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The dynamics of online hotel prices and the EU Booking.com case*

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Abstract

This paper analyses the dynamics of hotel prices listed on *Booking.com* in the period 2014-16. This period is characterised by the most important antitrust decisions regarding the use of price parity clauses by online travel agencies (OTAs) in the EU. First, we document the dynamics of hotel prices on *Booking.com* in tourism regions of three EU member states: France, Italy, and Spain. The evidence suggests that prices decreased in 2015, the year in which the major antitrust decisions took place, whereas they bounced back in 2016. Second, we provide both a comprehensive explanation of the previous evidence and a rationalisation based on a theoretical model of the OTAs sector. Overall, our overarching analysis of the price dynamics on *Booking.com* allows to explain both the impact of removing price parities and the possible response of the OTAs.

Keywords: Price parity clauses; hotel booking; online travel agencies; *Booking.com*.

JEL Classification: D40, L42, L81.

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1 Introduction

The lodging sector has undergone profound changes in the past decade due to the increasing incidence of online retail channels. In 2014, tourist accommodation was booked online for 55% of the trips made by residents of the EU.[1] The majority of these online sales took place through Online Travel Agencies (OTAs). One common practice adopted by OTAs is the use of price parity clauses, which prevent listed hotels from offering better deals on alternative sale channels. Price parity clauses are usually divided into two types. A *"wide" price parity clause* requires that the price charged by the hotel on the OTA cannot be reduced when selling via alternative channels, including rival OTAs and direct selling. A *"narrow" price parity clause* is less rigid, as it allows the hotel to charge a lower price when selling through other OTAs; however, the hotel cannot charge a lower price when selling directly.

This practice has raised serious antitrust concerns, given the fact that in most countries the OTA sector is already highly concentrated. The adoption of price parity clauses may indeed reduce competition between OTAs, thereby increasing the commission rate paid by client hotels, which would in turn raise final prices. Based on this "theory of harm", a number of National Competition Authorities (NCAs) across the EU started investigating the use of these clauses, with Italy and France at the forefront of those who led the enquiries. This issue has not yet been addressed in the US, thus contributing to question whether or not price parity clauses should be a matter of antitrust investigation.

In this context, we focus on hotels listed on *Booking.com*, the most prominent OTA in the EU, controlling almost 60% of the market in 2016.[2] By considering the period 2014-16, we document the price dynamics of hotels in comparable Mediterranean tourism regions of three different EU countries: France, Italy, and Spain. In particular, for each hotel and date of stay, we match rooms with identical or very similar characteristics and compare prices at one year distance. Our evidence shows an overall price decrease between 2014 and 2015, followed by a price surge between 2015 and 2016. At a country level, we find that, in comparison to Spain, France and Italy experienced a sharper price drop in 2014-15, and then a less intense price increase in 2015-16. These results raise a number of relevant questions, such as: what explains the opposite direction of price changes between 2014-15 and 2015-16? What factors drive the different price patterns across nations?

[1] Source: Statistics on ICT use in tourism. Retrieved at http://ec.europa.eu/eurostat/statistics-explained/index.php/Statistics_on_ICT_use_in_tourism

[2] See the HOTREC 2015-16 Annual Report, which is available at: http://www.hotrec.eu/cust/documentrequest.aspx?DocID=4995.

The period of our study was characterised by a series of important events, which may have affected the pricing decisions of hotels listed on *Booking.com*. First, in April 2015 a series of coordinated antitrust investigations on OTAs culminated with *Booking.com*'s commitment to the Italian, French and Swedish NCAs to partially remove price parity clauses. This commitment was applied EU-wide and came into force on July 1st, 2015. Second, the North African turmoil, which peaked with terrorist attacks in Tunisia and Egypt, dramatically impacted the tourist flows in the Mediterranean area starting from the end of 2015. Third, between 2015 and 2016, *Booking.com* introduced new revenue management tools for hotels and enhanced the range of online services available for platform users.

We interpret the evidence provided on hotel price dynamics in light of the main events reported above. Regarding the period 2014-15, the price decrease is consistent with the expected effect of the antitrust intervention. The partial removal of price parity clauses, *ceteris paribus*, should increase competition in the OTA sector, thereby contributing to reduce final prices. This price decrease is even more remarkable as tourist flows increased between 2014 and 2015 in all our destinations. Moreover, country patterns are also in line with the intensity of the antitrust activity: countries that actively enquired on the case, such as France and Italy, experienced a sharper drop in hotel prices. This interpretation is reinforced when specifically looking at local effects of antitrust decisions. Indeed, prices in France decreased even further following *Booking.com*'s commitment on July 1st, 2015.

Turning to the period 2015-16, although parity clauses were (partially or totally) banned, hotel prices bounced back. This is only partially explained by the growing demand enjoyed by the tourism regions that we consider. In fact, we argue that innovative online tools adopted by *Booking.com* increased the quality of the service provided to both client hotels and final customers. Consequently, this additional element may have contributed to driving prices up. Although we fall short of providing conclusive evidence on this point, we substantiate this argument on the basis of the results of a simple model of the OTA sector. Our theoretical analysis allows to address both the effect parity clauses on hotel prices and the incentives for OTAs to introduce innovative tools. However, also for this second period, the country pattern reflects the intensity of the antitrust actions, given that price increases were less prominent precisely in France and Italy.

To sum up, our results highlight a beneficial effect for hotel guests of antitrust intervention in the EU. On the one hand, the removal of price parities contributed to the observed reduction of prices listed on *Booking.com* between 2014 and 2015, proportional to the intensity of a country's antitrust engagement. On the other hand, such a removal may have limited the price increase that took place between 2015

and 2016, mainly driven by a combination of enhanced demand and *Booking.com*'s innovative activity. All in all, our analysis suggests that the EU antitrust experience may represent a benchmark also for other antitrust authorities that have not yet actively enquired on price parity clauses and other similar contractual restrictions.

Despite the growing attention on the economic effect of price parity clauses and their removal following antitrust intervention, the empirical research is still very limited. One exception is represented by Hunold *et al.* (2016), who use metasearch data of more than 45,000 hotels in different countries collected from *Kayak.com* from January to June 2016. Their study focuses on hotels in Germany, a country that fully abolished price parity clauses in 2016. They find the elimination of price parities incentivises hotels to expand room availability on OTAs and increase the number of sales channels. Moreover, they also show hotels charge the lowest price on the direct channel more often in Germany than in countries that did not abolish such clauses.[3]

Our paper both differs and complements the analysis of Hunold *et al.* (2016). They compare several sales channels, we instead focus on *Booking.com*. However, our data are extremely detailed, thus allowing for a precise matching of hotel rooms by type, characteristics, and quality. Importantly, we are also able to track prices throughout an extensive booking period. Moreover, whereas Hunold *et al.* (2016) mostly exploit country variations in price parity regimes, our dataset covers a relatively wide time span, thus allowing to evaluate the price dynamics before and after some of the most important EU antitrust decisions.

In contrast to the empirical literature, there is a burgeoning theoretical literature on price parity clauses. Boik and Corts (2016) and Johnson (2017) conclude that price parity clauses lead to higher commissions and higher final prices, thereby damaging final consumers. However, they do not explicitly model a direct sale channel for sellers. Edelman and Wright (2015) allow consumers to purchase directly from sellers or through a platform. Price parity clauses increase final prices and lead to excessive investment in frills, thereby harming consumers by diverting them from the direct channel. In Wang and Wright (2016) platforms provide both search and intermediation services. Consumers positively value these services, but can decide to free-ride if direct purchasing is allowed, a phenomenon called "showrooming". In this context, wide parity clauses prevent showrooming but hamper competition among OTAs. On the contrary, narrow price clauses may preserve competition, while at the same time avoiding free-riding on the platforms' search services.

[3]We also note a recent European Commission report evaluating whether or not removing wide price parities lowered commission fees and increased room price differentiation across channels (European Commission, 2017). The analysis is based upon OTAs metadata and a survey filled out by hotel owners in ten EU countries. The results were not conclusive and called for further enquiry.

Our theoretical model is related to Johansen and Vergé (2017), who consider two OTAs, several hotels, and a representative consumer with elastic demand. A key ingredient of their analysis is the interplay between hotels' substitutability and their possibility to delist from the OTAs, which imposes a limit to the fee they can charge. They find scenarios in which price parity clauses benefit consumers, and may even lead to Pareto superior outcomes in which hotels also gain. We differ from their approach as we characterise the consumer decision by using the spokes model of non-localised spatial competition (Chen and Riordan, 2007).[4] In our model, each hotel-channel pair is perceived as a horizontally differentiated product. For simplicity, we focus on two OTAs and two hotels. Importantly, when booking through an OTA, we assume consumers receive additional services which increase their utility. We also allow OTAs to invest in these services. Unlike Johansen and Vergé (2017), we find that banning parity clauses always reduces OTAs' profitability at the advantage of hotels, as commission fees decrease. Interestingly, if the additional services provided by the OTAs are highly valued, banning these clauses leads to higher prices. Hence, in comparison to previous contributions, our model can explain different price dynamics resulting from the removal of price parities.

To a lesser extent, our paper contributes to the flourishing literature on OTAs. Lu *et al.* (2015) evaluate the impact of introducing new online hotel sales channels on traditional intermediaries. Ursu (2015) studies the effect of ranking on search and booking behaviour on *Expedia*, and Ghose *et al.* (2014) evaluate the impact of different types of search engine rankings on consumers' booking behaviour. These studies do not address hotel pricing in relation to price parity clauses.

Finally, our work is related to the recent literature on dynamic pricing in the hotel and airline sectors. Although we do not aim to disentangle the motives for price fluctuations (*e.g.* opportunity costs of the perishable capacity as in Talluri and van Ryzin, 2004; sorting between different types of consumers, as in Alderighi *et al.*, 2016; strategic motives, as in Möller and Watanabe, 2010), our approach enables us to control for the dynamic structure of hotel prices.

The paper is organized as follows. Section 2 illustrates the *Booking.com* antitrust cases and other relevant events of the period 2014-16. Section 3 presents the data and our empirical strategy. Section 4 focuses on the price dynamics observed in 2014-15, whereas Section 5 considers the period 2015-16. Section 6 discusses and interprets the empirical findings. Section 7 provides a theoretical model of the OTA sector that enables us to rationalise the previous results. Section 8 concludes.

[4] This model has been recently adopted in the literature for a variety of applications (Caminal and Claici, 2007; Rhodes, 2011; Germano and Meier, 2013; Reggiani, 2014; Mantovani and Ruiz-Aliseda, 2016; *inter alia*).

2 The period 2014-16 and the Booking.com case

In the period 2014-16, several events occurred which, directly or indirectly, affected the lodging and tourism sector in the Mediterranean and, in particular, in the countries of our study: France, Italy and Spain. Table 1 briefly summarises them, with a focus on the *Booking.com* case as well as other pertinent geo-political facts that may have influenced the sector.

Starting from price parity clauses, following the complaints filed by rival OTAs and trade groups representing hotel owners, NCAs throughout Europe opened enquiries on *Booking.com* and other dominant OTAs. The first cases occurred in the UK and Germany. In the former country, the UK Office of Fair Trading investigated *Booking.com*, *Expedia*, and *IHG* (Intercontinental Hotels Group) on the related issue of preferential agreements. In the latter, the Bundeskartellamt (the German competition authority) prohibited *HRS* (Hotel Reservation Service) from using price parity clauses and, in December 2015, it reached a similar decision against *Booking.com*. More related to our analysis, in April 2015, the French, Italian and Swedish NCAs, after investigating *Booking.com*, accepted its commitment to switch from wide to narrow price parity clauses. The commitment came into effect across the EU on July 1st, 2015. We will specifically focus on this event in Section 4.3. Moreover, in August 2015, the French Parliament passed the Macron Law, according to which all price parity clauses were banned.[5] This provision came into force on January 1st, 2016. As it represents an interesting element of difference among the studied countries, it will be discussed in Section 5 in relation to hotel price dynamics in the period 2015-16.

There are two other factors that are important for our analysis, as they may have contributed to affect prices on OTAs in the tourism regions that we consider. First, tourism destinations in Mediterranean North Africa suffered from a drop in reservations, starting from summer 2015, as fears over terrorism drove many tourists away from Tunisia and Egypt. Moreover, Turkey was negatively affected by a number of terror attacks that took place between 2015 and 2016, and by the failed coup d'état attempt on July 15th, 2016. The impact of these events for our analysis will be examined in Section 6, as they are related to the growing demand experienced by the tourism regions in our sample in 2016. Second, between 2015 and 2016 *Booking.com* visibly improved the services offered to both client hotels and final customers. As a result, the quality of the booking service when using the platform is likely to have increased. *Booking.com*'s innovative strategies will be discussed in more detail in Sections 6 and 7, as they may help to explain the price dynamics documented for the period 2015-16.

[5] Similar laws were approved in Austria in November 2016 and in Italy in August 2017.

Table 1. Relevant events in the period 2014-16

Enquiries and decisions on price parity clauses in the EU	
May 2014	The Italian Competition Authority (ICA) investigates *Booking.com*.
Sep 2014	The UK Competition and Market Authority (CMA) investigates *Booking.com*.
Nov 2014	The French Competition Authority (FCA) investigates *Booking.com*.
Dec 2014	The European Commission launches market tests on OTAs
Apr 2015	Parallel decisions by the FCA, SCA and ICA:
	Booking.com commits to eliminate wide parity clauses.
Jul 2015	*Booking.com*'s commitment comes into effect in the EU.
Aug 2015	The French Parliament approves the Macron Law: all parity clauses are prohibited.
Sep 2015	CMA closes investigation on *Booking.com*.
Oct 2015	The Italian Parliament proposes a law to eliminate all parity clauses.
Dec 2015	The German Competition Authority (Bundeskartellamt) prohibits all parity clauses.
Jan 2016	The Macron Law comes into force.
Nov 2016	The Austrian Parliament approves a law eliminating all parity clauses.
North Africa and Middle East tourism-related events	
Mar 2015	Terror attack at the Bardo National Museum in Tunis, Tunisia.
Jun 2015	Terror attack at a beach resort in Sousse, Tunisia.
Jul 2015	UK issues a travel ban on Tunisia.
Oct 2015	Suicide bombers at Ankara Central Railway Station, Turkey.
Jan 2016	Red Sea terror attack in Hurghada, Egypt.
Jan 2016	Suicide bomber attack in Istanbul historic district, Turkey.
May 2016	Crash of an EgyptAir flight from Paris to Cairo.
Jul 2016	Failed coup d'état in Turkey.
Booking.com's innovative strategies	
Apr 2015	Introduction of the *BookingSuite* system to help hotels build innovative websites.
Aug 2015	Enhanced presence on social media channels.
Feb 2016	Launch of the *PassionSearch* service to personalise travellers' experience.
Mar 2016	Adoption of *RateManager* platform at the core of the *BookingSuite* system.
May 2016	Launch of *Booking Messages Interface* to improve the hotel-traveller interaction.
Jun 2016	Launch of data-driven *Booking.com Analytics* and *Opportunity Centre* for hotels.
Jul 2016	Release of *Booking Experiences* tool offering complementary services to travellers.

3 Data and empirical strategy

3.1 Data collection

The following empirical analysis is based on data retrieved from *Booking.com* in the period 2014-2016. The analysis focuses on four tourism regions in the Mediterranean: Sardinia and Sicily (Italy), Balearic Islands (Spain) and Corsica (France). The four regions are geographically close and have fairly similar characteristics, representing comparable alternatives for potential visitors. In fact, they attract the same kind of tourists not only for the beauty of their beaches, but also for their ancient culture, art, architecture, and for their cuisine, which is rooted in the traditional and distinct flavours and foods of the Mediterranean.[6] Moreover, they belong to three countries that have been affected by the European enquiries on *Booking.com* and its successive developments, albeit to different degrees. In particular, as previously introduced, Italy and France were directly involved in investigating price parity clauses, whereas Spain never played an active role.[7]

The data was retrieved using a "web crawler", designed to automatically connect to *Booking.com*. The crawler launched online queries to book accommodation in all the lodging establishments available in the regions studied. It then saved information about the posted prices together with the characteristics of the rooms available at each establishment. The crawler also retrieved data on the characteristics of the lodging establishments (*e.g.* type of establishment, number rooms, star rating, users reviews and so on) listed on *Booking.com* during the period of the study. For the purpose of our analysis, we will focus only on establishments listed as hotels.[8]

The crawler operated on a daily basis, providing information about the rooms' prices for a period ranging between 70 days prior to the stay and the day before the stay. The frequency of the queries is every five to ten days, becoming more frequent in the last two weeks before the date the room is requested. The data collected for 2014 and 2015 cover the March-December period, whereas those for 2016 only cover September and October.

[6] The Mediterranean diet is part of the "Intangible heritage" protected by UNESCO.

[7] The other countries participating at some stage to the EU investigation were Belgium, the Czech Republic, Germany, Hungary, Ireland, the Netherlands, and the UK.

[8] There are several reasons to justify this choice. Data on apartments, villas and other lodging establishments tend to be more "noisy". Indeed, many of these establishments are small family run businesses or private properties rented for the summer period. Their listing and pricing strategies are likely to be affected by a high number of factors (*e.g.* recurring consumers visiting every year in the same period), the contractual clauses imposed by *Booking.com* being only one of them. Finally, in contrast with small aparthotels and B&Bs, hotels are more likely to have a direct sales channel.

We also collected data on: (i) monthly airport arrivals in the four regions covered by the study, a proxy for tourist flows; (ii) the number of sale channels used by each hotel on *Kayak.com* at the end of our period of study.

3.2 Constructing the matched sample

Our empirical strategy is based on comparing the change in the *price of a specific room* set by a hotel in different years (2014, 2015, 2016). The matching of prices across years controls for: identical room characteristics (*e.g.,* double, deluxe, without seaview and so on); same day of the week; an identical or similar time interval separating the date of the booking from the date of stay. For example, suppose the date of stay is the second Saturday of September. If interested in the prices retrieved, say, one week before, then we match room prices on the following dates: 6 September 2014, 5 September 2015 and 3 September 2016.[9]

In the regression analysis we aim to explain different measures of the price differentials between years, controlling for a number of factors, including hotel characteristics (star rating, guest review score on *Booking.com*, room capacity, chain affiliation), the period the room is booked, the days before the stay, eventual changes in rooms' characteristics (seaview, breakfast, deluxe room, free cancellation), a proxy of the tourist flows, and a proxy for the town level occupancy rate. More details are provided in Figure 2 and Section 4.2.

The original dataset covers 9816 lodging firms. Table 2 shows that in the two Italian regions there is a prevalence of non-hotel lodging establishments.

Table 2. Establishment type by region (full sample)

	Lodging	Hotels	H/L (%)
Sardinia	3051	739	24.22
Sicily	4155	498	11.99
Corsica	758	413	54.48
Balearics	1727	845	48.93
Total	9691	2495	25.44

Out of these establishments, 2498 are hotels (25.44%), which are the focus of our study. After matching the rooms as explained above, the resulting sample consists of 1179 hotels: 241 in Sardinia; 276 in Sicily; 162 in Corsica and 500 in the Balearic

[9] Alternatively, our matching could be based on the date, but this would entail comparing prices for different days of the week, a factor normally associated with price variation (Melis and Piga, 2017).

Islands. The number of hotels reduces to 999 when observations for 2016 are also included. The resulting regional composition is: 220 hotels in Sardinia, 255 in Sicily, 158 in Corsica and 366 in the Balearic Islands.[10]

According to Table 3, our matching procedure allows us to include between 29% and 59% of all hotels present on *Booking.com* in the four regions considered. The numbers are comparable in the two matched subsamples 2014-15 and 2014-16, used in different parts of our study, with a slightly higher coverage in the former.

Table 3. Hotels matched by region and period

	2014-15	% matched	2014-16	% matched
Sardinia	241	32.61	220	29.77
Sicily	276	55.42	255	51.20
Corsica	162	39.22	158	38.35
Balearics	500	59.17	366	43.31
Total	1179	47.20	999	39.99

Table 4 shows that the hotels' characteristics in the matched sample are in line with those of the full sample. This confirms the randomness of the matching procedure. After the matching procedure, the 2014-15 sample included about 1.9 million matched price observations.

An important indicator of the comparability of the prices is the time interval separating the date of the booking from the date of stay. Figure 1 shows how such interval differs between 2014 and 2015 and reveals that most observations are characterised by a very similar time span. As a consequence, prices in 2015 are comparable with those registered in 2014. The 2014-16 sample is constructed following an identical procedure and includes about 564,000 matched price observations.

Two important controls in our analysis are: (i) tourist flow trends in the regions under analysis, and (ii) the percentage of hotels available when booking a room. Figure 2 summarizes these variables. The left panel reports the time profile of the number of arrivals at the airports of each region. As expected, we observe a markedly seasonal pattern. All regions are also characterized by a positive trend; the increase in arrivals is more pronounced in 2016 than in 2015, particularly for the Balearic Islands. The right panel, instead, reports the percentage of hotels available in each town/city for a given date of booking and date in which the rooms were requested. Overall, on average 73% of the hotels were available in the period 2014-15. We use this information in our analysis as an (inverse) proxy of the local occupancy.

[10]Note that the different matching procedure implies the data that we will use in Section 4 and 5 are not comparable with each other.

Table 4. Matching and hotel characteristics

	Obs		**Mean**		**Std Dev**		**Min**		**Max**	
	Full	Match	Full	Match	Full	Match	Full	Match	Full	Match
Rating	2426	994	8.26	8.16	0.75	0.68	4.7	5.4	10	9.6
Stars	1986	999	3.376	3.375	0.815	0.823	1	1	5	5
Capacity	2498	999	63.14	78.71	86.23	88.93	1	5	903	903
Chain	2498	999	0.1709	0.2422	0.3765	0.4286	0	0	1	1
On Booking	2498	999	21/03/11	07/12/09	-	-	28/08/01	28/08/01	14/10/16	01/10/14
Kayak Channels	-	999	-	3.8899	-	3.5089	-	0	-	13

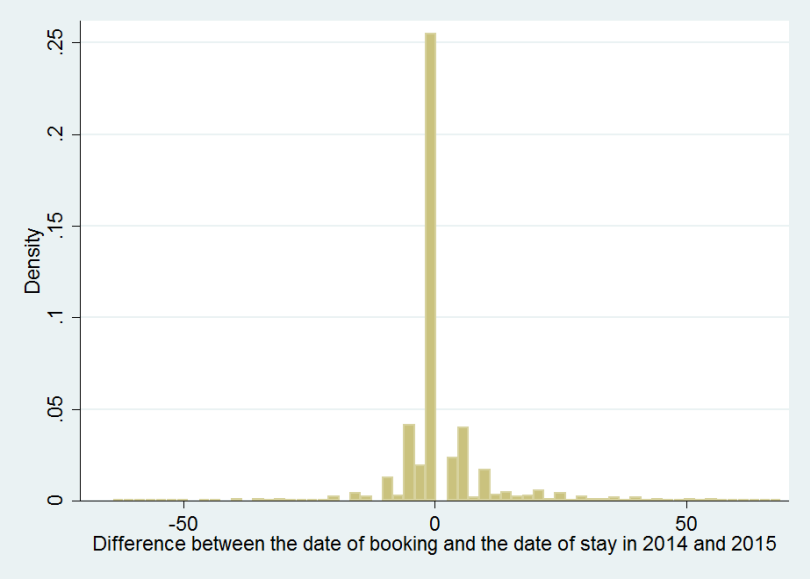


Figure 1. Histogram of the difference between the date of booking and the date of stay in 2014 and in 2015.

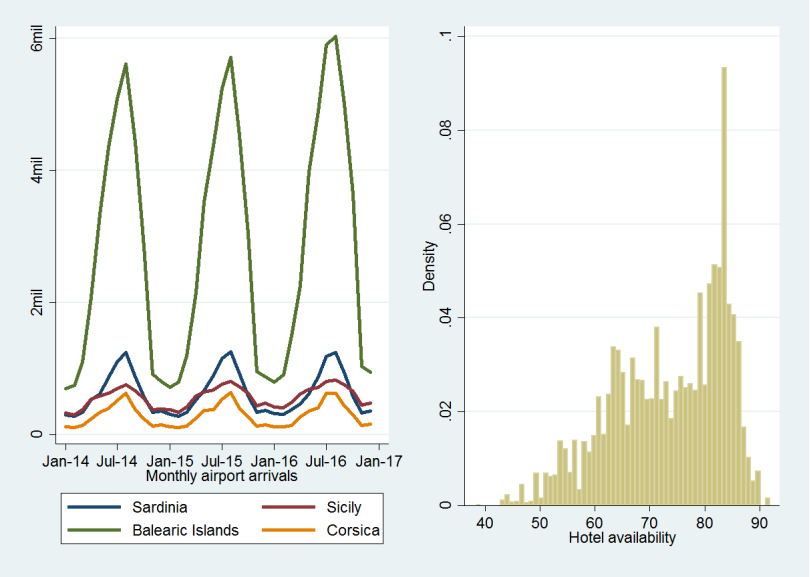


Figure 2. Time profile of the monthly airport arrivals by region (left) and the histogram of the available hotels per town, date of booking and night in (right).

4 Hotel price dynamics between 2014 and 2015

The period 2014-15 was characterised in the EU by a shift from wide parity to narrow parity clauses. As explained in Section 2, the commitment by *Booking.com* to the Italian and the French NCAs was made public in April 2015, and came into effect across the EU on July 1st, 2015. We are particularly interested in the evolution of prices in each country of our sample during this period. For this reason, the following analysis is performed at the nation level, *i.e.* focusing on France, Spain and Italy, which is the aggregate of Sicily and Sardinia.

4.1 Descriptive evidence

We start by looking into the prices of a double room, the most common type of room offered by hotels in our sample. Table 5 presents the average price of a double room in 2014 and 2015 by period of the year and star rating in the three nations. For ease of presentation, we report results for three subperiods, covering the medium and high tourist seasons: May-June, July-August and September-October. We also focus on hotels with at least a 2-star rating.

Overall, "Total" indicates that the average price of a double room in 2014 was the lowest in Italy, ranging from 108 to 135 euros in different periods. The corresponding price in Spain was instead between 110 and 159 euros, whereas it was the highest in France with average prices between 125 and 159 euros.

Moving on to 2015 and bearing in mind that the comparison involves equivalent dates in the two years, a first interesting pattern emerges. The average price of the *same* hotel room on *Booking.com* decreased in all the three nations, compared to 2014. In particular, prices in Italy ranged between 104 and 131 euros, in Spain between 108 and 158 euros and in France between 119 and 154 euros.

Table 6 reinforces the evidence presented above by focusing on several measures of price changes for all types of rooms in our sample. In particular, the first measure ("P change") represents the average absolute price change from 2014 to 2015. The second measure ("% P change") is the average percentage price change. Finally, the third measure ("% increase")[11] is the percentage of hotel rooms with a higher price in 2015. The "Total" rows confirm the results obtained above. Prices decreased in all nations and in all periods; on average, they fell between 5.02 and 8.88 euros in France, between 3.68 and 4.25 euros in Italy, and between 1.23 and 2.42 euros

[11] In order to allow for possible noise and approximation errors, we consider a price to have increased if it is at least two euros higher than the previous year. Most of the results are quantitatively but not qualitatively affected by adopting different definitions of price increase.

in Spain. The results are similar when looking at the average percentage changes. In France prices dropped the most (between 2% and 4%), in Italy between 1% and 2%. In Spain, instead, the relative price changes were actually positive.[12] A similar picture transpires from the percentage of rooms whose price increased in 2015: more than half of the rooms in our sample were quoted at the same or at a lower price compared to 2014. The percentage of rooms with an increased price ranged from 27% to 33% in France, from 33% to 35% in Italy, and from 42% to 48% in Spain.

In summary, a consumer booking the same hotel room for a night in 2015 is likely to have noticed a decrease in the room price compared to 2014. In France and in Italy, such a decrease was sometimes noticeable. These simple descriptives indicate a clear pattern in the prices between 2014 and 2015, a time span that included the most relevant investigations and decisions on *Booking.com*. There are also relevant heterogeneities at the national level. In particular, Spain registered the lowest average price decrease and the highest percentage of rooms with an increased price, whereas France showed the highest average price decrease together with the lowest percentage of more expensive rooms.

Further insights can be obtained by looking at Table 5 and 6 along different dimensions. A slightly more complex picture appears but the main findings remain unaffected. For example, according to Table 5, in all countries the highest prices occurred in the July-August high season period. Moreover, the average price of double rooms were from three to four and half times higher in 5-star rated hotels than in 2-star ones. Turning to price changes, reported in Table 6, sharp decreases occurred more often during the medium season, rather than the high one. The few positive price changes, instead, took place in the high season and, in particular, for 4-star and 5-star hotels in Spain. The absolute price changes increased with hotel rankings, whereas the relative price changes were somewhat similar. The country patterns identified above do not change along these two dimensions of the table.

The previous discussion can be summarized as follows:

Finding 1 *In all the three subperiods and across all hotel star ratings, prices tended to decrease in all the three nations between 2014 and 2015.*

Finding 2 *In most subperiods and across all hotel star ratings, the price decreases observed between 2014 and 2015 were larger in France, followed by Italy and Spain.*

This preliminary evidence on the evolution of prices in the different countries calls for further investigation. In the next sub-section, we present a regression analysis in order to control for a number of factors that may have driven our results.

[12] This puzzling finding is due to the fact that some high percentage positive changes correspond to rather small absolute price differences between 2014 and 2015.

Table 5. The average price of a double room by nation, stars and period, 2014 vs 2015.

		Italy			France			Spain		
		May/Jun	Jul/Aug	Sep/Oct	May/Jun	Jul/Aug	Sep/Oct	May/Jun	Jul/Aug	Sep/Oct
2	**2014**	72	81	72	79	97	74	56	83	59
	2015	70	78	70	76	93	70	54	85	57
	Obs	13,147	13,005	13,534	6,516	10,052	13,271	21,251	14,279	23,339
3	**2014**	84	101	82	116	137	106	81	126	84
	2015	80	97	79	108	132	100	78	121	82
	Obs	105,999	108,218	110,247	27,991	44,239	47,635	52,943	52,151	57,324
4	**2014**	131	152	129	206	250	183	131	172	133
	2015	126	149	125	192	246	175	131	174	133
	Obs	86,615	115,520	92,621	9,598	12,382	16,244	53,726	66,384	68,443
5	**2014**	247	320	242	290	371	325	254	319	243
	2015	244	315	233	266	357	310	252	319	236
	Obs	10,000	13,185	10,632	2,062	2,264	3,152	10,398	11,714	14,110
Total	**2014**	110	135	108	137	159	125	110	159	115
	2015	105	131	104	128	154	119	108	158	113
	Obs	215,761	249,928	227,034	46,167	68,937	80,302	138,318	144,528	163,216

Table 6. Hotel room price changes by nation, stars and period, 2014 vs 2015: absolute and percentage change and the share of rooms with increased price.

		Italy			France			Spain		
		May/Jun	Jul/Aug	Sep/Oct	May/Jun	Jul/Aug	Sep/Oct	May/Jun	Jul/Aug	Sep/Oct
2	**P change**	-1.96	-2.51	-1.97	-2.69	-3.56	-4.18	-2.53	1.46	-2.21
	% P change	-0.01	-0.01	-0.01	-0.03	-0.02	-0.04	0.00	0.04	-0.00
	% increase	0.28	0.3	0.31	0.19	0.3	0.24	0.38	0.52	0.39
	Obs	13,370	13,313	13,750	6,833	10,360	13,848	21,753	14,778	23,848
3	**P change**	-4.45	-4.38	-3.67	-7.95	-5.35	-6.21	-3.43	-4.80	-3.30
	% P change	-0.03	-0.02	-0.02	-0.04	-0.02	-0.03	-0.00	-0.01	-0.00
	% increase	0.29	0.29	0.29	0.27	0.31	0.28	0.38	0.43	0.39
	Obs	110,224	113,329	114,974	30,861	47,148	52,119	56,153	56,060	62,240
4	**P change**	-4.62	-3.19	-3.79	-12.72	-3.39	-8.02	-1.15	0.70	-0.96
	% P change	-0.01	0.00	0.01	-0.04	-0.01	-0.03	0.02	0.03	0.02
	% increase	0.38	0.39	0.39	0.34	0.4	0.33	0.46	0.51	0.45
	Obs	90,757	121,010	98,053	10,495	12,843	17,715	60,625	74,011	76,848
5	**P change**	-1.77	-3.32	-7.94	-23.8	-14.02	-14.7	-2.72	0.25	-6.71
	% P change	-0.00	-0.00	-0.02	-0.08	-0.03	-0.03	0.01	0.01	-0.01
	% increase	0.43	0.44	0.39	0.27	0.37	0.33	0.47	0.52	0.43
	Obs	10,753	14,076	11,471	2,076	2,274	3,270	10,629	12,210	14,683
Total	**P change**	-4.25	-3.68	-3.83	-8.88	-5.02	-6.57	-2.32	-1.23	-2.42
	% P change	-0.02	-0.01	-0.01	-0.04	-0.02	-0.03	0.01	0.02	0.01
	% increase	0.33	0.35	0.34	0.27	0.33	0.28	0.42	0.48	0.42
	Obs	225,104	261,728	238,248	50,265	72,625	86,952	149,160	157,059	177,619

4.2 Regression analysis

The following analysis is based on a linear regression model. The dependent variables are the measures of *price changes* introduced in Table 6: (i) a continuous variable measuring the absolute price change compared to the previous year ("*P change*"); (ii) a continuous variable measuring the percentage price change compared to the previous year ("*% P change*"); (iii) a dummy variable denoting if the room was quoted at a higher price compared to the previous year ("*% increase*").[13] The equation that we estimate is:

$$y_i = u_h + \sum\nolimits_j \beta_j X_j^i + \sum\nolimits_k \beta_k W_k + \sum\nolimits_j \sum\nolimits_h \gamma_{jh} X_j Z_h + \varepsilon_i \tag{1}$$

where i denotes the room in a hotel booked for a given night, h is the hotel and u_h the hotels' fixed effects. We control for:

(a) a vector X_j^i of room i's characteristics, including the number of days prior to stay, and variations from 2014 to 2015 in: room quality, breakfast inclusion, free cancellation, room's view;

(b) a vector W_k of town and period related characteristics, including the period of booking, and variations from 2014 to 2015 related to: tourist arrivals to the closest airport, and available hotels in town;

(c) a vector Z_h of hotel characteristics, including star rating, number of sales channels, chain affiliation;

(d) interaction terms.[14]

We do not include the results of the estimation, given the large amount of controls employed.[15] We focus instead on the predicted values based upon the results of the regression.

For the period 2014-15, Figures 3 and 4 respectively report the predictions for the absolute price difference and the predicted percentage of rooms with increased price.[16] Predictions are broken down by subperiod, star rating and nation.

[13] As we are mostly interested in the qualitative conclusions of the analysis, we adopt a linear model also for the "*% increase*" dependent variable.

[14] Due to the inclusion of u_h, the vector Z_h is identified only via the interactions.

[15] Full estimation results are available upon request.

[16] We omit the predicted values on the percentage price change, as results are qualitatively similar.

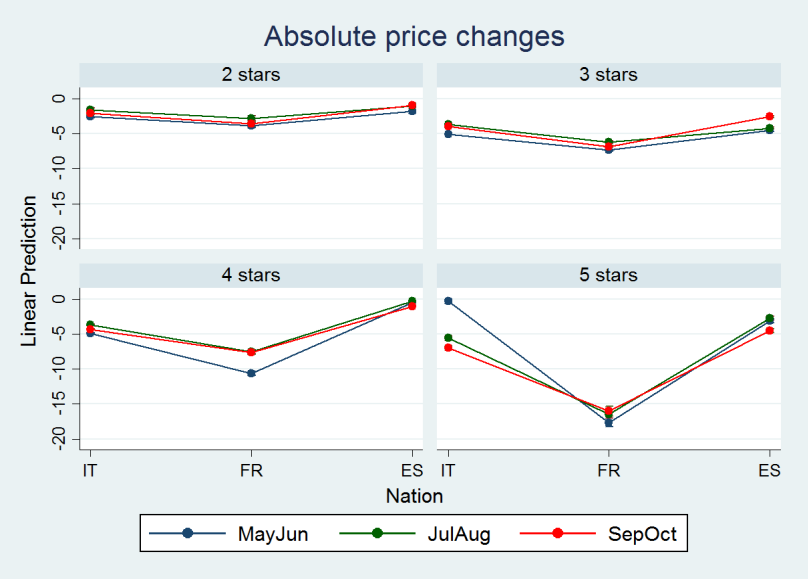


Figure 3. Absolute room price differences, 2014 vs 2015, by nation, star rating and period; linear predictions.

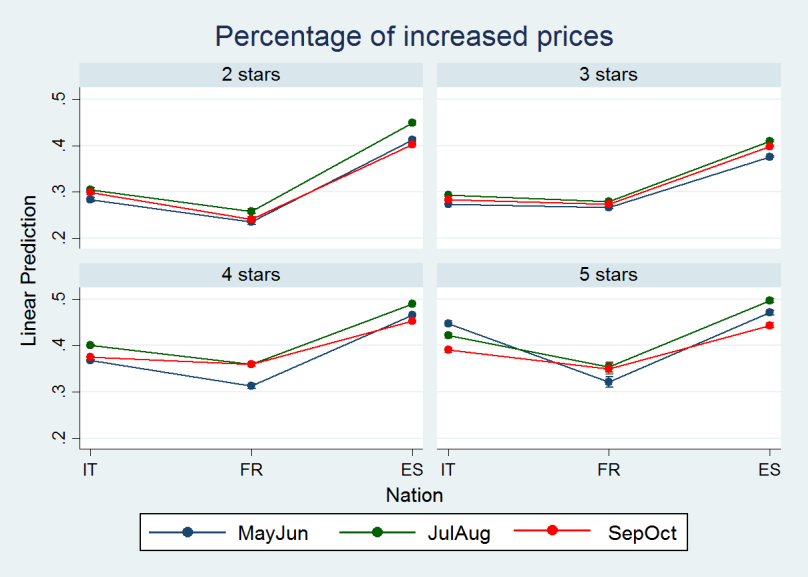


Figure 4. Percentage of rooms with increased price, 2014 vs 2015, by nation, star rating and period; linear predictions.

The results in Figure 3 corroborate the conclusions of the descriptive analysis. Consistent with Finding 1, the predicted room prices indicate a decrease from 2014 to 2015 in all countries, subperiods and hotel categories. The analysis also suggests that the star rating has a very important influence on hotel price changes. In particular, even if there are exceptions (*e.g.* 5-star hotels during the May/June period in Italy), on average, higher rated hotels reduced their prices significantly more. The subperiod does not have a significant impact on the absolute price changes of 2 and 3-star hotels. On the contrary, particularly for France, the price changes for highly rated hotels are more pronounced during high season. Importantly, in line with Finding 2, the predicted absolute price drops are largest in France, across all subperiods and categories. The predicted price changes in Italy and Spain are smaller than in France. Even though there are notable exceptions (*e.g.* 5-star hotels in May/June or 3-star hotels in September/October), prices decrease more in Italy than in Spain.

Figure 4 reinforces the evidence provided above by plotting the predicted percentage of rooms with a higher price in 2015 as compared to 2014. In all regions, subperiods and nations, prices went up in less than 50% of the rooms considered. Price increases are more likely in hotels with a high star rating (with the exception of France) and in high season. The likelihood of observing higher prices is lowest in France for all categories and subperiods, whereas it is highest in Spain. Our main findings are therefore confirmed and strengthened.

4.3 Booking.com's commitment and hotel prices

Our data are particularly suited to investigate a possible immediate impact of *Booking.com*'s commitment to stop enforcing wide parity clauses that came into effect in the EU on July 1st, 2015. To this aim, we focus on prices posted on *Booking.com* at a week's distance before and after the commitment, *i.e.* between June 24th and July 8th, 2015. We consider prices for rooms from July 3rd until July 31st. We run a similar regression to (1) for the time span identified above with the addition of a dummy variable, which is assigned a value of one for prices posted after July 1st, 2015. The analysis is performed on a narrow selection of dates to better isolate the effect (if any) of *Booking.com*'s commitment.

We focus on absolute price changes ("P change"). Figure 5 reports the predicted price reductions before and after the commitment. Such price changes were not significantly different in Italy and in Spain: the point predictions are very similar and the 95% confidence intervals largely overlap. On the contrary, in France, the price change after the commitment was significantly larger than before. In particular, prices fell by 5.96 euros before July 1st, whereas they dropped by 8.30 euros after.

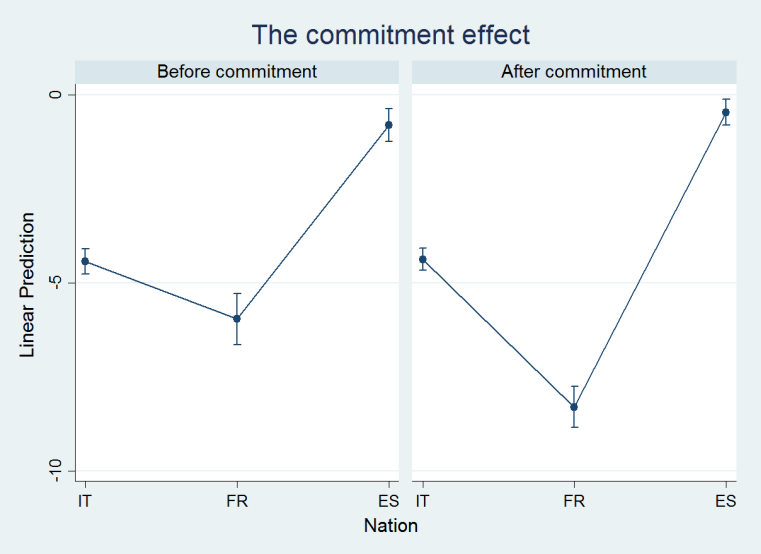


Figure 5. 2014-15 price differences by nation, before and after *Booking*'s commitment came into force (July 1st, 2015); linear predictions.

Figure 6 confirms our findings by showing the predicted absolute price differences by the date in which the room is used. The notable feature of this figure is that price changes after the commitment are significantly lower in France for most dates, whereas the before (blue) and after (red) lines often overlap in Italy and Spain.

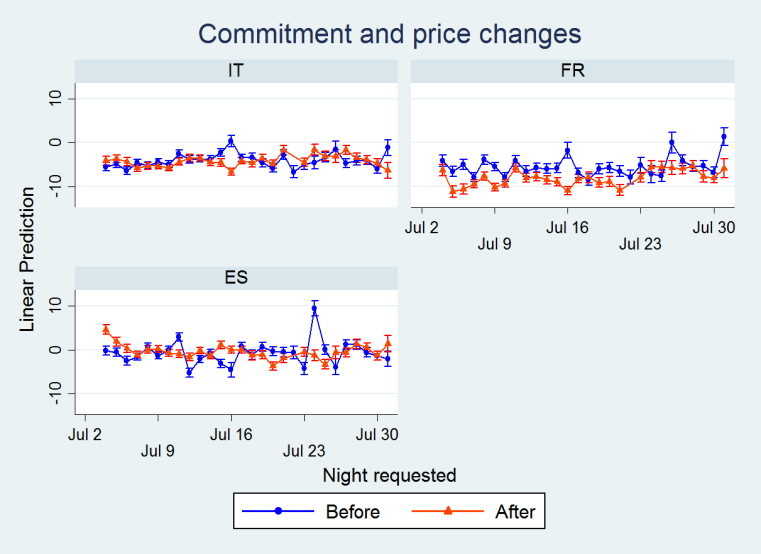


Figure 6. 2014-15 price differences by nation and night requested, before and after Booking.com's commitment; linear predictions.

The previous evidence is further reinforced by the following exercise. We consider prices posted on *Booking.com* between June 13th and June 27th, assuming a "hypothetical" commitment took place on June 20th, 2015. This methodology resembles a "placebo treatment" and its effect (if any) should be random. Figure 7 reports the results in terms of the 2014-15 predicted absolute price changes. The graph clearly shows that there is no change in the price differences in any of the three nations considered.

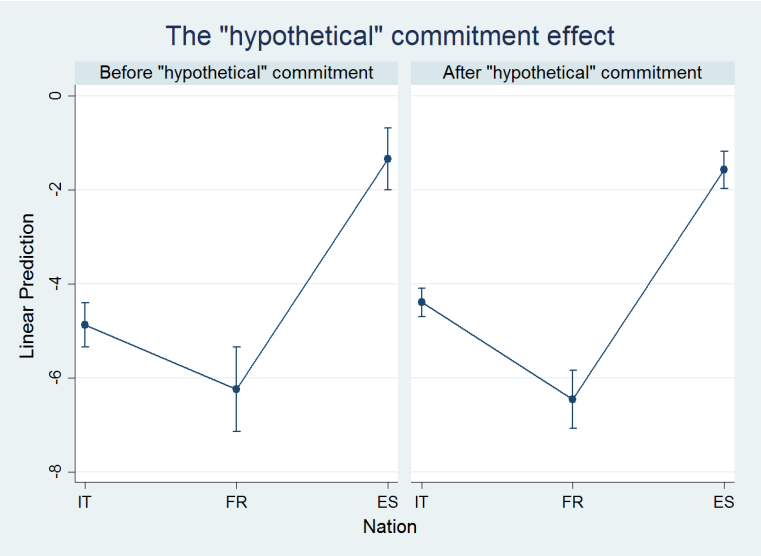


Figure 7. 2014-15 price differences by nation, before and after a "hypothetical" commitment (June 20th, 2015); linear predictions.

This discussion can be summarized as:

Finding 3 *Immediately after Booking.com's commitment to eliminate wide parity clauses (July 1st, 2015), prices were subject to further reduction only in France, whereas no additional change was registered in Italy or Spain.*

Not only was France at the forefront of the enquiry into *Booking.com*, but at that time its parliament was debating on the Macron Law. One of its provisions was to outlaw the use of price parity clauses, therefore going beyond the commitment by *Booking.com* in the EU. Overall, our evidence indicates that one of the most relevant events in the *Booking.com*'s antitrust investigation may have had an instant impact on hotel prices. However, such an impact took place only in France, a country which took a particularly proactive stance against price parity clauses.

5 Hotel price dynamics between 2015 and 2016

We now consider the period 2015-16. The major event related to price parity clauses was the Macron Law in France, approved in August 2015. Although it is not clear to what extent its provisions were enforced, starting from January 2016, all types of parity clauses were prohibited in France. The period sampled only covers rooms for the months of September and October and the triple matching (2014, 2015 and 2016) implies that the sample is slightly smaller than the one used for the period 2014-15.

5.1 Descriptive evidence

As in the previous section, we first present a comparison of the average price of a double room in 2014, 2015 and 2016. Table 7 reveals a completely different price pattern compared to 2014-15. In fact, the average price of double rooms has sensibly *increased* in 2016 in all three nations. The most substantial rise took place in Spain, for all categories of hotels, whereas in France the increment in price was the lowest. In fact, France is the only nation where the prices did not return to the levels of 2014. Instead, in Italy and particularly in Spain, a double room was on average more expensive in 2016 than in 2014.

Table 8 reinforces the above findings by looking at all types of rooms. In particular, between 2015 and 2016 the absolute price of a room increased by 16.19 euros in Spain, by 3.71 euros in Italy and by 3.02 euros in France. This translates into a 20% price increase in Spain, a 5% increase in Italy and a 4% increase in France. Finally, 72% of the rooms in Spain were quoted at a higher price in 2016 than in 2015, compared to only 46% of the rooms in both Italy and France.

These results are qualitatively similar for almost all hotel categories, with the exception of 2-star hotels in Italy, which experienced a slight price decrease also in 2016. Moreover, in Italy the highest percentage increases were registered in hotels with a higher star rating, whereas the opposite occurred in Spain.

The previous discussion can be summarized as follows:

Finding 4 *In the considered subperiod and across all hotel star ratings, prices tended to increase in all three nations between 2015 and 2016.*

Finding 5 *In the considered subperiod and across all hotel star ratings, prices tended to increase more in Spain followed by Italy and France.*

Table 7. The average price of a double room by nation, stars and period, 2014 vs 2015 vs 2016.

		Italy	France	Spain
2 stars	**2014**	72	72	61
	2015	69	67	61
	2016	69	69	79
	Obs	12,748	13,139	9,966
3 stars	**2014**	80	103	82
	2015	76	97	78
	2016	83	99	102
	Obs	98,782	43,356	40,203
4 stars	**2014**	125	175	131
	2015	121	167	132
	2016	139	170	155
	Obs	82,142	15,104	51,201
5 stars	**2014**	231	310	238
	2015	224	296	231
	2016	245	350	257
	Obs	8,664	2,776	12,568
Total	**2014**	104	120	119
	2015	100	113	118
	2016	112	118	141
	Obs	202,336	74,375	113,938

Table 8. Hotel room price changes by nation, stars and period, 2014-15 vs 2015-16: absolute and percentage change and the share of rooms with increased price.

		Italy		France		Spain	
		14-15	15-16	14-15	15-16	14-15	15-16
2 stars	**P change**	-2.77	-1.78	-5.16	2.05	-0.33	17.64
	% P change	-0.02	-0.01	-0.05	0.04	0.02	0.31
	% increase	0.30	0.26	0.21	0.44	0.43	0.77
	Obs	12842	12822	13404	13413	10191	10267
3 stars	**P change**	-4.17	1.74	-6.74	2.89	-3.51	17.66
	% P change	-0.03	0.04	-0.04	0.05	-0.01	0.27
	% increase	0.29	0.43	0.27	0.45	0.38	0.77
	Obs	102203	103042	46453	47088	43280	43084
4 stars	**P change**	-4.10	6.14	-7.87	0.67	-0.07	14.87
	% P change	0.00	0.07	-0.03	0.03	0.03	0.14
	% increase	0.39	0.50	0.33	0.47	0.46	0.70
	Obs	85789	85267	16269	16759	56723	56764
5 stars	**P change**	-7.00	10.77	-14.14	23.63	-6.78	15.91
	% P change	-0.02	0.07	-0.02	0.10	-0.01	0.08
	% increase	0.40	0.61	0.34	0.69	0.43	0.63
	Obs	9287	9488	2800	2824	12843	13143
Total	**P change**	-4.18	3.71	-6.97	3.02	-2.00	16.19
	% P change	-0.01	0.05	-0.04	0.04	0.01	0.20
	% increase	0.34	0.46	0.27	0.46	0.43	0.72
	Obs	210121	210619	78926	80084	123037	123258

5.2 Regression analysis

We complement the descriptive evidence with a regression analysis of the price changes in 2014-15 and in 2015-16. This allows controlling for many of the factors that may have affected the price dynamics documented in the previous subsection. In particular, we estimate a linear regression model similar to (1) in which the dependent variables are the usual measures of price change. The only difference is that each observation is "split" into two, respectively capturing the 2014-15 and the 2015-16 price change. As in Section 4.2, we do not include the full results of the estimation. Instead, we graphically report the predicted values.

The regression results are summarized in Figure 8. The dependent variable is the percentage of rooms with an increased price. The 2015-16 predicted percentage is plotted in red. The results largely confirm the descriptive evidence: hotels are more likely to have increased their room prices in 2016. This finding applies across all star rating and in all three nations. Figure 8 also highlights, for both periods, a higher probability of observing a price increase in Spain relative to France and Italy, with the only exception being represented by 5-star hotels.

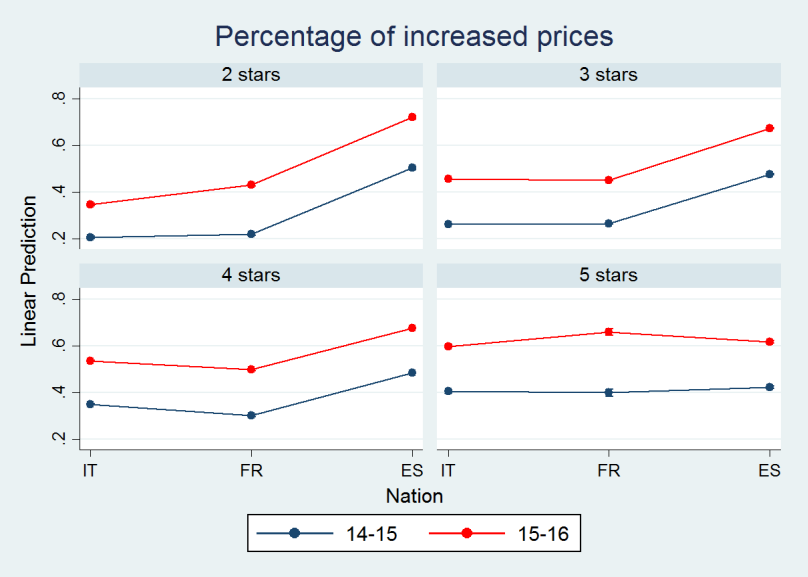


Figure 8. Percentage of rooms with increased price, 2014-15 vs 2015-16, by nation and star rating; linear predictions.

Figure 9 reinforces our results by also looking at the predicted absolute and percentage price difference across years; the price changes for 2015-16 are in red. The evidence confirms that hotels, in all nations and for all star ratings, experienced on average a price increment in 2016. With the exceptions of the 5-star hotels, the highest price increases took place in Spain. France and Italy registered only moderate yet non-negligible increases: the absolute value was less than 10 euros in hotels rated up to 4-stars.

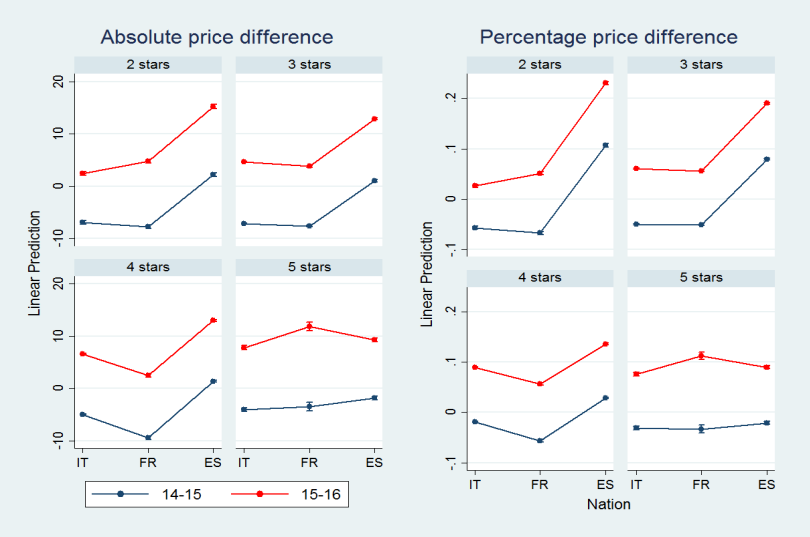


Figure 9. Absolute and percentage room price differences, 2014-15 vs 2015-16, by nation and stars, linear predictions.

6 Rationalisation of the results

The empirical analysis highlighted *two main trends* for hotel prices on *Booking.com*. First, between 2014 and 2015 the prices decreased throughout most of our sample. This trend was particularly evident in France and in Italy, where the average room prices fell by about 7 and 4 euros, respectively. In Spain, the decrease was only of about 2 euros. Second, prices bounced back in all these countries between 2015 and 2016. A very sharp price surge was registered in Spain, whereas non-negligible yet less dramatic increases were observed also in Italy and France.

This evidence triggers two important questions. First, what drives these opposite price dynamics between the two periods under investigation? Second, what explains the nation-level patterns identified above? Consider Spain and France. The former is characterised by a relatively low price decrease between 2014 and 2015 followed

by a significant increase between 2015 and 2016, whereas the latter had exactly the opposite experience. It is possible to rationalise our main empirical findings by taking into account the interplay between different yet related facts that characterised the period 2014-16. A crucial and distinguishing feature of the *entire* period was the antitrust activity carried out in the EU on the use of price parity clauses. On the contrary, the other relevant factors (see Section 2) mostly affected the period 2015-16.

The price reduction identified in 2014-15 (Finding 1) is compatible with the (partial) removal of price parity clauses. In April 2015, *Booking.com* committed to remove narrow price parity clauses across the EU, as at July 1st 2015. According to the "theory of harm", such a removal was expected to lower hotel prices, and this is precisely what our data revealed. Moreover, France and Italy experienced a more pronounced price reduction than Spain (Finding 2), which can be explained by the fact that their NCAs were at the forefront of the investigations. Additional support to this interpretation is provided by the further price decrease documented in France around the time *Booking.com*'s commitment came into effect (Finding 3). It should also be remembered that France in the midst of approving the Macron Law, thereby taking a stronger stance against all types of price parity restrictions.

We also note that the price dynamics observed between 2014 and 2015 arose despite other factors that could have worked in the opposite direction. Compared to 2014, the year 2015 witnessed a moderate increase in tourist arrivals in all regions studied (Figure 2). This may partially be explained by the increasing fear over terrorist attacks in North Africa and Turkey. The Sousse attack in Tunisia on June 26th, 2015, with a death toll of 38 tourists, 30 of whom were British, had a strong emotional impact. However, on its own, this fact may not have *immediately* influenced hotel prices in the regions that we study.

It was only in the following period that the situation dramatically changed. The Sousse attack was followed by a series of tragic events in Egypt and Turkey (see Table 1) and there is strong evidence showing that tourist flows were significantly impacted especially in 2016. The price increases documented in our empirical analysis between 2015 and 2016 (Finding 4) may therefore be demand driven, as tourists were mostly redirected to Mediterranean destinations in Spain, France and Italy.[17] Our regression analysis indirectly controlled for this trend by incorporating hotel-level fixed effects.

[17] According to the Financial Times (May 30, 2016), "In Spain, for example, the number of foreign tourist arrivals in April rose 11.3 per cent compared with the same month in 2015, [...]. Visitors from the UK were the primary driver behind the increase, with some 4m visiting in the first four months of this year, a 19.4 per cent increase compared with the same period in 2015. The shift to Spain comes as terrorist attacks in Tunisia, Turkey and Egypt, and warnings from governments for their citizens to avoid travel to some destinations in those countries, have led many seeking an inexpensive beach holiday to look elsewhere."

A strong demand increase is not the only relevant development that took place between 2015 and 2016. Indeed, in that period, *Booking.com* undertook significant structural changes that improved the quality of its services. On the one side, it innovated its website and added complementary features that *directly* enhanced the customer experience. For example, starting from summer 2015, *Booking.com* strengthened its presence on social media.[18] Between February and July 2016, it further catered to travelers by personalising its offers and increasing the interaction with hotels.[19] On the other side, it expanded its support to client hotels, and this *indirectly* benefited final customers. In particular, in April 2015, it launched the *BookingSuite* system, which helps independent and boutique hotels to build innovative and user-friendly websites. In March 2016, the *RateManager* platform was introduced at the core of *BookingSuite*; this platform is able to pinpoint the optimal prices for each day and rate type in order to maximize revenue. An important online feature was also added: a hotel room was not only indicated as discounted, but the website started to include both the full price, crossed out in red, and the discounted price with the percentage reduction offered to hotel guests. This new layout, although not providing any real benefit, can be perceived by customers as a quality-enhancing service, while simultaneously helping hotels to implement more effective revenue management.

All in all, we argue that the combined effect of the enhanced tourist demand and *Booking.com*'s innovative strategies may have countered the removal of the price parity clauses, thereby explaining the hotel price increases between 2015 and 2016. Nonetheless, the different antitrust experiences may have once again influenced the country-level price dynamics. Spain, in fact, registered a remarkable price surge in 2016, whereas price increments in Italy and France were relatively modest (Finding 5). Also this finding may be related to the fact that the NCAs of the latter countries were particularly active in investigating *Booking.com*'s price parity clauses.

In the next section we provide a simple theoretical model that formalises the interaction between OTAs and hotels, in order to provide additional insights on the different price dynamics observed on *Booking.com* between 2014-15 and 2015-16. We analyse the impact on hotel pricing of: (i) removing parity clauses, and (ii) OTAs' quality-enhancing innovative activity.

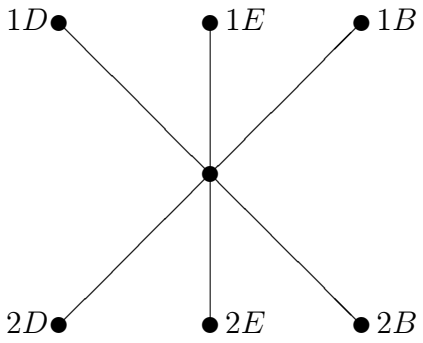
[18] In August 2015, it invited travellers to share pictures of their summer adventures and, in order to interact more with its customers, it turned some of the submitted pictures into animated GIFs.

[19] In February 2016, *Booking.com* launched the *PassionSearch* service to help travellers easily search and uncover destinations matching their interests. In May 2016, it released the *Booking Messages Interface*, a chat tool to better connect hotels and travelers. Finally, in July 2016, it introduced for some destinations the *Booking Experiences Tool*, through which users can browse a full list of things to do and book tickets in advance.

7 Price dynamics and the effect of parity clauses: a theoretical approach

We set up a simple model of the lodging sector in which hotels can sell both directly and through OTAs. We consider two hotels, indicated with $h = 1, 2$, and two OTAs, for example *Booking.com* (B) and *Expedia* (E), indicated with $o = B, E$. Hence, there are three sales channels, given that customers can book a room either directly from the hotel (D), or via one of the two OTAs. Each booking option consists of a hotel-channel pair, which is perceived by customers as horizontally differentiated. To model customer preferences over horizontally differentiated rooms, we follow Chen and Riordan (2007) in using their "spokes" model of non-localised competition. Thus, our market can be represented by a spatial structure with $n = 6$ spokes, where each booking option is represented by a point at the origin of a line of length 1/2. The other end of a line is called its terminal, and the terminals of all lines meet at a point called the centre (see Figure 10).

Figure 10. The Spokes Model



There exists a unit mass of customers willing to book at most one room. They are uniformly distributed over this spatial structure. Booking a room generates a gross utility $v_{h,o}$ which is symmetric across hotel-channel pairs, hence $v_{h,o} = v$. As common in the extant literature on spatial models, v is large enough for the market to be covered.[20] Importantly, we assume that, when booking through an OTA, customers receive additional information and/or services that additively increase their gross utility to $v + \alpha$, ($\alpha > 0$). For example, they may value supplementary information available on the OTA's website, such as peer reviews, ratings and special offers.

[20] The exact value of v above which our analysis holds can be found in the Appendix.

As indicated above, each spoke $k = 1D$, $2D$, $1B$, $2B$, $1E$, $2E$ represents a horizontally differentiated sale channel. A customer located at $x_k = 0$ has a strong preference for sale channel k, which exactly matches his preference. Instead, a customer located at $x_k = 1/2$, is indifferent across all channels, as he has to cover the same distance to reach them. Transport costs are captured by $t \geq 0$. In line with Chen and Riordan (2007), we assume each customer compares the spoke on which he is located with one randomly drawn from the remaining five channels. All booking channels compete with each other, *i.e.* competition is non-localised.

Finally, selling a room on each channel is assumed to be costless apart from the fees charged by OTAs. In particular, each hotel h has to pay a booking fee $f_{h,o}$ per each room sold through the OTA o.[21] We will typically write f_{ho} instead of $f_{h,o}$, and similarly for other variables. The timing of the game is as follows:

1. The OTAs set their commission fees: $\{f_{1B}, f_{2B}, f_{1E}, f_{2E}\}$.

2. The hotels set their prices on each sale channel: $\{p_{1D}, p_{1B}, p_{1E}, p_{2D}, p_{2B}, p_{2E}\}$.

3. Customers book a hotel room through a sale channel.

The previous discussion translates into the following. The utility of a customer located at x_{hD} is:

$$u_{x_{hD}} = \begin{cases} v - x_{hD} - p_{hD} & \text{if booking hotel } h \text{ from the direct channel } D \\ v - (1 - x_{hD}) - p_{lD} & \text{if booking hotel } l \neq h \text{ through the direct channel} \\ \alpha + v - (1 - x_{ho}) - p_{ho} & \text{if booking hotel } h \text{ through one of the OTAs } o \end{cases},$$

and similarly for customers located on other spokes.

The lengthy expressions for the indifferent customers, that play a crucial role in identifying demand functions, are reported in the Appendix. In order to simplify the exposition, we also move to the Appendix the detailed solution of the model under two different scenarios, depending on whether or not price parity clauses are allowed by antitrust authorities. In the next subsections we discuss the most relevant results. As players are symmetric, the distinction between wide and narrow price parities becomes immaterial, as in Johansen and Vergé (2017).

[21] OTAs usually impose revenue-sharing rules on hotels, and the share paid as commission is constant. However, using a revenue-sharing rule as in Johnson (2017), for example, would have rendered our analysis non-tractable.

7.1 The effect of price parity clauses on hotel room prices

As previously introduced, our theoretical analysis is based on the comparison between a scenario in which all price parities are prohibited and one in which they can be enforced by OTAs. In order to guarantee that an equilibrium exists in both scenarios:

Assumption 1 *We assume* $\alpha < t$.

Assumption 1 ensures that all demand segments are positive. This implies that in equilibrium all sale channels are used to book a room.

The equilibrium commission fees and hotel room prices are respectively given by:

$$\begin{aligned} f_{ho}^N &= \frac{5t+\alpha}{3}; \quad p_{hD}^N = \frac{2}{9}(10t-\alpha),\ p_{ho}^N = \frac{55t+8\alpha}{18}; \\ f_{ho}^P &= \frac{5t(3t+\alpha)}{6t+4\alpha}; \quad p_h^P = \frac{5t(2t+\alpha)}{3t+2\alpha}, \end{aligned}$$

where superscript N indicates no price parities and P price parities.

Obviously, absent price parities, $p_{ho}^N > p_{hD}^N$, as hotels pay a fee to be listed on the OTAs' platforms. As a consequence, under price parities hotels end up posting the same price, p_h^P, on all sales channels. Moreover, it is immediate to find that fees increase under price parities:

$$f_{ho}^P > f_{ho}^N.$$

Turning to hotel prices, while it can be easily ascertained that $p_h^P > p_{hD}^N$, we interestingly find that $p_h^P > p_{ho}^N$ when $\alpha \leq \widehat{\alpha} = 0.307t$. We can then state the following:

Proposition 1 *Following the removal of price parity clauses: (i) hotel prices charged on OTAs may either decrease or increase, depending on the additional utility enjoyed by customers when booking through OTAs; (ii) hotel prices charged on the direct channel always decrease. In particular, the following price ranking holds:*

$$\begin{aligned} p_{hD}^N &< p_{ho}^N < p_h^P \ \textit{if}\ \alpha \in (0,\ \widehat{\alpha}), \\ p_{hD}^N &< p_h^P < p_{ho}^N \ \textit{if}\ \alpha \in [\widehat{\alpha}, t). \end{aligned}$$

Hence, our theoretical model reveals that prohibiting price parities tends to lower prices on OTAs only if α is relatively small, *i.e.* when the additional satisfaction a customer gains from booking through OTAs is limited. On the contrary, when customers highly appreciate the ancillary and complementary services offered by OTAs, prices may increase without price parities.

The above proposition then conveys an interesting message, especially in terms of the results highlighted in the empirical analysis. Following the removal of price parities, prices decreased in the period 2014-2015, and then bounced back in 2015-2016. As we stressed in Section 6, especially between 2015 and 2016, *Booking.com* introduced a number of innovative features and complementary services that increased customer satisfaction. This may contribute to rationalise the price dynamics documented in our regions.

Turning to profits, the equilibrium expressions are:

$$\begin{aligned} \pi_h^N &= \frac{125t^2 + 2\alpha\,(\alpha - 5t)}{135},\ \pi_o^N = \frac{2(5t+\alpha)^2}{135}; \\ \pi_h^P &= \frac{15t^2 - 2\alpha\,(\alpha - 2t)}{6(3t+2\alpha)},\ \pi_o^P = \frac{(3t+\alpha)(5t+2\alpha)}{6(3t+2\alpha)}. \end{aligned}$$

From their comparison, we find:

$$\pi_h^P < \pi_h^N,\ \pi_o^P > \pi_o^N.$$

As expected, OTAs always gain from enforcing price parity clauses, while hotels suffer a profit loss, given that commission fees increase. As expected, OTAs' profits are always increasing in α. However, we notice that π_o^N is more responsive than π_o^P, *i.e.* $\partial\pi_o^N/\partial\alpha > \partial\pi_o^P/\partial\alpha$. It follows that OTAs have a higher incentive to provide additional services to customers in absence of price parities. The next subsection attempts to shed more light on this point.

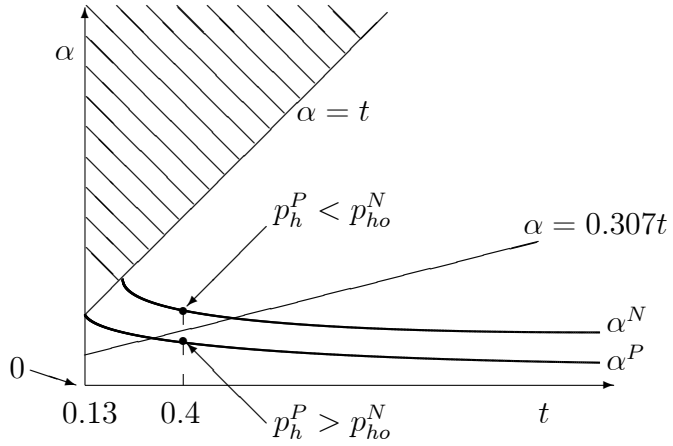
7.2 OTAs' investment in service enhancements

We consider the case in which OTAs can invest to increase the additional services provided to final customers. For simplicity, we use a convex cost of investment, $C(\alpha) = \alpha^2/2$. OTAs' profit functions are now given by $\Pi_o = \pi_o - \alpha^2/2$, and they decide the optimal level of α in a pre-stage of the game. Explicit solutions are not reported in the text, but it is straightforward to confirm that in equilibrium $\alpha^N > \alpha^P$.[22] In Figure 11 we provide a graphical representation of such investment levels as a function of t.[23]

[22] Calculations are available upon request.

[23] We assume that $t > 0.13$ in order to guarantee that demands are positive in both scenarios. We also focus on the parametric region where Assumption 1 holds.

Figure 11. Investing in α



The results of Proposition 1 are captured in the figure by explicitly plotting the threshold value $\widehat{\alpha} = 0.307t$. For a given value of t, it is more likely to end up in the region where $p_{ho}^N > p_h^P$ when α is relatively high ($\alpha > \widehat{\alpha}$). Consider for example $t = 0.4$. The corresponding optimal investment levels are $\alpha^N = 0.16$ and $\alpha^P = 0.08$, and $\widehat{\alpha} = 0.123$. As it can be seen in Figure 11, $\alpha^P < \widehat{\alpha} < \alpha^N$. Without the antitrust intervention, OTAs would enforce price parities, and the resulting investment level would fall below $\widehat{\alpha}$ ($p_{ho}^N < p_h^P$ when $\alpha = 0.08$). In the short term, for a given α, the prohibition of price parities would then drive prices down on OTAs. Online prices are indeed easily adjustable, whereas strategic investments in supplementary services may require some time to be implemented. In other words, OTAs may have responded to antitrust decisions against price parities by investing more in α, as our model suggests, but only in the medium term. Considering again $t = 0.4$, this means that, when additional services are provided to customers, prices tend to increase. Indeed, they may even be higher than their level prior to the removal of price parities ($p_{ho}^N > p_h^P$ when $\alpha = 0.16$).

The previous analysis suggests that OTAs may decide to enhance customer experience in (partial) response to the impossibility of using price parity restrictions. We attempt to determine whether this was indeed the case for *Booking.com*. As widely discussed, in the period 2015-16 *Booking.com* introduced a series of additional tools and complementary services for both customers and client hotels. One of these newly introduced features, namely the percentage price reduction displayed to *Booking.com*'s users, is available in our data. Previously, a hotel room was simply

indicated as discounted, as we observed in the 2014-15 sample. On the contrary, in the 2016 sample, both the full price, crossed out in red, and the discounted price (with the percentage reduction) were included.

Our strategy is the following. We divide the hotels into two groups, depending on whether or not they displayed percentage price reductions in 2016. Table 9 shows that around 27% of the hotels in our 2014-16 sample adopted the new discount feature proposed by *Booking.com*, although the percentage is slightly lower in France. We conjecture that these hotels are also more likely to adopt other *Booking.com*'s innovative tools, particularly in terms of revenue management (*e.g. RateManager*). Hence, they are expected to effectively implement dynamic pricing strategies that did not necessarily lead to average price reductions despite the adoption of such discounts.

Table 9. Hotels using the Booking.com discount feature, 2014-16 sample

	Discount	No discount	% discount
Italy	137	340	28.72
France	35	123	22.15
Spain	99	257	27.81
Total	271	720	27.35

In order to test our conjecture, we modify the regression presented in Section 5.2 by adding a dummy variable that is assigned a value of one if the hotel used the discount feature in 2016. The results are presented in Figure 12, in which the dependent variable is the percentage of rooms with an increased price.[24] We find that 3 and 4-star hotels using the discount feature were no less likely to have registered a price increase in all countries. A similar conclusion is obtained also for 2-star discounting hotels in Spain and in Italy. Consistent with our interpretation, most hotels are using the discount feature as part of a well pondered revenue management strategy, that helped sustain relatively higher prices. The only exception is represented by 5-star hotels that use discounts, as they are less likely to increase their prices in all nations. This may be due to the fact that, contrary to lower rated hotels, 5-star hotels often use discounts to clear out excess capacity.

[24] Qualitatively identical results are obtained using the other two dependent variables; results are available upon request.

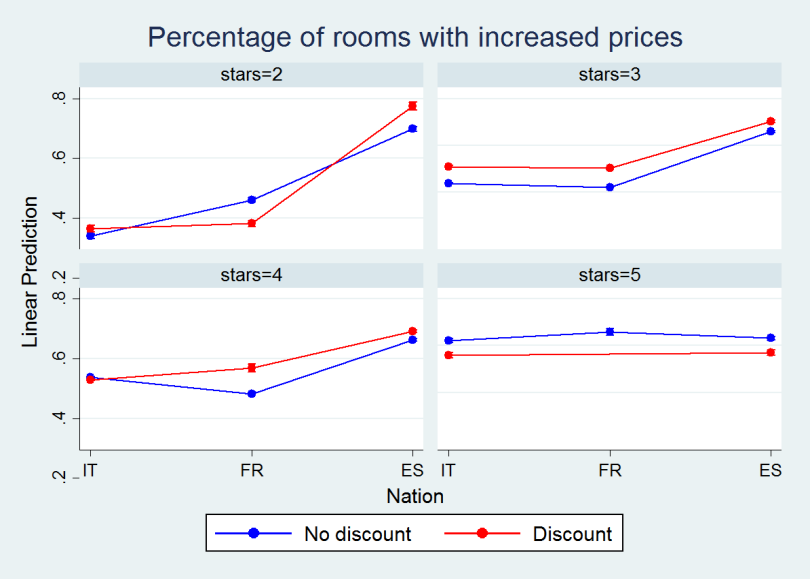


Figure 12. Percentage of rooms with increased price, 2014-15 and 2015-16, by nation, star rating and discounts; linear predictions.

7.3 Welfare implications

Our theoretical analysis shows that the removal of price parities may have an ambiguous effect on hotel prices, particularly when consumers highly value the additional services provided by OTAs. This calls for a careful evaluation of the social desirability of this type of antitrust intervention.

We compute in both scenarios consumer surplus and total welfare, whose expressions are in the Appendix. Their comparison reveals that, for given α:

$$CS^P < CS^N, \; SW^P > SW^N.$$

Customers as a whole lose out under price parity clauses, whose enforcement allows OTAs to raise the commission fees, which are then passed through to final consumers. This result is in line with the theory of harm adopted by EU competition authorities. Nonetheless, in our model the removal of such clauses does not uniformly affect all customers. Those booking directly from the hotel benefit from a lower price (Proposition 1.ii), whereas customers booking through OTAs may pay higher prices (Proposition 1.i). However, our analysis reveals that OTAs' customers can be somehow compensated by the additional services they receive. Indeed, we noted that OTAs may react to the prohibition of price parities by enhancing cus-

tomer experience, thereby further increasing their surplus. As a consequence, the prohibition of price parities benefits all hotel guests, independently of the booking channel they use.

Finally, and to a certain extent counterintuitively, our analysis suggests that price parities are not detrimental to total surplus as a measure of social welfare. Under price parities, the gain for OTAs is higher than the sum of the losses incurred by both customers and hotels. This is due to the fact that OTAs can extract most of the surplus from listed hotels. Hence, an antitrust agency mainly interested in preventing contractual agreements damaging hotels, and/or aiming to protect final customers, should still prohibit price parities. We would also like to stress that this last result crucially depends on the market structure we adopted to model the OTA sector. It is indeed relatively simple to verify that, in presence of only one OTA, total welfare decreases under price parity; the other relevant policy implications remain unaffected.

8 Concluding remarks

This paper was motivated by the growing debate on the use of price parity clauses by OTAs. A plethora of investigations and decisions has characterised the EU antitrust activity since 2010, whereas no significant action has been taken elsewhere. *Booking.com*, the dominant OTA in the EU market, was the main target of these investigations, together with *Expedia* and *HRS*.

In 2015, the coordinated activity of some European NCAs induced *Booking.com* to eliminate wide parity clauses from its contractual agreements with client hotels. Between 2015 and 2016, France, soon followed by other EU countries, went even further and eliminated all types of price restrictions by law. The aim was to increase competition in the OTA sector and guarantee hotels a higher flexibility in setting their prices. The expected result was a reduction in the final price charged to customers when booking a hotel room. However, the impact of these antitrust measures is far from being fully understood, not only in terms of hotel prices, but also in relation to the potential response of dominant OTAs, such as *Booking.com*. We have contributed to this discussion by providing an overarching analysis, which combines empirical evidence and theoretical results.

First, we have collected data on hotel prices posted on *Booking.com* during the period 2014-16 for four important EU tourism regions, *i.e.* the main Mediterranean islands of Italy, France and Spain. Our empirical analysis was based on a matching procedure, through which we were able to compare room prices across a set time span. The results have highlighted *two main trends* in all nations considered: (i)

prices decreased between 2014 and 2015; (ii) prices bounced back between 2015 and 2016. When looking at the results by nation, we observed that prices in Spain decreased less than in France and Italy in 2014-15, whereas they increased more in 2015-16. We have also documented the possible impact on hotel prices of the commitment offered by *Booking.com* to remove wide price parities, which came into effect on July 1st, 2015. We have shown that prices in France further decreased immediately after the commitment.

Second, we have attempted to rationalise this evidence both in light of the events that characterised the period under investigation and through the analysis of a theoretical model of the OTA sector. In general, the overall price decrease between 2014 and 2015 was in line with the partial removal of price parity clauses, whereas the ensuing price rise between 2015 and 2016 was probably due to a combination of factors, in particular enhanced demand and innovative services provided by OTAs. Regarding the interpretation of the country-level price patterns, we have highlighted that countries experienced price changes compatible with the role they played in enquiring price parity clauses.

To sum up, our main findings are in line with the ultimate spirit and goal of the EU antitrust intervention. In particular, our analysis supports the beneficial impact of removing price parity clauses for both client hotels and final consumers. On the one side, especially for the period 2014-15, an active antitrust intervention contributed to the observed drop in prices. On the other side, in the following period, it helped to contain the price surge that was mainly driven by the tourism boom registered in 2016 in the concerned regions. France and Italy, who led the investigations, registered sizeable price decreases in 2014-15, followed by relatively limited price increases in 2015-16. Spain, who adopted a "wait-and-see" approach, was characterised instead by negligible decreases in 2014-15 and particularly relevant price increases in 2015-16.

Furthermore, our analysis has revealed that *Booking.com* may have accelerated the introduction of innovative features and complementary services for customers and client hotels following the ban of price parity clauses. In order to support the latter conjecture, we have documented a progressive effort in that direction by *Booking.com*, precisely between 2015 and 2016. We also have proposed a theoretical framework in which we have demonstrated that OTAs invested more to provide a host of additional valuable services and features for customers, when prevented from using restrictive agreements with hotels.

The scope of this paper could be further extended. For example, future research could account for the rapid rise of *Airbnb*, a player that is disrupting the lodging

sector.[25] The use of this platform has indeed flourished in the EU in the last few years. However, as its rise has been steady over time, we reckon that it may not have significantly affected the price dynamics documented in our analysis. Moreover, considering the properties available on *Airbnb* as valuable alternatives to hotel rooms has become predominant mainly in big cities, less so in the tourism regions that we cover. In fact, *Airbnb* mostly substitutes other types of lodging establishments, such as B&Bs, apartments and residences.

Finally, given the currently available data, our results cannot be considered as conclusive with regard to the final impact on hotel prices, resulting from banning parity clauses. Moreover, the theoretical model also presents some limitations. For example, the assumption of symmetry across OTAs, although allowing for a simplified resolution of the model, does not enable us to investigate the difference between wide and narrow price parities. Notwithstanding its empirical and theoretical limitations, our paper represents an important first step towards assessing the effectiveness of antitrust intervention in relation to price parity restrictions.

[25] Coyle and Yeung (2016) discuss at length the growing importance of *Airbnb* in the sector.

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Appendix

Indifferent consumers

Using the utility functions introduced in Section 7, we can identify six types of indifferent customers. This allows specifying the twelve demand segments that characterise our spatial structure with six spokes. To begin with, the customer indifferent between the two hotel rooms when booking through direct channels is identified as:

$$\widehat{x}_{hD,lD} = \frac{1}{2} + \frac{p_{lD} - p_{hD}}{2}.$$

Then, the customer indifferent between booking from the same hotel h through different OTAs, with OTA $m \neq o$, is:

$$\widehat{x}_{ho,hm} = \frac{1}{2} + \frac{p_{hm} - p_{ho}}{2}.$$

The customer indifferent between the two hotels by using the same OTA is:

$$\widehat{x}_{ho,lo} = \frac{1}{2} + \frac{p_{lo} - p_{ho}}{2};$$

whereas the customer indifferent between the two hotels when using two different OTAs is given by:

$$\widehat{x}_{hl,mo} = \frac{1}{2} + \frac{p_{lo} - p_{hm}}{2}.$$

Finally, the customer indifferent between booking from hotel h, either directly or through an OTA, is:

$$\widehat{x}_{hD,ho} = \frac{1-\alpha}{2} + \frac{p_{ho} - p_{hD}}{2},$$

whereas the one indifferent between one hotel using an OTA and the other using the direct channel is:

$$\widehat{x}_{hD,lo} = \frac{1-\alpha}{2} + \frac{p_{lo} - p_{hD}}{2}.$$

Notice that only the latter expressions depend on α, the additional value provided to users when booking a room through an OTA.

No price parity clauses

Consider the situation in which any type of price parity is prohibited. The profit function of hotel 1 is given by:

$$\pi_1 = \frac{2}{n}\left[p_{1D}D_{1D} + (p_{1B} - f_{1B})D_{1B} + (p_{1E} - f_{1E})D_{1E}\right],$$

where the demand segments are, respectively:[26]

$$\begin{aligned}
D_{1D} &= \frac{1}{n-1}\left(\widehat{x}_{1D2D} + \widehat{x}_{1D1B} + \widehat{x}_{1D1E} + \widehat{x}_{1D2B} + \widehat{x}_{1D2E}\right), \\
D_{1B} &= \frac{1}{n-1}[(1 - \widehat{x}_{1D1B}) + (1 - \widehat{x}_{2D1B}) + \widehat{x}_{1B2B} + \widehat{x}_{1B1E} + \widehat{x}_{1B2E}], \\
D_{1E} &= \frac{1}{n-1}[(1 - \widehat{x}_{1D1E}) + (1 - \widehat{x}_{2D1E}) + (1 - \widehat{x}_{2B1E}) + (1 - \widehat{x}_{2BE1}) + \widehat{x}_{1E2E}].
\end{aligned}$$

Similarly, the profit of hotel 2 is:

$$\pi_2 = \frac{2}{n}\left[p_{2D}D_{2D} + (p_{2B} - f_{2B})D_{2B} + (p_{2E} - f_{2E})D_{2E}\right],$$

with the demand segments now being:

$$\begin{aligned}
D_{2D} &= \frac{1}{n-1}\left[(1 - \widehat{x}_{1D2D}) + \widehat{x}_{2D1B} + \widehat{x}_{2D1E} + \widehat{x}_{2D2B} + \widehat{x}_{2D2E}\right], \\
D_{2B} &= \frac{1}{n-1}\left[(1 - \widehat{x}_{1D2B}) + (1 - \widehat{x}_{2D2B}) + (1 - \widehat{x}_{1B2B}) + \widehat{x}_{2B1E} + \widehat{x}_{2B2E}\right], \\
D_{2E} &= \frac{1}{n-1}\left[(1 - \widehat{x}_{1D2E}) + (1 - \widehat{x}_{2D2E}) + (1 - \widehat{x}_{1B2E}) + (1 - \widehat{x}_{2B2E}) + (1 - \widehat{x}_{1E2E})\right].
\end{aligned}$$

The profit functions of the two OTAs are respectively given by:

$$\pi_B = \frac{2}{n}\left[f_{1B}D_{1B} + f_{2B}D_{2B}\right],\ \pi_E = \frac{2}{n}\left[f_{1E}D_{1E} + f_{2E}D_{2E}\right].$$

By taking FOCs on $\pi_1$and π_2, we can find prices as a function of fees f_{ho}; plugging them into π_B and π_E and differentiating, we obtain the equilibrium values of the

[26]Each demand segment is composed by those consumers who compare one of hotel 1's selling channels with the other sale channels; a customer randomly picked on a spoke has then a probability 1/5 of also considering any of the remaining five options. We will typically write $\widehat{x}_{1D2D}$ instead of $\widehat{x}_{1D,2D}$, and so on.

fees, which are symmetric at the equilibrium, as we also reported in Subsection 7.1:

$$f_{ho}^N = \frac{5t + \alpha}{3}.$$

Remember that N indicates equilibrium values for the no price parities case. It is easy to verify that the equilibrium fees are "incentive compatible", *i.e.* a hotel cannot increase profits by unilaterally delisting from one or both OTAs. The equilibrium prices charged by hotels on their direct selling channel and on the OTAs are respectively given by:

$$p_{hD}^N = \frac{2}{9}(10t - \alpha),\ p_{ho}^N = \frac{55t + 8\alpha}{18},$$

as we already know. It is immediate to prove that $p_{ho}^N > f_{ho}^N$, and that $p_{hD}^N > 0$ if $\alpha < 10t$. Moreover, all demand segments are positive when $\alpha < 5.5t$. Assuming this condition holds, equilibrium profits for hotels and OTAs are:

$$\pi_h^N = \frac{125t^2 + 2\alpha\,(\alpha - 5t)}{135},\ \pi_o^N = \frac{2(5t + \alpha)^2}{135}.$$

The equilibrium consumer surplus and total welfare are given by:

$$CS^N = v - \frac{1585t^2 - 200t\alpha - 8\alpha^2}{540t},\ SW^N = v - \frac{37t^2 - 56t\alpha - 8\alpha^2}{108t}.$$

The above expressions are positive for a sufficiently high value of v, which we assume to hold.[27] Our analysis suggests that, in an equilibrium in which parity clauses are forbidden or not adopted, all firms in the lodging industry (OTAs and hotels) enjoy positive profits in all sale channels, provided $\alpha < 10t$. In particular, when parameter α is not excessive, OTAs cannot extract all surplus from the hotels through the fees, as $p_{ho}^N > f_{ho}^N$, as we previously noticed.

[27] In particular, we need to impose $v > \frac{1585t^2 - 200t\alpha - 8\alpha^2}{540t}$ for consumer surplus to be positive. This implies, *a fortiori*, that total welfare is positive as well.

Price parities

Consider a scenario in which both OTAs impose to hotels a price parity clause. The constraint implies that $p_h \leq \min\{p_{hD}, p_{hm}\}$. We demonstrated that, in absence of price parities, hotels would charge a lower price on their direct sale channel; hence, wide parity clauses translate into: $p_h = p_{hD} = p_{hm}$. The hotels' profit functions are:

$$\begin{aligned}\pi_1 &= \frac{2}{n}\left[p_1 D_{1D} + (p_1 - f_{1B})D_{1B} + (p_1 - w_{1E})D_{1E}\right], \\ \pi_2 &= \frac{2}{n}\left[p_2 D_{2D} + (p_2 - f_{2B})D_{2B} + (p_2 - w_{2E})D_{2E}\right].\end{aligned}$$

OTAs' profit functions are the same as before. Following similar steps as in the previous scenario, we find that: *(i)* the OTAs are willing to increase their fee as much as possible; *(ii)* the "incentive compatibility constraint" becomes binding. An unconstrained profit maximization would then lead to a full extraction of the hotels' surplus. Hence, hotels would unilaterally deviate by delisting from one or both OTAs. As a result, at equilibrium, OTAs charge a fee which makes hotels indifferent between listing or not:

$$f_{ho}^P = \frac{5t(3t+\alpha)}{6t+4\alpha}.$$

Remember that superscript P denotes equilibrium values for the price parity case. The equilibrium price is:

$$p_h^P = \frac{5t(2t+\alpha)}{3t+2\alpha},$$

with $p_h^P > f_{ho}^P$. Demand segments are positive when $\alpha < t$, as by Assumption 1. Equilibrium profits for hotels and OTAs are respectively given by:

$$\pi_h^P = \frac{15t^2 - 2\alpha(\alpha - 2t)}{6(3t+2\alpha)},\ \pi_o^P = \frac{(3t+\alpha)(5t+2\alpha)}{6(3t+2\alpha)}.$$

Consumer surplus and total welfare are:

$$CS^P = v - \frac{645t^3 + 210t^2\alpha - 104t\alpha^2 - 16\alpha^2}{60t(3t+2\alpha)},\ SW^P = v - \frac{15t^2 - 40t\alpha - 8\alpha^2}{60t}.$$

The above expressions are positive for sufficiently high values of v,which we assumed to hold throughout our paper. In particular, $CS^P > 0$ when $v > \frac{645t^3+210t^2\alpha-104t\alpha^2-16\alpha^2}{60t(3t+2\alpha)}$, which becomes the binding condition for v, as we also mention in Section 7.