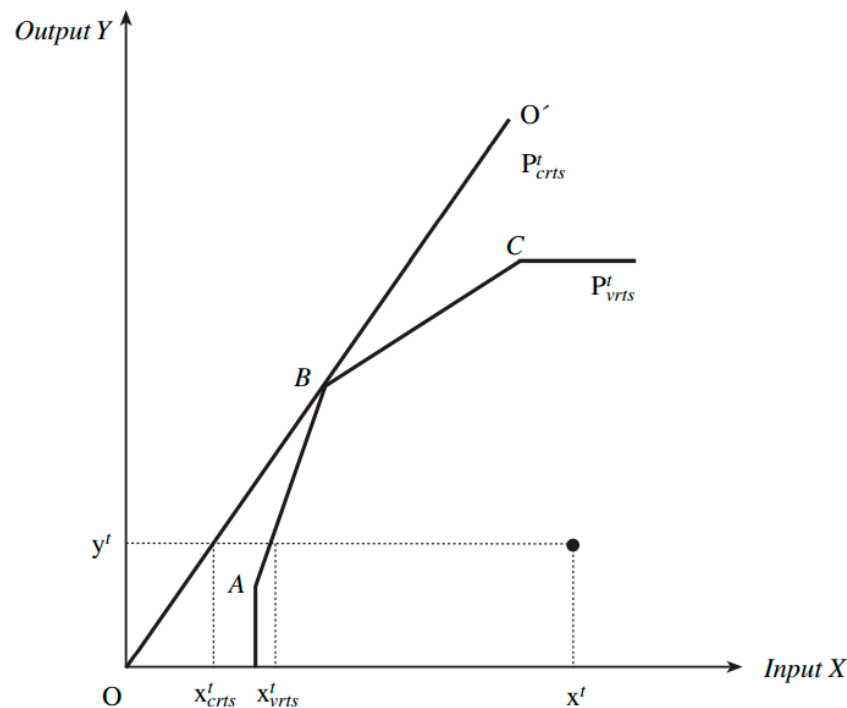


Figure A2. Constant and variable return to scale. source: Own based on Alberca-Oliver (2010).

The technological frontier with CRTS is the envelope of the set of production possibilities P^t_{crtts} and is defined by the segment that has its origin in O and passes through point B which represents the most productive scale (Banker, 1984). If the existence of variable returns is assumed, the technological frontier would be the upper envelope of P^t_{vrtts} , limited in this case by the segment ABC and the horizontal extension from this last point. Thus, to calculate the distance of a unit with respect to the vector of inputs (factor-oriented models), Farrell (1957) considers the property of reciprocity between the distance function and the technical efficiency index. Thereby, the distance is the inverse of the efficiency index, and vice versa. Therefore, if the value of MI for an organization is equal to 1, it indicates that the level of productivity has not changed between the 2 periods of time considered. On the other hand, an index value less than one means that the productivity level has decreased. Finally, if MI has a value greater than unity, it will indicate an increase in the level of productivity.

Now, as the value taken by the productivity index is the result of the product of 2 factors, the $EFFch$ and $TECHch$, it must be considered that these can behave differently. Therefore, efficiency may be worsening and at the same time technological progress may occur and thus an improvement in technical change. Similarly, the components of the variation experienced by the efficiency, pure and of scale, can evolve in the same direction or in the opposite direction now considered.

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