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The moderating effect of seasonality in the hotel industry. Does market concentration favour tacit collusion?

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Abstract

Market concentration is associated with higher prices. However, previous research has not considered whether the market concentration effect on prices is moderated by seasonality in markets where firms switch from peak demand to low demand periods. This study analyzes market concentration effect on prices and price variability in the hotel industry. Through hedonic price models, the paper analyzes the influence of market concentration on hotel prices and how quality, distance to the city center or seasonality influence hotel prices. A higher market concentration is associated with higher prices. The effect of market concentration on prices is 1.7 times higher in the peak demand season than in the low demand season. Price variability between hotels for a given day in a particular market is partially explained by differences in service quality among hotels in the same city but also by the level of market concentration. We find that higher market concentration reduces price variability, a result consistent with the existence of tacit collusion.

Keywords: Market concentration, tacit collusion, hedonic prices, seasonality, hotel industry

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1. Introduction

A firm's profitability in a particular market is a consequence of the interaction of many different factors, such as the firm's strategy, competitors' decisions, the existence of entry barriers, regulation and intervention from governments, consumers' behavior, or the existence of substitutes, among others, but a significant aspect is the role of the market concentration. A higher market concentration may facilitate tacit collusion, in which firms coordinate their decisions, increasing their profits by setting output or prices closer to what a monopoly would have decided. Even if firms compete by taking individual decisions without coordination, their market power may be more significant if the market has a higher market concentration (Ivaldi *et al.*, 2003). The most commonly used measure of market concentration is the Herfindahl-Hirschman index (Rhoades, 1993; Spiegel, 2021; Avila-Cano and Triguero-Ruiz,2022). In fact, the Herfindahl-Hirschman index has become a tool for competition authorities to decide if they need to thoroughly examine a merger before authorizing it. Particularly, according to the US Department of Justice and Federal Trade Commission, if the Herfindahl-Hirschman index increases more than 100 points, as a consequence of a merger, that merger requires further analysis (Horizontal mergers guidelines 2010). Similarly, in Europe, the guidelines for mergers acknowledge the importance of the Herfindahl index as a source of useful information for assessing the impact of a merger. If the Herfindahl index is above 2000 and the merger potentially increases it by more than 150, according to the guidelines, there is concern about the potential effect the higher market concentration may have (Guidelines for horizontal mergers published in the Official Journal of the European Union, 2003). Of course, from the perspective of investors or potential new entrants in a market, the Herfindahl index may signal higher profitability. According to the evidence from different markets, higher market concentration is associated with higher markups (Czarnitzki *et al.*, 2010; Dunn and Shapiro, 2014).

The hotel industry is commonly characterized in the economic literature as a case of oligopolistic competition (Aguiló *et al.*, 2003; Aznar,2021; Nababan *et al.*, 2023). However, the academic literature on the market concentration effects on prices, market power or profitability for the hotel industry is limited (Pan, 2005; Gan and Hernandez, 2013; Lado-Sestayo *et al.*, 2013). One of the possible tools to analyze the effect of market concentration on prices is by including the Herfindahl-Hirschman index as an explanatory variable when using hedonic prices. Hedonic prices were introduced by Rosen (Rosen, 1974) as a methodology to assess concrete product characteristics' impact on the price. Hedonic prices have been widely used for a myriad of industries and products. Among others, hedonic prices have been used to analyze the housing market (Herath and Maier,2010), restaurants (Yim *et al.*, 2014) and fair-trade coffee (Schollenberg, 2012), to mention a few examples. This paper focuses on the hospitality industry, characterized by product differentiation (Aznar,2021; Nababan *et al.*,2023). Hotels differ in location and the quality and variety of services they offer tourists. Several authors have applied the methodology of hedonic prices to assess the influence of location and quality of the service provided by the hotel on hotel prices (Rigall-Torrent *et al.*, 2011; Yang *et al.*, 2016; Kim *et al.*, 2020).

There are some gaps in the current academic literature about the influence of higher market concentration on prices, particularly for industries with the specific characteristics associated with the hotel industry, location and quality as strategic variables, and a significant level of seasonality. The first gap relates to how seasonality influences the effect that a higher market concentration may have on higher prices. On valley periods, in which demand is lower, and there is an excess of capacity, consequently with lower occupancy rates, hotels may have a higher incentive to lower prices as a strategy to capture a higher market share and increase individual profits. Whereas in periods of high occupancy rates, hotels can exert greater market power, so prices can be closer to the consumers' willingness to pay without necessarily implying tacit collusion, as hotels close to their maximum capacity do not have incentives to drop prices, their capacity constraint does not allow them to benefit from lower prices. A question the academic literature has not answered yet is if, in low-demand periods,

a higher market concentration reduces the incentive for lowering prices, facilitating tacit coordination or tacit collusion. According to this hypothesis, prices in local markets with higher market concentration may be higher. A second gap in the academic literature is that, to the best of our knowledge, what academic literature has not examined is if higher market concentration reduces price variability in the hotel industry, an expected outcome of tacit collusion or tacit cooperation. This paper contributes to the academic literature on industrial organization, applied to the hotel industry by studying if seasonality moderates the market concentration influence on prices and if the higher concentration is associated with lower price dispersion, a possible indicator of tacit collusion or tacit coordination.

2. Literature review and research hypotheses

2.1. The influence of higher market concentration on prices

Oligopolistic models have assumed traditionally that firms compete, maximizing their profits, by considering as decision variables price, output, location or quality, among others, or that firms decide the optimum strategy for more than one variable, either simultaneously or sequentially (Tremblay and Tremblay, 2019; Heywood and Ye, 2009; Lu and Poddar, 2005). The academic literature on industrial organization offers several frameworks for the analysis of firms' behaviour and market welfare. One of the most commonly used frameworks is the structure-conduct-performance paradigm (Evanoff and Fortier, 1988; Ferguson and Ferguson, 1994; Berry *et al*., 2019). This paradigm is based on the idea that the market structure frames firms' decisions; consequently, we obtain different results regarding profits, markups and levels of welfare. One expected outcome from this particular analysis framework is that, in general, a higher market concentration favours higher prices, either because the equilibrium in each market results in prices being a negative function in terms of the number of market participants or because higher market concentration favours tacit collusion or tacit cooperation. These hypotheses have been consistently tested for different industries, for different periods of time, and in several geographical areas. Most of the literature on market concentration's influence on prices agrees that higher concentration is associated with higher prices and higher market power for the firms operating in each market. Table 1 summarizes some of these results from previous academic literature.

2.2.Hedonic prices and market concentration analysis in the hospitality industry

Hotels' competition takes place in markets characterized by product differentiation. Hotels are different in their location or the quality of their service to customers. Quality can be signaled in many ways, such as the number of stars or the online reviews and rates past customers give. Hotels also differ on particular aspects such as offering restaurants, swimming pools, parking, gym, spa or conference rooms, to mention a few possibilities. Such a level of product differentiation invites the use hedonic prices to get insights into how these particular features influence hotel prices. There is prolific literature on this specific topic. This section of the literature review summarizes some of the most relevant results.

Academic literature reveals some consensus on the relevance of distance as an explanatory variable for hotels' prices. Distance can refer to how far away the city center is, a particular spot or area that tourists love to visit, the distance to the beach, or the distance to ski facilities, depending on the destination type. A higher distance to the favourite customers' location is associated with lower prices, reinforcing the idea that location matters as a crucial decision variable for investors and hotel managers (Espinet *et al*., 2003; Sánchez-Ollero *et al*., 2014; Soler *et al*., 2019; Lévi *et al*.,2022). The importance of distance has been highlighted for different regions and countries, including the United States, China, Spain, Portugal and France, to mention a few examples. In terms of the academic literature, one additional consensus is that higher quality of service and better facilities, measured by the number of stars, increase the price (Espinet *et al*., 2003; Soler *et al*., 2019; Lévi *et al*.,2022). Online reviews are an

alternative option to measure the perceived quality of the service offered, a variable that adjusts much more quickly to changes in customers' perceptions than what takes the revision of the number of stars. The available empirical evidence shows a positive correlation between better ratings from online reviews and prices. The better the average rate past customers give, the higher hotel prices (Schuckert *et al.*, 2015; Wen *et al.*,2021). Hedonic prices have been used to test other hypotheses, such if more investment in being environmentally sustainable is associated with higher prices (Sánchez-Ollero *et al.*, 2014), if factors influencing the price differ if we consider weekdays or weekend rates (Chen and Rothschild, 2010) or if industrial legacy plays a negative role, meaning that areas that were heavily industrialized in the past, with old factories and decaying facilities with no use, imply a negative externality for the hotels located in the area, in terms of a lower willingness to pay from tourists(Lévi *et al.*,2022). The instrument of hedonic prices has also been used with alternative hotel accommodation options, such as Airbnb apartments. Some host characteristics, distance to the city center, and specific apartment features, such as the number of rooms, influence Airbnb apartment prices (Chen and Xie, 2017; Gibbs *et al.*,2018).

***Table 1**. The effect of higher market concentration on prices, evidence from academic literature.*

Journal	Authors	Year	Market	Main conclusion
Review of Economics and Statistics	Stavins	2001	Airline industry in the United States	Based on the analysis of 5804 tickets for 12 different routes, it concludes that price dispersion is lower for markets with higher market concentration.
International Journal of Health Care Finance and Economics	Schneider *et al.*	2008	Physicians operating in California, United States	From the county-level data analysis, the empirical evidence suggests higher market prices with a higher Herfindahl-Hirschman index.
Environment and Planning C: Politics and Space	Bet *et al.*	2015	Urban water in the South of Spain, Andalucia region	Private companies sell urban water at higher prices in highly concentrated markets.
Marketing Science	Singh and Zhu	2008	Car rental industry in airports in the United States	Based on the analysis of 407 airports, they conclude that more competition and less market concentration reduce prices. Adding one firm renting cars in a particular airport reduces prices on average by 2%
The Review of Economics and Statistics	Jackson	1992	The banking industry in the United States	Banks located in markets with higher concentration pay lower interest rates for their saving deposits, but the authors suggest that the relationship between market concentration and prices may not be linear.

Finally, academic literature on industrial organization applied to the hospitality industry has tried to measure the influence of higher market concentration on hotel performance. When market concentration increases, hotels increase their revenue per available room (Lado-Sestayo *et al.*,2017). A similar result suggests that accounting profits before taxes increase when the Herfindahl-Hirschman index increases (Pan, 2005). As a matter of fact, some authors suggest that hotels may invest in overcapacity, with more rooms than what the levels of demand require. This artificial rise in the level of market concentration can act as a deterring mechanism for potential entrants (Conlin and Kadiyali, 2006). Only a few attempts have been made to measure tacit collusion in the hospitality industry. It is worth highlighting the NBER working paper, based on data from Texas from 2003 to 2005(Gan and Hernandez,2013). This work deals with agglomeration's effects on hotels' prices but also includes as an

explanatory variable market concentration. However, the authors find a counterintuitive result, as a higher market concentration index is associated with lower prices; it should be noticed that most of the sample corresponds to rural areas with markets in there is only a small number of participants, below 5 hotels in most of the cases, therefore making difficult to generalize this result for urban areas. Higher market concentration may be associated with higher prices or revenues per room and a higher profit margin, defined as Earnings before interest and taxes (EBIT) over revenues (Lado-Sestayo *et al*.,2016).

2.3.Hypotheses

Based on the previous analysis, this paper proposes the following hypothesis:
H1: A higher market concentration has a positive relationship with prices.
H2: As higher market concentration increases, hotel price variability decreases.
H3: The impact of higher market concentration on price variability is moderated by seasonality.
H4: A higher rate from reviewers has a positive relationship with hotel prices.
H5: For urban hotels, distance to the city center negatively affects hotel prices.
H6: Urban hotels apply higher prices for weekend bookings than for weekdays.

3. Methodology

3.1. Data sample and variables

The main objective of this research is to measure the influence of higher market concentration on hotel prices. At the same time, hedonic price methodology facilitates measuring how other factors, such as quality of the service provided, distance to the city center, seasonality or booking for weekdays or weekends, influence prices in the hotel industry. The data sample selected requires access to a measure of market concentration. The Spanish region of Catalonia, in the northeast of the country, constitutes the geographical scope of this research, as the regional government makes the number of rooms available for each hotel in each city a part of the census of hotels published yearly. According to data for 2022, Catalonia's population is close to 7.5 million, but it receives each year around 15 million international tourists, making it one of the three top regions in Spain in terms of tourism as a critical industry with relevant contributions to both, the GDP and the level of employment. Knowing the number of rooms each hotel has related to the total number of rooms in a particular mark*et al*lows us to construct a proxy for the Herfindahl-Hirschman index. If a market has n firms in a specific industry and s_i is the market share of each firm, then the Herfindahl-Hirschman index is:

$$HHI = \sum_{i=1}^{i=n} s_i^2 \qquad (1)$$

The Herfindahl-Hirschman index adds all the market shares squared. Its value goes from a maximum of 10,000 for a monopoly to close to 0 in a perfectly competitive market as the number of firms increases. The percentage of rooms each hotel has over the total number of rooms will be a good proxy for the market shares if hotels located in the same city have similar occupancy rates. Therefore, this paper has worked with a Herfindahl index based on the number of rooms per hotel over each city's total number of rooms.

Catalonia is divided into four provinces with four cities as the capitals of each province, Barcelona, Lleida, Tarragona and Girona. The data sample refers to 335 price observations from Lleida, Tarragona, and Girona, as these three cities share a similar tourism model. In contrast, Barcelona has many particularities as a top European destination. Prices were collected from Booking.com for 35 different checking-in days, from the 13th of February to the 7th of July, combining observations for days in which

demand varies considerably due to the level of seasonality. The high-season period demand begins in May and ends in late September. Table 2 summarizes the description of the variables collected for each price observation.

Table 2. *Variables description and source of information*

Variable name	Variable definition	Source	Expected relationship with the dependent variable
Price	Price for two nights in a double room	Booking.com	It is the dependent variable
Weekend	Dummy variable with value 1 for booking at a weekend	Calendar	+
Quality	Average rating from online reviewers	Booking.com	+
Distance to the center	Distance from the hotel address to the city center (meters)	Google maps	-
Free cancellation	Dummy variable with value 1 if the hotel allows cancelling the reservation without any cancellation fees	Booking.com	+
Seasonality	Dummy variable with value 1 if the checking is in the period May to September, high season	Calendar	+
Herfindahl-Hirschman index	Herfindahl index for each city, based on hotel rooms over the total rooms available at each city	Hotel Census from the regional government	+
Days	Number of days between the reservation and the check-in	Booking.com	-
Airport	Dummy variable with value 1 if the city has a close airport	Google maps	+

Regarding the sample size, the data collected corresponds to all hotels available at Booking.com on the dates the information was collected for the three cities. Table 3 summarizes relevant information for the three cities considered in this research. The three cities differ in their Herfindahl index for the hotel industry, and in all cases, the sample of hotels analyzed covers more than 40% of the total population of hotels.

Table 3*. Relevant information for Girona, Lleida and Tarragona hotel industry markets (year 2022)*

	Girona	Lleida	Tarragona
Herfindahl index	660	554	2388
% of the sample over the total population	43.3%	46.2%	54%
GDP per capita	€40,700	€32,500	€35,900
Consumer price index	112.6	113.31	111.61
Dummy variable for airport	1	0	0

Table 4 reports the descriptive statistics for the dependent and independent variables. The average price for a two-day hotel booking is €125.93, the minimum price is €89, with the maximum price being 7 times more, €629. The quality ranges from 6.90 to 9.40, and the scale available when customers give their opinion and rate their experience goes from 1 to 10. Finally, the distance to the center is measured in meters; the minimum distance to the city center in the sample of hotels is 100 meters, whereas the maximum distance corresponds to a hotel located 3 kilometers away from the city center.

***Table 4**. Descriptive statistics*

Variable	Number of observations	Mean	Standard deviation	Min	Max
Price	335	€125.9328	€90.30106	€89	€629
Quality	335	8.2487	0.48293	6.90	9.40
Distance	335	875.901 m	661.06215 m	100 m	3100 m
Days	335	184.89	65.899	94	268
Herfindahl index	335	1165.7612	822.47820	554	2388

3.2. Model setting

The first model we test estimates the hotel price for a two-night stay through a hedonic price regression model that considers as explanatory variables the market concentration at each market, the quality of the service provided by the hotel, measured by the average rate online reviewers have given in Booking.com, the distance to the city center and the number of days between the day of the booking and the day of the check-in. The model also includes some dummy variables as control variables, including a dummy variable for a weekend booking, a dummy variable for the hotel giving the option to cancel the reservation without any penalty fee, one dummy variable for booking during peak demand season and the last one for cities with an airport. The model can be described as follows:

$$\ln p_{it} = \beta_0 + \beta_1 quality_i + \beta_2 distance_i + \beta_3 HHI_i + \beta_4 Days_{it} + \sum_{j=1}^{K} \beta_j \gamma_{ji} + \varepsilon_{it} \quad (2)$$

Where $\ln p_{it}$ refers to the natural logarithm of each price at each given date as the dependent variable. The explanatory variables for each hotel, i, are the quality provided, the distance to the city center, the Herfindahl-Hirschman index (HHI_i), the number of days from booking to the check-in day, and a set of dummy variables that act as control variables, γ_{ji}.

We explore a second model setting that is, to the best of our knowledge, an addition to the academic literature on market concentration and pricing. Assuming higher market concentration is an incentive for tacit cooperation or tacit collusion, we can expect higher prices but also less price variability as fewer hotels act unilaterally in setting prices deviating from the tacit agreement. This hypothesis is tested by setting the following model:

$$|p_{ict} - \bar{p}_{ct}| = \beta_0 + \beta_1 |q_{ict} - \bar{q}_c| + \beta_2 \left|d_{it} - \bar{d}_c\right| + \beta_3 HHI_c + \varepsilon_{ict} \quad (3)$$

The dependent variable for this model is the absolute value for the price deviation, each day t, between each individual price p_{ict} and the average price for that day at a city level, $\bar{p}_{ct}$. The explanatory variables are the absolute value for the difference in quality between the quality at each observed hotel q_{ict}, for a given day in each city, and the average quality of the city $\bar{q}_c$, the absolute value for the difference between the distance to the city center for each hotel d_{it} and the average distance for each city $\bar{d}_c$; but also includes the Herfindahl-Hirschman index. The idea of this model is that price variability at each market can be explained by quality variability and distance variability, but that market concentration is a moderating factor. A negative β_3 for market concentration suggests that as the market concentration increases, price variability decreases, an expected outcome in the presence of tacit collusion or cooperation.

4. Results and discussion

The first model of hedonic prices measures the influence of quality of the service, distance to the city center, seasonality, and booking for a weekend in hotel prices but includes as a relevant explanatory variable the level of market concentration.

$$\ln p_{it} = \beta_0 + \beta_1 quality_i + \beta_2 distance_i + \beta_3 HHI_i + \beta_4 Days_{it} + \sum_{j=1}^{K} \beta_j \gamma_{ji} + \varepsilon_{it} \quad (4)$$

Table 5 shows the results from the regression model followed by its corresponding discussion.

***Table 5**. Hedonic prices with market concentration for the hotel industry regressions.*

Variables	Model 1	Model 2
Intercept	-190.73 (0.010)**	-216.645 (0.002)***
Quality	33.584 (0.000)***	31.220 (0.000)***
Distance	-0.014 (0.000)***	-0.014 (0.014)**
Herfindahl-Hirschman index	0.028 (0.000)***	0.028 (0.000)***
Days	-0.238 0.302	
Weekend	34.521 (0.000)***	31.220 (0.000)***
Free cancellation	24.003 (0.001)**	24.135 (0.001)**
Season (peak demand period)	80.545 (0.011)**	48.922 (0.000)***
Airport	131.872 (0.000)***	131.413 (0.000)***
ANOVA analysis F statistic	45.789 (0.000)***	52.166 (0.000)**
R^2 adjusted	0.518	0.517

**Significant at 5% level
***Significant at 1% level

According to the hedonic price model, market concentration, measured through a proxy for the Herfindahl-Hirschman price index, has a positive relationship with prices; an increase by 100 points in the index implies €2.8 increase in the price for a two-night stay. Quality and distance to the city center coefficients have the expected influence on hotel prices. Higher quality positively impacts prices, and further distance to the city center reduces customers' willingness to pay. The only variable that is not statistically significant is the number of days between the booking and the check-in. Having an airport

close to the city, allowing for free cancellation, being in the peak demand season or booking for a weekend positively affects hotel prices.

To address if the influence of market concentration on hotel prices may differ for peak and low season periods, the same regression has been conducted, dividing the sample into two groups of observations, running a regression for data corresponding to peak demand period and another one for low demand period. Table 6 summarizes the results.

Table 6. *Hedonic prices and market concentration influence according to seasonality*

Variables	Low demand season	High demand season
Intercept	-187.297 (0.032)**	-172.537 (0.079)
Quality	32.955 (0.001)***	33.229 (0.004)***
Distance	-0.08 (0.273)	-0.018 (0.024)**
Herfindahl-Hirschman index	0.019 (0.004)***	0.034 (0.000)**
Weekend	21.264 (0.034)**	34.574 (0.001)***
Free cancellation	33.548 (0.000)***	17.816 (0.096)
Airport	98.885 (0.000)***	152.945 (0.000)***
ANOVA analysis F statistic	21.436 (0.000)***	36.265 (0.000)**
R^2 adjusted	0.467	0.523
Number of observations	141	194

**Significant at 5% level
***Significant at 1% level

Market concentration influences prices. As the market concentration increases, hotels apply higher prices, but this effect is more relevant in peak demand seasons, as the change in price when market concentration increases ($\partial P / \partial HH$), is in peak demand season 1.7 times the one observed in low demand season. Distance is not significant from a statistical point of view in low-demand periods as an explanatory variable for hotel prices. Finally, the coefficient associated with the dummy variable airport is much stronger in the peak demand season, in which the number of tourists from foreign countries considering flights the most suitable option to travel is much higher.

The second model we test is less common in the academic literature for hedonic prices in the hospitality industry but may be particularly relevant as it explains price differences between hotels based on their product differentiation, how different they are in the quality of the service they offer, or the distance to the city center, but adding as an explanatory variable the Herfindahl-Hirschman index. It is worth

mentioning that if the coefficient corresponding to the market concentration is negative, it means that higher concentration reduces price variability, an expected result if there is some degree of tacit collusion. The model can be written as follows:

$$|p_{ict} - \bar{p}_{ct}| = \beta_0 + \beta_1 |q_{ict} - \bar{q}_c| + \beta_2 \left|d_{it} - \bar{d}_c\right| + \beta_3 \, HHI_c + \varepsilon_{ict} \qquad (4)$$

Table 7 summarizes the regression analysis followed by a discussion of the main results.

Table 7. *Price variability and market concentration analysis.*

Variables	Model 1	Model 2
Intercept	45.962 (0.000)***	46.451 (0.000)***
Herfindahl-Hirschman index	-0.016 (0.000)***	-0.016 (0.000)***
Difference in quality	44.808 (0.000)***	44.612 (0.014)**
Difference in distance	0.001 (0.819)	
ANOVA analysis F statistic	12.286 (0.000)***	18.460 (0.000)**
R^2 adjusted	0.099	0.102

**Significant at 5% level
***Significant at 1% level

Market concentration is statistically significant as an explanatory variable for the price variability observed at the hotel industry level. The higher the Herfindahl index, the lower the price dispersion observed. An increase of 100 points in the market concentration index decreases price variability by €1.6. According to our sample data, differences in distance are not relevant to explain the variability observed in hotel prices for each city, whereas differences in quality explain, to a certain extent, the price variability observed in each city analyzed.

5. Conclusions

The literature on oligopolistic markets, including the hospitality industry, suggests a positive relationship between market concentration and prices. A higher market concentration, generally measured through the Herfindahl-Hirschman index, is associated with higher prices and lower price variability (Stavins, 2001; Schneider *et al.*, 2008; Singh and Zhu,2008). However, the analysis of how market concentration affects prices in the hospitality industry is limited. The scant evidence refers mainly to the United States market and does not consider urban areas (Gan and Hernandez, 2013). This paper constitutes a first attempt to analyze the influence of market concentration on prices and price variability for the hotel industry, empirically analyzing European urban markets. The main novelty and addition to the current literature on tourism economics from this research is the analysis of the role played by seasonality as a moderating factor on the influence market concentration has on hotel prices and price variability, a study not previously conducted to the best of our knowledge.

Our empirical results from the hedonic price model applied to the hotel industry reinforce previous findings and the theoretical framework for understanding how hotel location and the quality of the service, as relevant product differentiation factors, influence hotel prices. A location close to spots valued by tourists allows hotel managers to apply higher prices (Espinet *et al.*,2003; Soler *et al.*, 2019). For the urban markets analyzed in this paper, for every 100 meters the hotel is closer to the city centre, the average price increases by €1.4. However, a new result in the academic literature is that when seasonality is considered, the variable distance becomes only significant for the high-demand period. This result suggests that location relevance may differ depending on tourist destinations' seasonality level and the high-demand period's length. In terms of the quality of the service offered, many papers have confirmed that higher quality is associated with higher prices (Schuckert *et al.*,2015; Wen *et al.*,2021). Our analysis confirms this relationship. One additional point, on a 0 to 10 scale, on the online average rating allows hotel managers to increase prices on average by €33; interestingly, this influence is the same for high-demand or low-demand periods, concluding that seasonality does not moderate the effect on quality, a relevant result not only for academia, also for managers and investors in the hospitality industry.

5.1. Theoretical implications

From a theoretical perspective, economists have developed and empirically tested models to understand which factors may positively influence the likelihood of tacit collusion (Ivaldi *et al.*,2003). Understanding how different factors influence the likelihood of tacit collusion is a relevant question, as tacit collusion shapes welfare between market participants and has significant long-term consequences in aspects such as the industry level of innovation. The theoretical framework for oligopolistic market analysis suggests frequent price adjustments, growing market demands, and capacity constraints favour collusion (Ivaldi *et al.*, 2003). These three factors are present in the hotel industry. The hotel industry can adjust prices almost immediately. Equally relevant is that price information is transparent, as it is available to all firms. The European hospitality industry is a growing market and has experienced a strong recovery after the pandemic. Finally, hotels face a capacity constraint regarding the number of available rooms.

Our results confirm the theoretical framework for tacit collusion in the hotel industry. Higher market concentration implies higher prices and less price variability. The market concentration measured by the Herfindahl index reduces price variability. A 100-point increase in the index reduces price variability by €1.6; similarly, a 100-point increase in the market concentration index increases average hotel prices by € 2.8. These results complement the available empirical evidence about market concentration and prices in the hotel industry by analyzing European urban markets (Gan and Hernandez, 2013).

The originality of the paper and its value addition to the current knowledge in tourism economics is the inclusion in the analysis of the role played by seasonality in moderating the influence of market concentration in the likelihood of tacit collusion and higher prices. To the best of our knowledge, this question has not been previously analyzed from an empirical perspective. Our data suggests that market concentration is associated with higher prices for both high-demand and low-demand periods. However, the coefficient that measures the positive effect of higher market concentration on prices is 78% higher when considering the high-demand period than the regression coefficient for the low-demand period. This result is consistent with the idea that tacit collusion and higher prices are more likely to occur in periods of strong occupancy rates and when consumers have a more inelastic demand. However, it is also a meaningful and a new result on the analysis of market concentration and price relationship that even for periods of lower demand and weaker occupancy rate, market concentration is associated with higher prices, suggesting that no matter if hotels can increase their occupancy by

lowering prices, in a more concentrated market they will be less likely to apply deviation strategies from the collusive option.

5.2. Managerial and practical implications

Revenue management is a key element to guarantee profitability in the hotel industry. Our results about how quality, distance, and market concentration influence hotel prices, adding the moderating role played by seasonality, are relevant for practitioners and other hospitality industry stakeholders. In particular, hotel managers deciding the pricing strategy will benefit from knowing the influence the distance to the city centre and the quality of the service offered to customers have on hotel prices. The fact that the quality of the service impact on hotel prices is not influenced by the level of seasonality, whereas the distance to the city centre has a significant effect on prices only for high-demand periods may influence the allocation of investment resources when hotel investors decide on concrete locations and the quality of the service offered.

The influence of market concentration on price variability and the likelihood of tacit collusion can play a relevant role in decisions taken by different stakeholders in the hospitality industry, from hotel companies deciding their portfolio of hotels to the competition authorities deciding which markets to focus on. The main result of this research is that higher market concentration is associated with higher prices, which is significant in both periods of high and low demand. However, seasonality appears to be very relevant in this relationship. If market concentration increases by 100 points, average prices increase by €1.9 in low-demand periods but €3.4 in high-demand periods. Hotel investors may benefit from higher prices in a highly concentrated market, but a longer-lasting high-demand period is a catalyst. From the perspective of competition authorities, constrained by limited resources, our empirical findings invite them to focus on markets with a high market concentration level but in which the strong high demand for most of the year facilitates firms' involvement in collusive behaviour.

5.3. Limitations and future research directions

This research contributes to the previous literature in tourism economics from the perspective of looking at market concentration influence on hotel price, considering data for Europan urban markets, contributing to the academic literature that up to now has mainly considered the empirical evidence for the United States. The main novelty is the analysis of the moderating role played by seasonality, a common feature in the hospitality industry. However, some limitations are worth considering, as they can be considered in future research.

The first limitation relates to the size of the sample; the cities considered are located in the region of Catalonia, Spain, but the results and findings of this research may benefit from enlarging the scope of the analysis, including more cities from different European countries. One additional limitation relates to the variables we considered as explanatory factors for hotel prices and price variability. Although there is consensus from previous academic literature on the relevance of the distance to the city centre, the quality of the service and the market concentration, other variables may be crucial in improving our understanding of hotel prices. The value for the R square adjusted, particularly for the regression model analyzing price variability, invites future research to consider other variables such as the hotel's commitment to sustainability, the different management styles, whether they are independent or chain hotels, or the market destination's structural characteristics. From a methodological perspective, a limitation to be considered is the approach to the Herfindalh-Hirschmann index, based on number of rooms each hotel has. The market concentration may show different results based on each hotel's demand if their occupancy rates show high heterogeneity.

There are many interesting lines of future research on the analysis of market concentration, prices, and industrial organization applied to the hotel industry, which are the topics of this paper. One first line of future research is to complement the analysis of hedonic prices by looking at profitability. Better location and quality service are associated with higher prices, but it cannot be directly inferred that it translates into higher profitability. Better locations are more expensive, and investing in quality may be costly and experience diminishing returns at some point. Academic literature has focused more on how location and quality influence prices, but without reaching conclusive results about profitability. As the main addition this paper makes to the analysis of the relationship between market concentration and hotel prices is the role of seasonality, a clear future line of research is to focus on how the length of the high and low demand period influences the likelihood of collusive behaviour of hotels. Additionally, this paper has looked at the role of seasonality and how it relates to market concentration and hotel prices, but for urban destinations. The hotel industry is present in many other relevant markets, such as heritage and cultural tourism destinations or sun and beach destinations, in which the theoretical framework and empirical results may differ from what we have presented. Future research looking at other alternative markets will improve our comprehensive understanding of the particularities of competition and market concentration in the hospitality industry.

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