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Spatial density, average prices and price dispersion. Evidence from the Spanish hotel industry*

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Abstract

Based on the assumption that location is especially relevant in the lodging industry, we exploit a dataset of Spanish hotels to examine the relationship between spatial competition and retail price level and dispersion. Our results support the hypothesis that a greater density of competitors implies both a lower level and less dispersion of retail prices. We find that close competitors, in terms of hotel category and distance, have a stronger effect on price setting behavior. Moreover, we report weak evidence that the relationship between spatial competition and price level depends on whether the day considered belongs to the midweek or the weekend. Therefore, variation in the type of consumers seems to play quite an important role in explaining the relationship.

Keywords: Price level, price dispersion, spatial competition, hotel industry.
JEL Classification L11, L81, D43

Resumen

Partiendo del supuesto de que la localización es especialmente relevante para el sector del alojamiento, utilizamos una base de datos de hoteles españoles para examinar la relación entre competencia espacial y el nivel y la dispersión de los precios de las habitaciones. Nuestros resultados confirman la hipótesis de que una mayor densidad de competidores implica niveles de precios menores y menor dispersión de precios. Los competidores cercanos, ya lo sean en términos de categoría hotelera como de distancia, tienen una mayor influencia sobre la fijación de precios. Adicionalmente, encontramos evidencia débil acerca de que la relación entre competencia espacial y el nivel de precios depende de si el día considerado es laborable o corresponde al fin de semana. Por tanto, las variaciones en el tipo de consumidores parecen tener un papel importante en la explicación de esta relación.

Palabras clave: Nivel de precios, dispersión de precios, competencia espacial, sector hotelero.

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I. INTRODUCTION

It is broadly accepted that intensity of competition is an essential variable to explain equilibrium prices in local retail markets. Nevertheless, the theoretical literature shows a contradictory picture of this relationship. Following the commonly held view based on the Chamberlin's (1933) monopolistic competition model, a lower number of sellers in a local market would imply price increases. Extending on this basic approach it is easy to predict that, in this case, the dispersion of prices is also increased. Some alternative approaches can involve completely different predictions. For instance, opposing results can arise from an analysis based on the well-known search cost theories, where it is supposed that price information is costly for consumers. This is the case of the model developed by Varian (1980) or by Carlson and McAfee (1983). While results for price levels in these modern approaches contrast with each other, both models show a positive correlation between the number of sellers and the degree of price dispersion. Nowadays, theories explaining the relationship between prices and the number of firms have matured to the point where research economists should focus on testing the models (Carlson and McAfee, 1983; Dahlby and West, 1986).

Differences in predictions encouraged an engrossing debate that was well supported by evidence and which was aimed at ascertaining which theories describe retail pricing behavior in real markets in the most appropriate way. The empirical literature shows that more intense competition is often related with lower price levels. In the majority of cases this reduction in price levels has allowed economists to call for market liberalization policies in some traditionally regulated industries (i.e. Morrison and Winston, 1990; Schmidt, 2001). However, the empirical evidence on price dispersion and its relation with the number of firms is mostly mixed. Therefore, recently an increasing number of studies are being devoted to testing the relationship between price dispersion and competition in different industries (i.e. Barron, Taylor, and Umbeck, 2004; Syverson, 2007; Lewis, 2008; Gerardi and Shapiro, 2009).

In this paper, we are interested in contributing to the debate about the relationship between competition and both price levels and price dispersion. To this end, we will perform an empirical analysis using a dataset for the Spanish hotel industry. The hotel industry provides a set of attractive specific advantages in comparison to other alternative study cases. First, the hotel lodging service is to be consumed in the same place where the seller is located. Hence, the spatial location of sellers will be especially relevant in our study. Second, the consumer should be clearly informed of the quality of the hotel lodgings by a mandatory sectoral regulation. Thus, we can easily control for hotel quality in our analysis. Third, we will also offer an indirect approximation of the sensitivity of the relationship between spatial competition and prices when sellers are faced with changes in the type of consumers. We will carry out a comparative analysis of results obtained from each one of seven consecutive days of the week where, in essence, only demand-side changes can take place. In this short period the structure of costs and the number of competing firms remain constant, while there may be remarkable changes in the proportions of businesspersons and leisure consumers between midweek and weekend days.

Special efforts will be made to control for a number of specific factors related with the study case. First, as differentiation is an essential strategy in the hotel industry, we will control for the particular characteristics of the hotels, especially those related with the quality of the services on offer, branding and hotel size. Second, we will attempt to disentangle seller density from local demand intensity. A higher spatial density of sellers in an area could be associated to stronger demand intensity and, in turn, both variables together can affect the optimal pricing behavior. We will therefore take into account location-specific variables with the intention of capturing differences in local demand intensity. Third, unlike previous studies on the issue, we will take into consideration the possibility that exogenous spatial factors jointly affect the price setting behavior of nearby hotels. We will use the method developed recently by Kelejian and Prucha (2007) in order to obtain valid inference in the presence of heteroskedasticity and spatially autocorrelated disturbance terms.

The rest of the paper is organized as follows. Section II presents a review of some well-known representative models and their predictions about the subject in which we are interested. In Section III we describe the dataset used in this study and put forward the econometric specification to be estimated. In Section IV we present and comment on the main results. The final section provides the summary conclusions of the paper.

II. PREDICTIONS AND EMPIRICAL RESULTS FROM PREVIOUS RESEARCH

We start this section by reviewing only a few of the representative theoretical models on the subject with the intention of illustrating how some alternative theories can imply different predictions.

First, in the traditional theoretical framework of monopolistic competition an increase in the number of firms induces a fall in both average prices and price dispersion. The results on average prices are derived from the basic assumptions of Chamberlin's (1933) model in which consumers, who are perfectly well informed about alternative sellers, perceive products to be heterogeneous across sellers. Nevertheless, in this model prices are identical across all firms, and the existence of price dispersion requires the introduction of asymmetries in production cost or in seller demands. A good example to explain price dispersion can be found in Perloff and Salop (1985), who consider asymmetries in the elasticity of sellers' demands. In this model an increase in the number of firms for each specific brand induces a reduction in markups toward zero and, since marginal costs among competing firms coincide, price dispersion decreases.

Second, some alternative theories in which consumers differ in the cost involved in becoming perfectly well informed so as to be able to discover the minimum price yield results concerning average prices and price dispersion that are the opposite to those described above. This is the case of the model by Salop and Stiglitz (1977), which supports the existence of dispersion of prices although products are homogeneous and sellers have the same marginal cost. In this case, consumers are grouped into two types: informed and uninformed. While informed buyers have low search costs and buy only from the cheapest store, uninformed persons shop at random. In this model, prices at certain stores are persistently lower than in others and this allows consumers to learn from their purchasing experience. The effect of the possibility of learning on price distribution would be to limit the explanation of the observed persistence in price dispersion.[1] This disadvantage is not present in Varian's (1980) model of sales, in which each store draws its price from an equilibrium price distribution. In this model, firms engage in sales behavior in order to price discriminate among informed and uninformed buyers. For our purposes, the main predictions of Varian's (1980) model are that a higher number of sellers is linked both with a higher average price and with greater price dispersion.

Third, we can obtain a combination of the above results, that is to say, predictions of the average price according to the most conventional models and predictions on price dispersion in line with Varian's model. We are thus referring to two models, also based on consumers' search costs, but which allow the existence of price dispersion to be explained without having to invoke the presence of mixed strategies. This is the case of Carlson and McAfee's (1983) model, which develops an explicit solution where a larger number of firms induces a general reduction in markups and, consequently, in average prices. Conversely, price dispersion is limited by the dispersion of marginal production costs. Hence, if there are no differences in marginal costs across firms, then price dispersion could not be justified. An interesting alternative to this model is the one developed by Anderson and de Palma (2005), which shows that it is possible to obtain the same predictions of prices even without assuming differences in marginal production costs. In this modern treatment, the

[1] For evidence of persistence of price dispersion see, for example, Lach (2002).

authors simulate how prices change with the number of firms under a uniform distribution function for reservation prices. Results show that if the number of firms increases, the average price decreases from monopoly level until half this level in the limiting case. Moreover, prices become more dispersed as the number of firms increases. Particularly, the highest price equals the monopoly price, while the lowest price tends toward marginal production cost.

In the last two decades a substantial number of empirical studies have been conducted on the relationship between intensity of competition and retail pricing behavior. In the rest of this section, we briefly discuss some empirical studies on this subject.

Although some recent papers like Ward, Shimshack, Perloff, and Harris (2002) and Thomadsen (2007) have found price-increasing competition in some markets, evidence on this phenomenon is exceptional. Empirical evidence suggests that, in general, competition reduces price levels. Morrison and Winston (1990), for example, study the airlines industry that operates in the USA and Schmidt (2001) focuses on the USA railroad industry. These researchers have found that fares are higher where the number of route-carriers is lower. Other studies have reported similar results. This is the case of the recent works by Barron, Taylor, and Umbeck (2004), who investigate gas stations in four metropolitan areas, and by Syverson (2007) who examines the ready-mixed concrete plants in the USA. Both the last two papers mentioned above also contribute, in turn, to the burning debate about the real role of competition in dispersion of prices. The results supported the idea that higher seller density implies a decline in upper-bound prices, thus leading to a decrease in price dispersion.

Other authors have found opposite results with respect to the correlation between competition and price dispersion. The early paper by Marvel (1976) on USA retail gasoline prices found a positive link among number of sellers and price dispersion. Since then, several investigations have also supported this result. This is the case of the paper by Walsh and Whelan (1999), which focuses on Irish grocery markets and refers explicitly to the importance of considering sellers' characteristics in order to analyze price dispersion. Similar results were obtained recently for the gasoline market by Lewis (2008). An interesting aspect of this last work is that the association between spatial competition and price dispersion becomes clearly positive only when the author separates localized submarkets by seller type, which would indicate that demand intensities in different local areas are also a relevant variable to be taken into consideration. However, the recent study by Gerardi and Shapiro (2009) suggests that the positive correlation between competence and price dispersion could be attributed to omitted-variable bias. These authors show how this might happen in relation to previous studies conducted by Borenstein and Rose (1994) and Stanvis (2001) for the USA airline industry, where time-invariant characteristics that are specific for each route-carrier are not controlled.

The inconclusive evidence about how retail price dispersion is generally related to spatial competition reinforces the need to extend the empirical work to other industries.

III. DATASET AND ECONOMETRIC SPECIFICATION

We collected data on room prices and the characteristics of hotels located in the metropolitan area of Madrid. Madrid is the capital of Spain and its largest city. It is the seat of the Government of Spain, of the local Government of the Community of Madrid, and of the main political institutions of Spain. It is an important center for international business and trade, and one of the largest financial centers in Europe. Madrid is also an important cultural and recreational destination.

Since there is no official definition of the metropolitan area, we decided to use the one proposed by García Ballesteros and Sanz Berzal (2002).[2] Figure 1 shows a map of the metropolitan area of Madrid and the location of all the hotels in this area. Hotel locations were taken from the Statistical Institute of the Community of Madrid.[3] In Figure 1 we also distinguish three different sub-areas. The majority of hotels, 169 out of 315, are situated in the central districts, in which the main attractions of Madrid are located. The remaining hotels are located in the suburbs of the city (20%) and in the surrounding municipalities (24%).

The prices used in this work were taken from a website[4] and correspond to the price, including taxes, of one night in a standard double room. We obtained prices for every night in a week, from July 9 to July 15 2008.[5] No local holidays were being celebrated and no especial events were taking place in Madrid on those days. Also, data from the Spanish National Statistics Institute (INE) indicate that the occupancy rate in the Madrid hotel market for

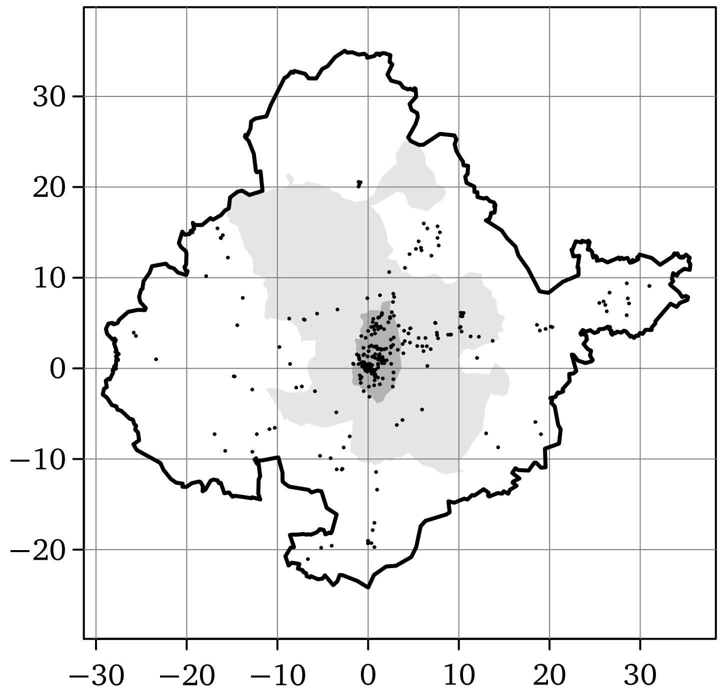
[2] The metropolitan area comprises 27 municipalities: Madrid, Alcalá de Henares, Alcobendas, Alcorcón, Boadilla del Monte, Brunete, Colmenar Viejo, Coslada, Fuenlabrada, Getafe, Leganés, Majadahonda, Mejorada del Campo, Móstoles, Paracuellos del Jarama, Parla, Pinto, Pozuelo de Alarcón, Rivas-Vaciamadrid, Las Rozas, San Fernando de Henares, San Sebastián de los Reyes, Torrejón de Ardoz, Tres Cantos, Velilla de San Antonio, Villaviciosa de Odón, Villanueva de la Cañada, and Villanueva del Pardillo.

[3] http://www.madrid.org/nomecalles/

[4] GTA Hotels, http://www.gtahotels.com. We chose this Internet site because of its wide coverage of Madrid hotels.

[5] Data were collected on June 25 2008.

__Figure 1__ – Location of hotels in the metropolitan area of Madrid



The axes measure the distance in kilometers from the center of the city. The dark shaded area in the middle covers the central districts of the city. The lighter shaded area covers the suburbs of the city of Madrid. The unshaded area corresponds to the surrounding municipalities of Madrid.

July 2008 was well below the full rate and that occupancy on labor days was quite similar to that of weekend days (50.4% and 57.7%, respectively). In the final sample we included all hotels for which we were able to obtain prices for every day of the week considered. The hotels in the sample account for approximately 70% of the total number of hotels, i.e. 217 out of 315.

Our estimation strategy is as follows. First, we used a simple regression model for the price levels:

$$(1) \quad p_{it} = x_{it}'\beta_t + \epsilon_{it}$$

where p_{it} is the logarithm of the room price set by hotel $i = 1, \ldots, N$ on day $t = 1, \ldots, T$, x_{it} is a vector of K covariates, β_t is a vector of unknown parameters corresponding to day t, and ϵ_{it} is a regression disturbance. The covariates include measures for the spatial density of competitors as well as controls for hotel and location characteristics. In our case, most of the covariates do not vary across the days in our sample, so there are no efficiency gains from the joint estimation of the system of T equations (1), and the price level regressions are estimated by OLS equation by equation.

Second, using the error terms of the price level regressions, we specified the following model for the conditional variance of p:

$$(2) \quad \epsilon_{it}^2 = x_{it}'\phi_t + \eta_{it}$$

where ϕ_t is a vector of unknown parameters and η_{it} is a regression disturbance. This is a valid regression model for $\text{Var}(p|x)$, given that $E(\epsilon|x) = 0$. We obtain a feasible regression model by replacing the true error terms with the OLS residuals from equation (1):

$$(3) \quad \hat{\epsilon}_{it}^2 = x_{it}'\phi_t + \omega_{it}$$

While we can obtain consistent estimates of the parameters of price level and price dispersion regressions by means of OLS, obtaining valid standard errors requires some care. First, equation (2) implies conditional heteroskedasticity in the price level regression. Second, in our case unobserved effects related to location may be affecting the prices of closely located hotels, and the regression disturbances are spatially dependent. Both complications can be taken into account with the covariance matrix estimator developed by Kelejian and Prucha (2007), which is consistent under spatial dependence and heteroskedasticity of the error terms. We use a straightforward multivariate extension of this covariance matrix estimator that allows us to test cross-equation restrictions on the parameters of regression systems given in equations (1) and (3). In the case of price level regressions, we estimate the covariance matrix of the stacked regression parameters $\beta = (\beta_1', \beta_2', \ldots, \beta_T')'$ with:

$$(4) \quad \hat{\text{Var}}(\hat{\beta}) = N \left(\sum_{i=1}^{N} X_i'X_i \right)^{-1} \hat{\Psi} \left(\sum_{i=1}^{N} X_i'X_i \right)^{-1}$$

where X_i is a $T \times TK$ block diagonal matrix collecting the covariates of hotel i across the T days in the sample:

$$(5) \quad X_i = \begin{pmatrix} x_{i1}' & 0 & \dots & 0 \\ 0 & x_{i2}' & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & x_{iT}' \end{pmatrix}$$

and:

$$(6) \quad \hat{\Psi} = \frac{1}{N} \sum_{i=1}^{N} \sum_{j=1}^{N} X_i'\hat{\epsilon}_i\hat{\epsilon}_j'X_j K(d_{ij}/d_n)$$

where $\hat{\epsilon}_i$ is the T-dimension vector whose elements are the residuals corresponding to hotel i, $K(\cdot)$ is a kernel function, d_{ij} is a distance measure between observations i and j, and d_n is a bandwidth parameter controlling the amount of kernel smoothing. It is well known that the choice of the kernel function is less critical than the choice of the bandwidth parameter. In our application we follow Kelejian and Prucha's (2007) suggestion and use a Parzen kernel, but with a larger bandwidth parameter than the one suggested by these authors, following the analysis conducted by Lambert, Florax, and Cho (2008). For the distance measure, d_{ij}, we use the Euclidean distance between each pair of hotels.

The explanatory variables included in the regressions can be classified into three groups. The first group includes variables related to hotel characteristics, since the perceived quality and number of services offered by hotels could affect room prices. One important way of indicating the quality of an establishment is by using the official hotel category. As in many other countries, the category of a hotel in Spain is ranked by the number of gold stars it has been awarded. A larger number of stars indicates a better record of quality and guarantees that the hotel has certain services and facilities. In the metropolitan area of Madrid the quality and the availability of specific services and facilities for each hotel category are regulated by the autonomous Government of the Community of Madrid. In Table 1 we summarize some important differences in hotel characteristics from one hotel category to another. We use the dummies *Stars3*, *Stars4*, and *Stars5* to signal 3, 4, and 5 gold star hotels, respectively. The reference group is made up of 2 gold star hotels.[6] We also include the dummies *AC*, *NH*and *Tryp*, which correspond to the most important chains that operate in the metropolitan area of Madrid: AC, NH and Tryp-Meliá. By including these variables we attempt to control for differences in prices arising from branding strategies and consumer loyalty. These chains operate mainly urban hotels in the largest cities of Spain, and their hotels represent 27% of our sample. The rest of the hotels in the metropolitan area either belong to small local chains or are independent hotels. Another variable included in our regressions, *Rooms*, is the number of rooms (in hundreds) in each hotel in the sample, since pricing behavior could be related to hotel size.[7] The last variable in this group is *Breakfast*, a dummy variable that takes a value of 1 if the reported price includes breakfast. At the time of collecting the data there was no way to adjust room prices not to include breakfast. We therefore add the breakfast variable to control for price

[6] Our sample does not include observations on 1-star hotels. This category only accounts for 2.5% of all hotels in the metropolitan area of Madrid.

[7] Data about number of rooms were obtained from Turespaña (2008).

Table 1 *– Minimum dimensions, facilities and services according to the hotel category*

Dimensions, facilities and services	Category (number of gold stars)				
	5	4	3	2	1
Corridor with rooms on both sides (meters wide)	1.65	1.50	1.40	1.30	1.20
Corridor with rooms to one side (meters wide)	1.50	1.40	1.30	1.20	1.10
Main stairway (meters wide)	1.50	1.40	1.30	1.20	1.10
Height of room (meters)	2.70	2.60	2.60	2.50	2.50
Standard double room surface (square meters)	17.00	16.00	15.00	14.00	12.00
Bathroom surface (square meters)	5.00	4.50	4.00	3.50	3.50
Telephone in all rooms	✔	✔	✔	✔	
Autonomous stairway for service	✔	✔	✔		
Independent access for clients and service staff	✔	✔	✔		
Hoist	✔	✔	✔		
Elevator when hotel has less than three floors	✔	✔	✔		
Bar	✔	✔	✔		
Covered parking	✔	✔			
Access to data transmission resources	✔	✔			
Strongbox and snack bar in rooms	✔	✔			
Soundproofed rooms	✔	✔			
Adjustable air conditioning in all public spaces	✔	✔			
Adjustable air conditioning with remote control	✔				
24 hours service (with possibility of cooked foods)	✔				
Baggage storage facilities	✔				
With separate WC	✔				
Telephone in bathroom	✔				
Bathtub and shower per room	✔				

This information was taken from the Order 77/2006 of the Autonomous Community of Madrid, which regulates hotel establishments. Required facilities or services for each hotel category are marked with a ✔.

differences that are due to the inclusion of breakfast in the room price.

The second group of variables is related to location characteristics. Since we will attempt to estimate the effect on prices caused by a higher spatial density of competitors net of effects due to a higher number of potential customers, we must also control for possible differences in demand intensity across geographical areas. We introduce two variables, *DCenter* and *DAirport*, reflecting the logarithm of the Euclidean distances of each hotel to two focal points in the metropolitan area of Madrid. On the one hand, we take into account the distance from the city center. Important political institutions of Spain and the headquarters of the most important Spanish financial institutions are located around the city center of Madrid (the Puerta del Sol Square), and it is an area where tourists can carry out a wide range of entertainment activities. On the other hand, we use the distance from the international airport of Madrid. An important meeting point for businesspeople, the Trade Fair Institution of Madrid (IFEMA), is located near the airport. We also use a set of dummies to distinguish hotels located in the suburbs of Madrid, *Suburbs*, and in the surrounding municipalities of Madrid, *Metrop*. Most of the attractions for visitors to Madrid are located in the central districts, but some of the surrounding municipalities also have important cultural and economic attractions. The suburbs of Madrid are mainly residential and industrial districts. The last variable in this group, *RGDPpc*, controls for the level of economic activity in each of the surrounding municipalities. We expect economic activity to have a positive influence on the demand for hotel rooms on business days. More specifically, for this purpose, we use the logarithm of the gross domestic product per capita of each municipality relative to that of the city of Madrid. Data about the GDP per capita of the municipalities were obtained from the Statistical Institute of the Community of Madrid.

The last group of variables, and the most important for our purposes, controls for the local density of competitors. We follow the recent work by Barron, Taylor, and Umbeck (2004) and we consider competitors of a given hotel to be all other hotels that are located no farther than a certain distance away. The choice of this fixed distance is not trivial, especially in the case we are considering, as hotel density presents strong variations across the metropolitan area of Madrid. While we focus on the results obtained for a radius of 200 meters, which is approximately the average nearest-neighbor distance in the central districts of Madrid, we have also repeated the analysis for other radii of 400 meters and 600 meters, which are the approximate average nearest-neighbor distances in the suburbs of Madrid and in the surrounding municipalities, respectively. As a further refinement, we have also split competitors into close competitors, i.e. those that have the same official category as the hotel under consideration, and other competitors, i.e. those with a different category.

In the empirical analysis that follows, the number of close competitors and the number of other competitors are reflected in the variables *CloseComp* and *OtherComp*. We expect the effect of close competitors to be stronger than the effect of other competitors.

IV. RESULTS

The estimates for the price level equations are reported in Table 2 on the next page. Broadly speaking, these estimates show some differences in price setting between weekend days (Friday and Saturday), and midweek days (Wednesday, Thursday, Sunday, Monday and Tuesday). Here, we briefly comment on the most interesting results related with the control variables. First, most of the point estimates associated with the official hotel category dummies are strongly significant. These estimates measure relative differences in prices with respect to the lowest category of the hotels in our sample, i.e. 2 stars. As expected, the level of retail prices rises as new services are included and consumers are guaranteed better facilities. For example, our estimations indicate that room prices for 3 and 4 star hotels on Wednesdays are, respectively, 18% and 40% higher than those of 2 star hotels, all other factors remaining constant. These price differences are somewhat lower on weekend days. On Saturday, room prices of 3 star hotels are not significantly different from those set by 2 star hotels, and in the case of 4 star hotels the relative difference with respect to 2 star hotels reaches its minimum value. The biggest price difference between successive hotel categories occurs between 4 and 5 star hotels. This difference is higher on weekend days, where 5 star hotel prices are around 70% higher than those of 4 star hotels, than in midweek days, where the relative price difference is about 60%.

Second, we present the estimates related with additional characteristics of hotels. The coefficients associated to hotel chains AC and NH are all positive and, in most cases, strongly significant. A higher price level for both brands is in agreement with a higher reputation, as indicated in descriptive studies of corporate image.[8] In this case we also found noticeable differences among coefficient estimates corresponding to weekend and those corresponding to midweek. At weekends, prices of hotels associated to the AC chain are not significantly different from prices set by unbranded hotels. In contrast, the difference between AC hotels and unbranded hotels is strongly significant on midweek days and ranges from 26% to 43%. In the case of NH hotels, there

[8] For example, the "Key Audience Research" carried out by the Ipsos agency in 2008 on surveys among journalists indicated that AC and NH hotels are the chains that are most highly valued among the overall set that operate in Spain.

***Table 2** – Price level regressions*

	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
Constant	4.8470***	4.8532***	4.8341***	4.8446***	4.5355***	4.8223***	4.8158***
	(0.1107)	(0.1187)	(0.1089)	(0.1149)	(0.1473)	(0.1265)	(0.1212)
Stars3	0.1844***	0.1610**	0.1483**	0.0824	0.2800***	0.2608***	0.2176***
	(0.0623)	(0.0676)	(0.0743)	(0.0891)	(0.0975)	(0.0670)	(0.0644)
Stars4	0.3993***	0.3889***	0.3041***	0.2360***	0.3821***	0.4244***	0.3929***
	(0.0700)	(0.0747)	(0.0686)	(0.0813)	(0.0970)	(0.0723)	(0.0672)
Stars5	1.0298***	0.9940***	0.9844***	0.9242***	1.1091***	1.0195***	0.9693***
	(0.0937)	(0.0976)	(0.1015)	(0.1186)	(0.1325)	(0.1060)	(0.1010)
AC	0.3571***	0.3487***	0.0911	0.0866	0.2607***	0.4288***	0.4255***
	(0.0608)	(0.0589)	(0.0641)	(0.0614)	(0.0865)	(0.0639)	(0.0593)
NH	0.4116***	0.4061***	0.1137***	0.1215***	0.3733***	0.3195***	0.3419***
	(0.0404)	(0.0408)	(0.0398)	(0.0379)	(0.0492)	(0.0468)	(0.0506)
Tryp	−0.0196	−0.0598	−0.0228	0.0099	0.0617*	−0.0317	−0.0085
	(0.0457)	(0.0562)	(0.0344)	(0.0338)	(0.0366)	(0.0646)	(0.0475)
Rooms	−0.0555***	−0.0498***	−0.0518***	−0.0509***	−0.0399***	−0.0425***	−0.0406***
	(0.0121)	(0.0131)	(0.0156)	(0.0138)	(0.0149)	(0.0134)	(0.0133)
Breakfast	−0.0598	−0.0711*	0.0153	0.0197	−0.0003	−0.0843*	−0.0918**
	(0.0372)	(0.0370)	(0.0334)	(0.0300)	(0.0413)	(0.0498)	(0.0435)
DCenter	−0.0183	−0.0235	−0.0784***	−0.0680***	−0.0263	−0.0333	−0.0364
	(0.0241)	(0.0261)	(0.0276)	(0.0207)	(0.0238)	(0.0248)	(0.0225)
DAirport	−0.1374***	−0.1294***	−0.1330***	−0.1177***	−0.1007**	−0.1636***	−0.1463***
	(0.0338)	(0.0356)	(0.0307)	(0.0299)	(0.0410)	(0.0351)	(0.0360)
Suburbs	−0.2419***	−0.2307***	−0.1967***	−0.1612***	−0.1718***	−0.2583***	−0.2356***
	(0.0653)	(0.0687)	(0.0623)	(0.0556)	(0.0639)	(0.0640)	(0.0633)
Metrop	−0.0158	−0.0192	0.0064	−0.0078	−0.1089	0.0417	0.0291
	(0.0808)	(0.0791)	(0.0846)	(0.0767)	(0.0804)	(0.0802)	(0.0716)
RGDPpc	0.2958***	0.2884***	0.0538	0.0659	0.1555**	0.3336***	0.3009***
	(0.0552)	(0.0554)	(0.0635)	(0.0601)	(0.0613)	(0.0646)	(0.0632)
CloseComp	−0.0173***	−0.0177***	−0.0092**	−0.0088**	−0.0124**	−0.0198***	−0.0196***
	(0.0056)	(0.0057)	(0.0041)	(0.0037)	(0.0059)	(0.0061)	(0.0050)
OtherComp	0.0021	0.0001	−0.0026	0.0011	0.0091	0.0024	0.0010
	(0.0067)	(0.0074)	(0.0091)	(0.0058)	(0.0082)	(0.0078)	(0.0074)
Mean of dep. var.	4.7444	4.7471	4.6192	4.6295	4.6019	4.6891	4.6902
S.D. of dep. var.	0.3748	0.3755	0.3484	0.3319	0.3702	0.3723	0.3687
$\hat{\sigma}$	0.2354	0.2406	0.2347	0.2191	0.2502	0.2402	0.2383
R^2	0.6329	0.6180	0.5778	0.5944	0.5749	0.6124	0.6114
χ^2	688.01***	637.22***	320.79***	272.16***	287.65***	613.52***	570.24***

Equation by equation OLS estimates. Dependent variables are the logarithm of room prices on each day. Number of observations in each equation: 217. Figures between parentheses are standard errors robust to heteroskedasticity and spatial autocorrelation (Parzen kernel with bandwidth parameter $d_n = 1650$ meters). $\hat{\sigma}$ is the standard error of the regression. The statistics reported in the row labeled 'χ^2' are robust Wald tests on the joint significance of regression slopes. Significant estimates and statistics at the 10%, 5% or 1% levels, are marked with *, ** and ***, respectively.

***Table 3** – Price dispersion regressions*

	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
Constant	0.0719*	0.1015**	0.1464***	0.1150***	0.1037**	0.0495	0.0592
	(0.0371)	(0.0452)	(0.0501)	(0.0356)	(0.0458)	(0.0378)	(0.0377)
Stars3	−0.0076	−0.0216	−0.0202	−0.0235	−0.0407	−0.0095	−0.0069
	(0.0274)	(0.0377)	(0.0336)	(0.0223)	(0.0345)	(0.0217)	(0.0206)
Stars4	0.0102	−0.0030	0.0036	−0.0143	−0.0258	0.0186	0.0240
	(0.0253)	(0.0373)	(0.0327)	(0.0207)	(0.0332)	(0.0251)	(0.0221)
Stars5	0.0559	0.0421	0.0340	0.0358	0.0302	0.0659	0.0681
	(0.0610)	(0.0679)	(0.0678)	(0.0661)	(0.0779)	(0.0743)	(0.0765)
AC	−0.0489**	−0.0526**	−0.0368	−0.0190	0.0124	−0.0433**	−0.0486**
	(0.0212)	(0.0212)	(0.0297)	(0.0272)	(0.0382)	(0.0207)	(0.0204)
NH	−0.0391***	−0.0384***	−0.0382***	−0.0222**	0.0084	−0.0073	−0.0001
	(0.0113)	(0.0105)	(0.0125)	(0.0110)	(0.0116)	(0.0128)	(0.0124)
Tryp	−0.0239**	−0.0280**	−0.0353***	−0.0228**	−0.0307***	−0.0124	−0.0188
	(0.0118)	(0.0109)	(0.0116)	(0.0098)	(0.0102)	(0.0148)	(0.0125)
Rooms	−0.0080	−0.0080	−0.0084	−0.0054	−0.0107	−0.0097	−0.0104
	(0.0068)	(0.0068)	(0.0083)	(0.0078)	(0.0089)	(0.0085)	(0.0087)
Breakfast	−0.0201*	−0.0184	−0.0211	−0.0189*	−0.0093	−0.0090	−0.0152
	(0.0109)	(0.0112)	(0.0140)	(0.0102)	(0.0121)	(0.0138)	(0.0104)
DCenter	0.0048	0.0001	−0.0180**	−0.0130**	−0.0046	−0.0023	0.0010
	(0.0076)	(0.0082)	(0.0091)	(0.0063)	(0.0088)	(0.0079)	(0.0070)
DAirport	0.0059	−0.0006	−0.0159	−0.0095	0.0007	0.0126	0.0069
	(0.0103)	(0.0110)	(0.0118)	(0.0106)	(0.0127)	(0.0105)	(0.0104)
Suburbs	−0.0131	0.0034	0.0108	0.0155	0.0319	0.0016	0.0032
	(0.0182)	(0.0194)	(0.0188)	(0.0170)	(0.0224)	(0.0194)	(0.0194)
Metrop	−0.0307	−0.0158	0.0374	0.0351	0.0052	−0.0182	−0.0322*
	(0.0252)	(0.0252)	(0.0252)	(0.0229)	(0.0244)	(0.0258)	(0.0192)
RGDPpc	0.0068	0.0068	0.0065	0.0312	0.0148	0.0077	0.0036
	(0.0178)	(0.0177)	(0.0220)	(0.0218)	(0.0154)	(0.0150)	(0.0115)
CloseComp	−0.0032***	−0.0037**	−0.0041**	−0.0032***	−0.0033**	−0.0038**	−0.0035**
	(0.0012)	(0.0015)	(0.0017)	(0.0011)	(0.0014)	(0.0018)	(0.0016)
OtherComp	−0.0027	−0.0031	−0.0074**	−0.0038**	−0.0019	−0.0043*	−0.0036**
	(0.0021)	(0.0022)	(0.0035)	(0.0015)	(0.0023)	(0.0023)	(0.0018)
Mean of dep. var.	0.0513	0.0536	0.0510	0.0445	0.0580	0.0535	0.0526
S.D. of dep. var.	0.0991	0.1028	0.1106	0.1046	0.1203	0.1092	0.1087
$\hat{\sigma}$	0.0982	0.1017	0.1096	0.1048	0.1208	0.1093	0.1082
R^2	0.0856	0.0882	0.0862	0.0657	0.0617	0.0673	0.0778
χ^2	28.17**	29.31**	55.12***	55.14***	77.15***	30.52**	45.25***

Equation by equation OLS estimates. Dependent variables are the square of the residuals of estimations reported in Table 2. Number of observations in each equation: 217. Figures between parentheses are standard errors robust to heteroskedasticity and spatial autocorrelation (Parzen kernel with bandwidth parameter $d_n = 1650$ meters). $\hat{\sigma}$ is the standard error of the regression. The statistics reported in the row labeled 'χ^2' are robust Wald tests on the joint significance of regression slopes. Significant estimates and statistics at the 10%, 5% or 1% levels, are marked with *, ** and ***, respectively.

are significant price differences on all days of the week, but price differences are notably lower at the weekend.

Moreover, the pricing behavior is also affected by the size of the hotel. The point estimates reveal that retail price level is lower for hotels that have more rooms to offer. Clearly, if the occupancy rate was similar across hotels, this result would capture the existence of economies of scale in the industry. Finally, including breakfast in room service does not appear to be a relevant variable in pricing behavior. Nevertheless, some weakly significant negative coefficients are obtained for some midweek days. This finding could be due to the fact that, in the presence of an excess capacity for these days, sellers implement an aggressive strategy to capture consumers.

The variables included to control for the differences in intensity of local demand across geographical regions are, in several cases, significant at the standard levels. Results support the hypothesis that intensity of demand decreases with distance from the two focal points in the city of Madrid. Thus, price level decreases the farther the hotel is located away from the city center and from the airport. More specifically, we can see that the distance from the city center has a significant negative effect on weekend days. When the distance from Madrid city center is increased by 10%, the level of prices is reduced by between 0.68% and 0.78%. In contrast, the distance from the airport is strongly significant every day of the week. In this case, the price level decreases by between 1.01% and 1.64% when the distance from the airport is increased by 10%. Furthermore, the suburbs and surrounding municipalities are also taken into account with the aim of controlling for possible differences in demand intensity associated to location. Significant differences in local demand arise when the hotel is situated in the suburbs. In this case, there is strong evidence that prices are between 16.12% and 25.83% lower than those set by similar hotels located in the central districts. Finally, we attempt to control for the level of economic activity in each specific area of the metropolitan region with the idea that, on certain days, this could affect the intensity of local demand. There is evidence that the relative level of activity, which has been approximated by the local gross domestic product per capita, has a positive effect on the level of the corresponding local retail prices. Unsurprisingly the effect is only relevant on business days.

To analyze the relationship between retail pricing behavior and number of competitors, we separated the hotels that had been officially classified in the same category from those belonging to a different category. The results presented in Table 2 refer to price response to competitors which are located within a 200 meter radius around the hotel. From the estimated coefficients we can infer that greater competitive pressure from sellers offering the same quality clearly implies a fall in average retail prices. The point estimates of co-

Table 4 *– Tests for parameter equality across types of competitors*

	Price level regressions	Price dispersion regressions
Wednesday	4.41 [0.036]	0.04 [0.843]
Thursday	3.04 [0.081]	0.06 [0.803]
Friday	0.76 [0.384]	0.60 [0.437]
Saturday	2.49 [0.115]	0.12 [0.733]
Sunday	3.32 [0.068]	0.38 [0.536]
Monday	4.90 [0.027]	0.04 [0.838]
Tuesday	5.24 [0.022]	0.01 [0.933]

Wald tests based on the estimations reported in Tables 2 and 3. The null hypothesis of these tests is the equality of the coefficients of the *CloseComp* and *OtherComp* variables on each equation. The *p*-values of the tests are reported between brackets. Under the null hypotheses, all these tests are distributed as χ^2 variables with one degree of freedom.

efficients indicate that the presence of an additional close competitor reduces the level of retail prices by between 0.88% and 1.98%. However, there is no evidence that a greater number of competitors with a different number of gold stars will have an effect on price level.

The estimates for the price dispersion equations are reported in Table 3 on page 14. In this case, we found that only a few of the control variables significantly affect the variance of hotel prices. The results suggest that only chain membership, the inclusion of breakfast in room service, and the distance from the center of Madrid have an effect on the variance of prices on certain days of the week. Nevertheless, we obtain strong evidence for the effect of spatial competition on price dispersion. The presence of a greater number of close competitors implies a lower degree of price dispersion every day of the week. Far less evidence is obtained, however, when we attempt to measure the effects of competitors with different numbers of gold stars. Although the value of estimates indicates that an increase in the density of competitors with different official categories also implies a fall in price dispersion, coefficients are only significant at the standard levels on four days of the week.

In Tables 4 and 5 we test whether the relationship between spatial competition and retail prices obtained in our study is independent of the competitors' categories and whether it is also independent of the day of the week considered. First of all, in Table 4 we find that, in general, the separation between close competitors and other competitors seems important in the analysis of price level response. More specifically, we reject the hypothesis that price level is affected to an identical degree by the density of competitors with the

Table 5 – *Tests for parameter equality within groups of days*

	Weekdays	Weekends	All days
Price level regressions			
CloseComp	6.81 [0.146]	0.07 [0.792]	11.11 [0.085]
OtherComp	5.34 [0.254]	0.44 [0.509]	9.09 [0.169]
Price dispersion regressions			
CloseComp	0.70 [0.952]	0.75 [0.385]	1.31 [0.971]
OtherComp	2.93 [0.569]	1.34 [0.248]	8.74 [0.189]

Wald tests based on the estimations reported in Tables 2 and 3. The null hypothesis of these tests is the equality across sets of equations of the coefficients of the *CloseComp* variable, on the one hand, and of the *OtherComp* variable, on the other hand. The p-values of the tests are reported between brackets. Under the null hypotheses, the test statistics are distributed as χ^2 variables with 6 ('All days' column), 4 ('Weekdays') and 1 ('Weekends') degrees of freedom.

same and different official categories for midweek days. Only in the case of weekend days is there no evidence to show that separation of competitors is an important feature in explaining price level behavior. This is consistent with the fact that for the weekend consumers, the different hotel categories are more substitutive. In contrast, we do not find significant differences in the effects of close competitors and other competitors on the dispersion of hotel prices.

The statistics presented in Table 5 allow us to test the hypothesis of identical values of the parameters related to the variables *CloseComp* and *OtherComp* across days of the week. As we can see, for both price levels and price dispersion equations, there is no evidence against the hypothesis that the parameters of these variables do not vary across the midweek days. No evidence of parameter differences across weekend days could be found either. Nevertheless, at the 10% level of significance, we can reject the claim that density of competitor hotels with the same official category affects the price level across all days of the week in an identical manner. We can therefore weakly infer that density of competitors with the same category affects retail price levels on midweek and weekend days in different ways. Since business consumers are generally concentrated on midweek days and leisure consumers at weekends, this result suggests that the sort of consumers has a critical effect on the relationship.

Lastly, we attempt to ascertain the sensitivity of the results as regards the distance that was employed to define each hotel's competitors. To this end, in Tables 6 and 7 we compare the results from price level and price dispersion

Table 6 – *Price level regression estimates with different radii*

	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
CloseComp							
$r = 200$	-0.0173^{***}	-0.0177^{***}	-0.0092^{**}	-0.0088^{**}	-0.0124^{**}	-0.0198^{***}	-0.0196^{***}
	(0.0056)	(0.0057)	(0.0041)	(0.0037)	(0.0059)	(0.0061)	(0.0050)
$r = 400$	-0.0062^{**}	-0.0067^{**}	0.0005	0.0008	-0.0061	-0.0083^{**}	-0.0091^{***}
	(0.0027)	(0.0030)	(0.0032)	(0.0032)	(0.0038)	(0.0033)	(0.0033)
$r = 600$	-0.0035	-0.0033	0.0024	0.0028	-0.0024	-0.0057	-0.0057
	(0.0028)	(0.0032)	(0.0029)	(0.0032)	(0.0041)	(0.0036)	(0.0038)
OtherComp							
$r = 200$	0.0021	0.0001	-0.0026	0.0011	0.0091	0.0024	0.0010
	(0.0067)	(0.0074)	(0.0091)	(0.0058)	(0.0082)	(0.0078)	(0.0074)
$r = 400$	-0.0021	-0.0021	-0.0060	-0.0034	0.0033	-0.0014	-0.0009
	(0.0048)	(0.0053)	(0.0067)	(0.0055)	(0.0054)	(0.0053)	(0.0049)
$r = 600$	-0.0014	-0.0019	-0.0034	-0.0033	0.0007	-0.0014	-0.0010
	(0.0034)	(0.0038)	(0.0043)	(0.0043)	(0.0043)	(0.0038)	(0.0036)

Estimates and standard errors of the parameters of variables *CloseComp* and *OtherComp* in price level regressions that are similar to those reported in Table 2. All hotels which lie within a circle with radius r, in meters, are considered to be competitors of the hotel located at the center of the circle.

Table 7 – *Price dispersion regression estimates with different radii*

	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
CloseComp							
$r = 200$	-0.0032^{***}	-0.0037^{**}	-0.0041^{**}	-0.0032^{***}	-0.0033^{**}	-0.0038^{**}	-0.0035^{**}
	(0.0012)	(0.0015)	(0.0017)	(0.0011)	(0.0014)	(0.0018)	(0.0016)
$r = 400$	-0.0028^{***}	-0.0031^{***}	-0.0030^{***}	-0.0024^{**}	-0.0027^{**}	-0.0022^{**}	-0.0021^{**}
	(0.0010)	(0.0012)	(0.0011)	(0.0009)	(0.0012)	(0.0011)	(0.0010)
$r = 600$	-0.0023^{**}	-0.0025^{*}	-0.0024^{*}	-0.0014	-0.0020	-0.0019	-0.0015
	(0.0011)	(0.0015)	(0.0013)	(0.0010)	(0.0014)	(0.0013)	(0.0012)
OtherComp							
$r = 200$	-0.0027	-0.0031	-0.0074^{**}	-0.0038^{**}	-0.0019	-0.0043^{*}	-0.0036^{**}
	(0.0021)	(0.0022)	(0.0035)	(0.0015)	(0.0023)	(0.0023)	(0.0018)
$r = 400$	-0.0007	-0.0008	-0.0027	-0.0016	-0.0016	-0.0025	-0.0023
	(0.0020)	(0.0021)	(0.0028)	(0.0019)	(0.0024)	(0.0025)	(0.0025)
$r = 600$	-0.0003	-0.0001	-0.0006	-0.0012	-0.0008	-0.0015	-0.0016
	(0.0018)	(0.0021)	(0.0020)	(0.0018)	(0.0023)	(0.0022)	(0.0022)

Estimates and standard errors of the parameters of variables *CloseComp* and *OtherComp* in price dispersion regressions that are similar to those reported in Table 3. All hotels which lie within a circle with radius r, in meters, are considered to be competitors of the hotel located at the center of the circle.

regressions that use different radii. In order to save space, we only report the point estimates and standard errors corresponding to variables that control for the spatial density of competitors.[9] Perhaps the most relevant finding of the alternative specifications is the robust negative effect of spatial competition on retail price dispersion. Hence, the point estimate is negative in all cases, which reflects a substantial decrease in the variance of retail prices as the number of competitors that a hotel has increases. Furthermore, the empirical results are also consistent with the fact that the effect of the number of competitors on pricing behavior is significantly reduced by vertical differentiation and by an increase in the spatial distance among them. More specifically, for any radius above 200 meters, the coefficients related with competitors that have a different number of stars are not statistically significant at the standard levels (for both price level and dispersion equations). In summary, only the number of competitors with the same official category clearly affects pricing behavior and the effect of competitor density on pricing behavior becomes weaker as the radius considered gets larger.

V. CONCLUSIONS

Since different theoretical models offer different predictions on the relationship between spatial competition and retail prices, there is broad agreement among academic economists that evidence of this relationship is of particular interest in order to test the fulfillment of competing theories. The empirical results presented in the paper concern the pricing behavior of hotels located in the metropolitan area of Madrid. We found strong evidence in favor of the suggestion that spatial competition significantly affects both price levels and their dispersion. The great importance of spatial competition that is observed is not surprising because the lodging service must be consumed in the same place in which the seller is located. More specifically, our results clearly support the notion that the existence of a larger number of firms implies lower average retail prices and less price variance.

Furthermore, we were able to ascertain which classes of competitors are relevant in explaining pricing behavior. More particularly, we asked ourselves whether the effect is significantly different between competitors with the same and different official hotel categories. Our findings show that, in general, retail price level is less sensitive to competitors with different hotel categories. Some exceptions are obtained for weekend days, where we have not rejected

[9] The remaining estimates are remarkably insensitive to the choice of radius. The complete set of estimated coefficients for the alternative specifications is available from the corresponding author upon request.

the hypothesis that the same and different categories affect price level in an identical way. This is probably because substitution among hotels from different categories is relatively larger for consumers at weekends. As far as price dispersion behavior is concerned, there is not enough evidence of a different response to both groups of competitors.

The existence of particularities of results for some of the days of the week constitutes a major research question in this paper. It is interesting because ultimately the proportion of business and leisure consumers changes considerably between midweek days and weekends, while marginal cost and the number of firms remain quite invariable. Hence, in an indirect way, the case of the hotel industry has allowed us to obtain approximate empirical results associated with the sensitivity of the relationship under study to changes in the sort of consumers. Although we cannot reject identical retail price level responses to variations in spatial competition within both midweek and weekend days, we did find weak evidence that this response differs between midweek and weekend days. In the case of price dispersion, there is no evidence of differences among days of the week. In spite of the interest of these early results, at this stage more research is needed to be able to examine, in a direct way, the specific effect that changes in the sort of consumers have on the relationship.

Finally, we found that the empirical results are robust for different definitions of local markets. In general, if competitors are considered to be hotels that are located farther away, the effect of competition on retail prices level and dispersion gradually gets lower. In any of the dimensions of local markets considered here, the sign of the estimated coefficients indicated that price dispersion is inversely related to spatial competition. These results are independent of the type of competitors and days of the week that are considered, which, all in all, is fully consistent with the theoretical predictions derived from the traditional monopolistic approach.

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