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An analysis of the determinants of cruise traffic: An empirical application to the Spanish port system

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ABSTRACT

We study the determinants that affect the capacity of ports to attract cruise ships in Spain. The conclusion is that the likelihood of having cruise traffic is linked to ports located in populous areas and close to large airports, ports not specialized in container traffic but sharing facilities with ferries traffic and ports having a minimum depth of water. The amount of cruise traffic that a port can generate is also related to the population and the air connections, along with the tourist appeal and the facilities shared with other types of port traffic, namely roll-on roll-off and ferries.

1. Introduction

Cruises have become one of the most dynamic and fastest expanding segments of the international tourist industry regarding both cruise passenger demand (Sun et al., 2011) and the growing supply of vessels, and larger size vessels (see Weaver, 2005a, 2005b, on the trend towards super-sized cruise ships) which, with their greater ranges of cuisine and leisure are trying to respond to the increasingly complex demands and motivations of both first-time and returning passengers (see Jones, 2011).

According to Soriani et al. (2009), the cruise industry continues to be a dynamic sector, in continuous growth, and an increasingly important component of the global tourism industry. The total number of cruise passengers can be seen to have increased from half a million in 1970 (see Krause, 1980, for an analysis of the industry during its modern-day resurgence) to over 20.3 million in 2012 (according to CLIA estimates, 2013) with a figure of 25 million predicted for 2015 (WTO, 2010), although for Cruise Market Watch (2013) the economic crisis means that predictions for said year stand at around 22.5 million. There is no doubt that the crisis is turning into the main threat to the sector, especially in areas like the Mediterranean, and that it could cut short the excellent expectations with which the 21st century began in the wake of almost unbroken growth for almost three decades (Wild and Dearing, 2000).

All types of factors have influenced this expansion, from the early success of the Love Boat TV series (Weaver, 2005a) to national promotion and sales campaigns that range from early bookings with a minimal booking fee to last-minute sales, especially on the Internet. It is not hard to find cruises that cost way below traditional prices in the sector, some even at

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under 500€ per person on the Internet, including port authority charges. In fact, extreme cases can be found among the last-minute offers where the revenue from last minute fares is far below the cost of the services provided.

As cruises have become more common, they have stopped being a local phenomenon confined mainly to the Caribbean (see Petit-Charles and Marques, 2012, on the importance of cruises in the Caribbean and Wanhill, 1982, on their economic impact at ports of call since the end of the nineteen–seventies) and they have spread throughout a number of geographical areas all round the world, from Alaska (see Mak, 2008) to Asia (see Rodrigue and Notteboom, 2013). This great geographical expansion worldwide has also led to a rise in the desire of port authorities and tourist organizations to tempt them to new ports (see for example Jordan, 2013 on the expectations of Port of Spain in Trinidad and Tobago to be considered a Cruise Hub in the Caribbean given its geographical location).

Of the other geographical areas to which cruise tourism has spread, the Mediterranean stands out as the second biggest market with a 24% world market share. According to Soriani et al. (2009), the reasons that would justify this success include the following: easier navigation than in other geographical areas, as the Mediterranean is an almost completely enclosed basin and thus sheltered from strong oceanic streams; a good climate, which makes it possible to plan navigation over 8 months of the year, or even longer in the southern regions; the area offers diverse environments (a variety of coastal environments, islands and archipelagos) as well as unique cultural–historical attractions (towns, archaeological sites, etc.). The variety of destinations on offer in the Mediterranean is so wide-ranging and eclectic that it provides the opportunity to visit places ranging from the ruins of the main civilizations of antiquity (such as Egypt or all those of the Greco-Roman tradition) at one extreme, to the Holy Lands and the jewels of the Italian renaissance, and to Ibiza, the global capital of techno music with its never-ending parties, at the other (see Ettema and Schwanen, 2012, on this kind of tourism).

Italy stands out as the country with the highest number of cruise passengers in this area due both to the beauty of its destinations and also because of its role as a pivotal divide that splits the Mediterranean market into two distinct segments, one to the west and the other to the east. The Spanish port system stands out after Italy, with Barcelona as its standard bearer and the port that currently boasts the greatest amount of cruise passenger traffic; to be specific, in 2011 2.6 million cruise passengers passed through the port. It is therefore not surprising that two Spanish ports, namely Barcelona and Malaga, are rivaling Nice and Marseilles as the venue for the Seatrade Med international meeting (Government of Andalucian, 2012), an event which endeavors to replicate the functionality of Seatrade Miami in the Mediterranean geographical area.

Despite the importance of the sector and the increasing amount of literature that analyzes the main features and trends of cruise traffic (see Rodrigue and Notteboom, 2013, or Weeden et al., 2011), there is a clear lack of literature on empirical analyses that analyze the main determinants of the evolution of cruise traffic (see Papathanassis and Beckmann, 2011, or Gibson, 2008, on the lack of literature on cruises). In fact, there is nothing similar to this study in the prior literature, although some studies were found that seek to formulate hypotheses on the possible determinants of cruise traffic. These hypotheses were formulated from a synthesis of experts' opinions (Lekakou et al., 2009; Vaggelas and Pallis, 2010 and Wang et al., 2014); from the results of surveys to gauge the satisfaction of cruise passengers (Silvestre et al., 2008) or simply from observations of trends in the sector (Marti, 1990; Soriani et al., 2009; Rodrigue and Notteboom, 2013). Some first attempts of regressions have been made in recent years to find these determinants although, unfortunately, still with a very limited number of explanatory variables. For example, Petit-Charles and Marques (2012) attempted to explain cruise supply with two explanatory variables, namely excursions revenue and distance between the port of call and the port of embarkation. Meanwhile, Lee and Ramdeen (2013) tried to explain the vessel occupation rate using dummy variables for the various ship itineraries.

Among these precedents, Marti (1990), after a descriptive analysis of the sector, concludes by stressing the importance of geographical factors, specifically 'site' and 'situation', for determining the port selection process in the cruise industry. Petit-Charles and Marques (2012) also stress the importance of the situation. The tourist appeal of the port's hinterland and, especially, its ability to generate profits through excursions, also has many supporters (see Petit-Charles and Marques, 2012; Silvestre et al., 2008; Soriani et al., 2009 and Wang et al., 2014). There also seems to be a degree of theoretical consensus regarding how important it is for a port to have infrastructure good links with road networks and airports especially (see Vaggelas and Pallis, 2010; Lekakou et al., 2009; Soriani et al., 2009; Rodrigue and Notteboom, 2013; and Wang et al., 2014). Finally, some of these papers stress the importance of the port's technical features, including depth of waters and the economic efficiency of its services and operatives (see Vaggelas and Pallis, 2010; Lekakou et al., 2009; Soriani et al., 2009; or Wang et al., 2014).

This lack of literature and of methodologically-supported studies must be due to the fact that this is a sector where the factors that define the demand and those that define the supply are quite complex (see Weeden et al., 2011). However, it is due above all to the difficulty of constructing large-scale databases with a port set with cruise traffic or the potential to acquire it. Also, unlike international sea transport, and except for the under-developed Short Sea Shipping (see Puckett et al., 2011; Douet and Cappuccilli, 2011; Suárez-Alemán et al., 2013 and Medda and Trujillo, 2010, on the development and main trends of SSS) its nature as a complement might take priority over its nature as a substitute for cruise traffic between ports in close proximity as, following Rodrigue and Notteboom (2013), the objective of the cruise shipping companies is to design a good sequence of ports that define an attractive and competitive itinerary, where one stopover is located just a few hours sailing away from the preceding port.

In this context, our first objective is to present the first data panel estimate of the determinants that both positively and negatively influence the likelihood that a port is able to have cruise traffic. Subsequently, a new second phase panel data estimation of ports with cruise traffic seeks to determine the explanatory variables that impact on the overall number of cruise traffic that a port is able to achieve. For this second estimate only the ports with effective cruise traffic will be taken into account. In other words, the aim is to provide a set of useful results with a view to both gaining an understanding of the sector and for its planning.

We take a clearly relevant case for this analysis from the economic point-of-view, the Spanish port system. This is the country where traffic has most grown on the international scale outside the area of the Caribbean, turning, as previously mentioned, Barcelona into the main port in the Mediterranean. One of the strengths of this case study is the appeal of the country for tourists (see Claver-Cortés et al., 2007, on Spain's strengths for attracting mass tourism that, according to the data for the 2012 World Tourism Barometer of the WTO, have made it the second country in the world in tourism revenue and the third equal with China in numbers of tourists) and the geographical location of the country as a gateway to both the Mediterranean and to Europe on the Caribbean routes. Thus the country's ports are bases for a number of different itineraries, beginning with those in the western Mediterranean, and also autumn cruises between Spain and northern Africa. There are also ports on the Cantabrian coast which are occasional ports of call for cruises to the north of Europe. To this must be added ports like Seville and Cadiz with significant river cruise traffic throughout the whole year, without forgetting that all the vessels that once or twice a year are obliged to sail to Europe and depart for the Caribbean normally call in at these ports.

The rest of this article is organized as follows. Section 2 lays out the data and presents the methodological approach. Section 3 discusses the empirical results and the last section is devoted to the concluding remarks.

2. Data and methodology

The purpose of our empirical analysis is to examine the determinants of cruise traffic using data for Spanish port authorities. We analyze the likelihood that a port has cruise traffic and also the amount of cruise traffic that the port is able to generate. We consider different attributes of the region in which the port is located. In particular, we consider the tourist appeal of the region, which is captured through the number of hotels per capita. The potential complementarity between cruise traffic and airport traffic is also taken into account. We also consider the influence on cruise traffic of the region's population and the fact that the port is located on an island. Furthermore, we consider other types of Port Authority traffic specialization that may (or may not) share facilities with cruise traffic. Specifically, we consider regular ferry line passengers, non-containerized general traffic and containerized goods. Finally, the analysis also examines the role of port Authority-specific variables, such as the draught in the port and passenger charges.

We use attributes of the province instead of attributes of the city as explanatory variables. The hinterland of a port generally goes beyond the city and even the province. In the case of cruises, it should be noted that tourist attractions like beaches, mountains, natural parks and tourist resorts are not necessarily located in the main city.

Our empirical analysis is based on the estimation of two different sets of equations. In the first equation, the dependent variable is a dummy variable that takes a value of 1 if the port authority has cruise traffic in year *t* and 0 otherwise during the 2002–2010 period. In the second equation, we restrict the sample to those Port Authorities that have had cruise traffic in at least one year between 2002 and 2010. In this second equation, we use two different dependent variables to identify the amount of cruise traffic that the port authority is able to generate; the number of cruise passengers and the number of cruise ships.

Note that our analysis does not try to make a clear distinction between the demand and supply side of the cruise market. What our data is able to capture is the total amount of cruise traffic that a port moves every year. Such amount of traffic will be the result of the interlinked dynamics of demand and supply forces. This being said, differences between demand and supply may be conditioned on the load factors with carriers operating in the market. Hence, we use one variable that captures the overall level of activity concerning cruises (number of passengers) and a variable more directly related with the supply of cruises (number of cruise ships).

Regarding our empirical strategy, we follow a similar approach to that proposed by Heckman (1979) in his seminal paper on sample selection bias. In our context, the estimation of the two sets of equations is justified because factors explaining the likelihood of having cruise traffic may differ from factors determining the amount of cruise traffic that a port is able to generate. Furthermore, paying attention to the traffic equation alone implies not considering several ports in our analysis that do not have cruise traffic at all in the period under consideration.

The following briefly summarizes the relationships that, a priori, one would expect from the set of explanatory variables collected and the dependent variables. Overall, the expected arithmetical signs of the estimated relationships for the variables that are included in both equations should be the same. Generally, when the higher value of one variable increases the likelihood of having cruise traffic, it should also imply a higher amount of cruise traffic.

2.1. Attributes of the province

2.1.1. Number hotels per capita

Firstly, the number of hotel establishments per inhabitant is included as an indicator of tourism supply in the province. This is, in turn, a clear proxy of the area's tourist appeal which, in theory, should be positively related to the possibility of capturing cruise traffic either as an embarkation/disembarkation port or a way port.

This hypothesis is supported by the fact that for many studies (see, for example, Jones, 2011, or CLIA, 2011) the main variable that defines the choice of cruise by cruise passengers and shippers is the appeal of the destination. Moreover, for Gui and Russo (2011) the appeal of different destinations is an even more important variable in the Mediterranean area compared to the Caribbean. This is due to the greater appeal of European cities and their archeological sites for historical and cultural tourism (see Gui and Russo, 2011, Rodrigue and Notteboom, 2013 and Soriani et al., 2009 on this appeal).

It should also be noted that the number of hotels per capita should have an influence on the likelihood that a port becomes a starting or destination port for cruise traffic. Indeed, an ample supply of hotels is needed at embarkation/disembarkation ports where passengers requiring intercontinental flights or who have no definite connection available in the early hours of the morning can spend the night before the cruise.

The source for this variable is the *INE* (Spanish Statistics Institute).

2.1.2. Population

A positive relationship is expected between cruise traffic and the provincial population variable. Population is to a great extent a direct indicator of the size of a city's cultural, gastronomic and leisure offer which is, in turn, an important part of its appeal for tourists. Also, in a more indirect way and once more also for ports of embarkation, a large population of several million inhabitants in the surroundings of the port is a guarantee that cruise lines will be able to raise cruise ship occupation with last-minute special offers (see Buhalis and Law, 2008 on the growing importance of these offers in the tourist industry). Finally, there is no doubt that the big cities that possess a larger and more varied economic fabric with companies in a wide range of sectors facilitate the complicated logistics and supply chains of the major cruise vessels, which can carry over 5000 passengers and crew (see Page, 2009, and Véronneau and Roy, 2009, on the current complexity of supply chains in the cruise industry). The source for this variable is the *INE* (Spanish Statistics Institute).

2.1.3. D^{island}

A *dummy* variable is included that takes a value of 1 when the Port Authority's ports are located on an island and 0 for mainland ports (whether located on the Iberian Peninsula or in northern Africa). A positive relationship is also anticipated. Objectively, the Balearics and the Canary Islands are among the top tourist destinations in Europe (see Domínguez-Mujica et al., 2011, on the importance of the Balearics and the Canary Islands for tourism). But it is also possible that the undoubted appeal of these islands for cruise ships is reinforced by the very fact that they are islands. With this we are testing the hypothesis that an island *per se* is an attraction for cruises, among other things for its 'inhospitable' character, which means that it cannot be reached overland, and this would be supported by the idea that it is precisely the islands of the Caribbean that are the main cruise destination in the world (see see Petit-Charles and Marques, 2012, on the importance of cruises in the Caribbean). In fact, the cruise ship would appear to be the easiest way to visit several different islands in just a few days (see Kester, 2002, on how cruises are traditionally a valuable additional source of tourism for many islands).

The importance of islands to the cruise industry has led to the main cruise lines buying private islands in the Caribbean (see Weaver, 2005b on this trend) in order to offer them exclusively to their cruise passengers who, moreover, usually value them very positively, even over the traditional ports of call in the Caribbean. Obviously if this trend continues we could arrive at a point where the only calls that a cruise makes are at private islands, which, according to Carey (1996) and Weaver (2005b) has been a latent demand of cruise passengers since the end of the last century.

2.2. Port and airport traffic

2.2.1. Other port traffic

Any synergies or incompatibility that might exist between cruise traffic and other types of Port Authority traffic will also be analyzed. The analysis of these synergies is justified by the growing need that ports have for all port infrastructure to be cost-effective, which is difficult with cruise traffic alone (see Dwyer and Forsyth, 1998). It should be added that for some authors, such as Gui and Russo (2011), favoring passenger ship tourism may harm the port's cargo ship activity.

The following types of port traffic are included to test these hypotheses: non-containerized general goods traffic, containerized general goods traffic and regular ferry passenger traffic. By regular passenger traffic, we mean all passenger traffic (including ferries) that is not cruise traffic. Unfortunately, we are not able to include other indicators of port traffic, such as the relative importance of national and international traffic.

A positive relationship is expected between cruise traffic and general goods and regular ferry passenger traffic. In fact, these two types of traffic may be using facilities that could also be used by cruise traffic. It is possible to make a similar use of passenger terminals by cruises, passenger ferries and *roll-on roll-off* traffic vessels. On the other hand, a port with high container traffic could have specialized facilities for a type of traffic that does not produce synergies with cruise traffic. The same positive relationship is therefore not expected between cruise traffic and container traffic *a priori*. However, broadly-speaking, a port with a large amount of traffic might be considered to generate a fair amount of revenue which would enable it to offer more competitive dues to vessels, including cruise vessels. The source for port traffic statistics is the Spanish State Ports Organization (see http://www.puertos.es/en).

2.2.2. Airport traffic

A positive relationship is expected between cruise traffic and airports in the province (see for example Soriani et al., 2009 or Lekakou et al., 2009). A large proportion of passengers at Spanish airports (especially when the province in question possesses an area of coastline) are tourists from other parts of Spain, Europe and from overseas, which means that there could be major synergies with cruise traffic. Barcelona is a clear illustration of these synergies. It seems that the increased availability of flights to and from the United States at Barcelona-El Prat Airport has resulted in a sharp increase in cruise passengers from the US who sail out of the port of Barcelona. This is one of the aspects that explain why Barcelona is currently one of the main ports in the world as far as cruise traffic is concerned. Page (2009) goes even further in this respect when stating that the advent of cheaper air travel is one of the core factors for explaining the boom in cruise tourism.

There is no doubt that the existence of an international airport with a wide range and a high frequency of international air connections – which depend on passenger volumes – are crucial determinants for any port that wishes to set itself up as a homeport for cruise vessels (see Rodrigue and Notteboom, 2013, or Gui and Russo, 2011, for example, on the importance of air transport and airports in the cruise market).

It is almost impossible to make a clear distinction between way ports and homeports in our sample. There are ports, like Barcelona, which obviously fulfils the function of a homeport, while there are others, like Seville, Valencia, Palma and Gran Canaria, which play dual roles (for some vessels they are way ports and for others they are also homeports) and there are even some, like Malaga, which during some years of the sample primarily played the role of port of call and, during others, that of homeports. However, what is clear is that none of these ports has renounced on being or becoming a homeport in the present context, with shipping lines trying to make it as easy as possible for their potential European customers to embark. A good example of this is the MSC line, which generally allows all of the Eurozone ports in the Mediterranean where its vessels call in (Valencia, Marseille, Genoa, Civitavecchia, Barcelona, Palma, Palermo, Venice, Bari, and so on) to be used as embarkation ports, but virtually none of those that are outside.

Airport traffic is taken from the Spanish Airport Authority, *AENA* (see http://www.aena-aeropuertos.es).

2.3. Port authority features

2.3.1. Depth of berth and channels

The third group includes variables specific to the Port Authorities. Firstly, there is a dummy variable for ports with a draught of over 12 m. It needs to be restated here that, as has been analyzed in preceding sections, one of the main features of the cruise ship market is the exponential growth of average vessel size, requiring ports to have an ever greater minimum draught to be able to accommodate these great ships. The largest cruise ships have a draught of around 8.5 m, although some, like those of the Royal Caribbean Oasis class, even exceed 9 m (see Weaver, 2005a, 2005b on the growth in size of cruise ships and their berths). They do require a safety margin, however and according to what the Spanish State Ports Organization has advised us, this seems to have been set at a minimum 12 m for the vessels operating in Europe during the time period under analysis. Thus, we expect a positive relationship between this variable and the likelihood of having cruise traffic given the preference of the operators in the sector for operating with super-sized vessels.

2.3.2. Charges

Secondly, the passenger charges levied by each of the Port Authorities are included as a specific Port Authority variable. A negative relationship is expected between traffic and price. This relationship would be even stronger in this case given the trend among cruise companies to compete more and more on price (see Gui and Russo, 2011; Sun et al., 2011) as port dues are a major part of the end price that a cruise passenger has to pay.

This variable has been constructed as the quotient between per-passenger revenue and the total number of passengers that use the port. As such, charges for cruise passengers and ferry passengers are both included. This must be borne in mind when interpreting the result of the variable as it has not been possible to take into account the amount that is specifically charged for cruise traffic each year at each of the Port Authorities. Another limitation of data available to construct this variable is that we must focus on passenger charges levied by each of the port authorities because we do not have information about the charges levied by terminal operators to shipping companies. Passenger charges are paid by the passengers, who do not have the power to decide the port of call of a cruise ship, while the berthing fee and the other disbursements paid by the cruise ship-owners to terminal operators may have a stronger influence on the willingness of ship-owners to take their ships into a port.

It should be noted that according to the law that was valid during the period under consideration each of the Port Authorities used to set the charges for the fares individually. The new law that came into force in 2010 (see Castillo-Manzano and Asencio-Flores, 2012, and Castillo-Manzano and Fageda, forthcoming on changes to port system legislation and its effect on charges) means that charges are subject to a fixed amount for all Spanish ports. Additional amounts can be added to this set charge depending on the volume of traffic that the corresponding operator achieves in the port, in such a way that there will be a margin that enables Port Authorities to compete pricewise to attract greater cruise traffic. The data for both port charges and draughts have been taken from the Spanish State Port Organization's Year Books for the period under study.

For our analysis we use data on the 28 Port Authorities that comprised the Spanish port system during the 2002–2010 period. Although the Spanish port system currently comprises 29 Port Authorities, until 2004 the ports of Almería and Motril were considered to be a single Port Authority and their figures have been aggregated up to 2005. For this reason our analysis will consider them as a single Port Authority.

The two set of equations estimated for each of the Port Authorities (a) for the province (p) in year (t) are as follows:

$$D^{CRUISETRAFFIC>0} = \alpha + \beta_1 \text{ Number Hotels Per Capita}_{pt} + \beta_2 \text{ Population}_{pt} + \beta_3 \text{ Non-containerized General Traffic}_{at} + \beta_4 \text{ Container Traffic}_{at} + \beta_5 \text{ Ferry Passengers}_{at} + \beta_6 \text{ Airport Traffic}_{pt} + \beta_7 \text{ Depth of Berth and Channels}_{at} + \varepsilon \quad (1)$$

$$\text{Cruises traffic}_{at} = \alpha' + \beta'_1 \text{ Number Hotels Per Capita}_{pt} + \beta'_2 \text{ Population}_{pt} + \beta'_3 D_p^{\text{island}} + \beta'_4 \text{ Non-containerized General Traffic}_{at} + \beta'_5 \text{ Container Traffic}_{at} + \beta'_6 \text{ Ferry Passengers}_{at} + \beta'_7 \text{ Airport Traffic}_{pt} + \beta'_8 \text{ Charges}_{at} + \varepsilon \quad (2)$$

Our approach requires that the first equation has at least one explanatory variable in addition to those used in the second set of equations. In our context, the depth of berth and channels may determine the ability of a port to receive cruise traffic. However, it is also true that although cruise ships are typically large compared to cargo ships of similar GRT (gross registered tons), most cruise ships have a shallow draught. Therefore, once a port has a minimum depth of berth and channels, this should not have a major impact on the amount of cruise traffic that the port is able to generate, at least not in the Mediterranean in the period under study, 2002–2010, when the vessels that were operating were significantly smaller than those operating in the Caribbean. This trend has changed during this decade. There was a clear turning point with the arrival in 2011 of the NCL Epic in the Mediterranean, which since then has plied the area during the spring–summer season.

Note also that two variables are included in the second set of equations (D^{island}, *Charges*) but not in the first equation. The dummy variable for islands predicts success and failure perfectly in the first equation and so is automatically deleted by the econometric software when included in the regression. As will be explained below, the charges variable is only pertinent for inclusion when the sample focuses on ports with cruise traffic because it is constructed with revenues that ports obtain from passenger traffic. This variable will take a value of zero in ports with no passenger traffic.

Table 1 shows the descriptive statistics of the variables used in the empirical analysis. All variables show sufficient variability for their effects to be robustly captured in the empirical analysis. Table 2 shows the variance decomposition of the variables used in the empirical analysis in two orthogonal components: the within-component and the between-component. The within component indicates the variation of the variable over time, while the between component indicates the variation of the variable between provinces. Overall, the between variation is much higher for those variables related to port and airport traffic and population. Obviously, the dummy variables do not have within variation because they are time-invariant.

Table 1
Descriptive statistics of variables used in the empirical analysis ($N = 249$).

Variable	Mean	Standard deviation	Minimum value	Maximum value
Cruise passengers	169,957	376,193	0	2,344,925
Cruise ships	118.86	200.92	0	889
Number Hotels Per Capita	0.00035	0.00017	0.000071	0.00085
Population	1,132,399	900,048	65,488	5,352,034
D^{island}	0.11	0.30	0	1
Non-containerized General Traffic	1,833,593	2,078,655	122,607	9,777,619
Container Traffic	3,927,905	8,888,357	0	4.90e+07
Ferry Passengers	651,232.7	1,298,651	0	5,224,923
Airport Traffic	4,813,954	7,692,284	0	3.29e+07
Charges	0.0022	0.0030	0	0.034
Depth of Berth and Channels	0.85	0.35	0	1

Table 2
Variance decomposition of variables ($N = 249$).

Variable	Between variation	Within variation
Cruise Passengers	356,167	127,083
Cruise Ships	200.25	27.44
Number Hotels Per Capita	0.00017	0.000021
Population	911,753	76,630
D^{island}	0.31	0
Non-containerized General Traffic	2,033,203	567,051
Container Traffic	8,574,898	2,805,188
Ferry Passengers	1,294,329	254,661
Airport Traffic	7,738,585	1,111,850
Charges	0.0021	0.0026
Depth of Berth and Channels	0.35	0

Table 3
Correlation matrix of variables used in the empirical analysis ($N = 249$).

Variables	Cruise pass.	Cruise ships	Hotels	Pop.	Depth	Non-cont.	Container	Ferry	Airport	Charges	D^{island}
Cruise Pass.	1										
Cruise Ships	0.94	1									
Hotels	−0.007	−0.03	1								
Population	0.66	0.61	−0.25	1							
Depth	0.17	0.19	0.16	−0.01	1						
Non-contain.	0.74	0.75	−0.12	0.61	0.25	1					
Container	0.26	0.25	−0.30	0.49	0.17	0.66	1				
Ferry Pass.	0.28	0.33	0.01	−0.08	−0.07	0.42	0.40	1			
Airport	0.90	0.94	0.006	0.58	0.17	0.71	0.24	0.32	1		
Charges	−0.03	−0.02	−0.17	0.11	−0.24	−0.005	0.05	0.006	−0.02	1	
D^{island}	0.48	0.61	0.10	−0.6	0.15	0.42	0.04	0.53	0.67	−0.10	1

Table 3 shows the correlation matrix of the variables used in the empirical analysis. From this table it can be inferred that two variables may distort the results of the estimation. These variables are the general (non-containerized) traffic at the port and the total traffic at airports in the province. Both variables show a very high correlation with the dependent variable, which could cause an endogeneity bias due to their simultaneous determination. In addition, both variables show a high correlation with several explanatory variables, which could cause a multicollinearity problem that influences the individual identification of the effect of other variables. However, it is clear that there may be a causal relationship between these two variables and cruise traffic. This is particularly evident in the case of airport traffic in the province. Therefore, we present the results of the regressions with two complementary specifications. In the first, we include all explanatory variables. The second excludes the non-containerized general goods traffic at the port and airport traffic in the province variables.

3. Estimation and results

The data used in the empirical analysis are panel data by nature. However, the list is short both in terms of years and the number of Port Authorities. Also, there is high variability from one Port Authority to another, whereas the variability over the time period is much lower. The use of a fixed-effects model is therefore not recommended as it is a technique that exploits variability over time and, in our case, this is low. In fact, no variable is statistically significant in an estimation using a fixed-effects model and the arithmetical sign is opposite to what was anticipated in the majority of cases. An estimation with a random-effects model is also unadvisable as the Hausman Test suggests that there might be a correlation between the random effects and the error term, which means that the consistency of the random effects estimator cannot be guaranteed. Thus, we perform the estimations with pooled data. In the first equation we use a logit model while in the second equation we use ordinary least squares. In both equations, we include year specific effects (see Arellano, 2004, for a detailed analysis of the different techniques available with panel data).

At the same time, the Wooldridge autocorrelation test for panel data does not rule out the null hypothesis of the existence of autocorrelation (applying the test proposed by Wooldridge, 2002). Hence, we take into account the issue of autocorrelation in both equations. In the first equation the standard errors are clustered by time while the second set of equations uses the Prais-Winsten regression in which the error term follows an AR-1 process (see Greene, 2012 for an analysis of the main elements that should be taken into account in this estimation technique).

Finally, it was possible to determine traffic and price variables simultaneously because prices may affect demand but demand may also affect prices. This may impose an endogeneity bias in the estimation. Hence, we apply an instrumental variables procedure to address the potential endogeneity bias. We use lags of the price variable so that data for the price variable refers to previous years. The availability of information enables us to use the price variable with two lags. It cannot therefore be predicted that the prices for period $t - 2$ will be determined by traffic in period t.

It should be remembered that the first equation includes all port authorities while the second equation only uses the subsample of ports with positive cruise traffic. The overall sample is made up of 249 observations if we work with all the ports, i.e., in the analysis of the determinants that justify that a port can attract cruise traffic. However, the number of observations falls to 121 observations when we look at the Port Authorities with any cruise traffic other than zero in the period under consideration to analyze the determinants of the way that cruise traffic has evolved. In this regard, the estimation that focuses on the amount of cruise traffic includes the price variable. We use two lags of the price variable to address the possible endogeneity bias, which implies that we lose observations for two years.

Table 4 shows the results of the estimation of Eq. (1). Data in this table indicate the coefficients and standard errors for each of the explanatory variables, and it also shows the predicted change in the likelihood for an outcome to take place (i.e., the port has cruise traffic) as each independent variable changes from its minimum to maximum value while all other independent variables are held constant at their mean values.

Tables 5 and 6 show the results of the estimation of Eq. (2) with the two different dependent variables that capture the amount of cruise traffic at the port; number of cruise passengers and number of cruise ships. While Table 5 indicates the coefficients and standard errors for each of the explanatory variables, Table 6 shows the elasticities derived from these coefficients evaluated at the sample mean.

Table 4
Results of estimates of the logit equation.

Explanatory variables	Dependent variable: $D^{CRUISES\ TRAFFIC>0}$					
	Logit with all variables (1)			Logit excluding some variables (2)		
	Coefficients		Change in the predicted likelihoods (%)	Coefficients		Change in the predicted likelihoods (%)
Number Hotels Per Capita	−5,155.98***	(514.55)	−9.38	−5,100.20***	(496.30)	−71.94
Population	1.81e−06***	(1.05e−07)	5.56	4.04e−06***	(1.63e−07)	95.88
General Traffic	7.96e−07***	(1.01e−07)	3.31	–		–
Container Traffic	−2.54e−07***	(1.78e−08)	−99.5	−1.69e−07***	(1.00e−08)	−87.62
Ferry Passengers	6.31e−07***	(7.77e−08)	1.17	7.04e−07***	(5.33e−08)	29.92
Airport Traffic	9.95e−07***	(9.47e−08)	55.29	–		–
Depth of Berth and Channels	1.74***	(0.17)	2.8	2.21**	(0.09)	48.44
Intercept	−2.90***	(0.11)	–	−3.38***	(0.09)	–
Time dummies	Yes		–	Yes		–
R^2	0.41		–	0.28		–
N	249		–	249		–

Note 1: Standard errors in brackets (robust to heteroscedasticity and autocorrelation).
* Statistical significance at 10%.
** Statistical significance at 5%.
*** Statistical significance at 1%.

Table 5
Results of estimates of the traffic equation (coefficients and standard errors).

Explanatory variables	Dependent variable: cruise passengers				Dependent variable: cruise ships			
	OLS with all variables (1)		OLS with all variables (2		OLS with all variables (3)		OLS excluding some variables (4)	
Number Hotels Per Capita	2.58e+08**	(1.05e+08)	5.68e+08**	(1.05e+08)	140,075.3**	(28,977.62)	291,481.7***	(48,345.69)
Population	0.19***	(0.07)	0.40***	(0.07)	0.00007***	(0.000012)	0.00016***	(0.000017)
D^{island}	−48321.57	(170000.3)	430606.1***	(159305)	93.93**	(49.54)	306.06***	(61.94)
General Traffic	0.04**	(0.01)	–		0.000011**	(5.34e−06)	–	
Container Traffic	−0.007**	(0.003)	−0.004	(0.004)	−1.52e−06	(1.13e−06)	−3.78e−07	(1.32e−06)
Ferry Passengers	0.08**	(0.03)	0.10**	(0.05)	0.000022***	(7.81e−06)	0.000034***	(0.000011)
Airport Traffic	0.024***	(0.008)	–		0.000012***	(1.57e−06)	–	
Charges per Passenger	-1,657,205	(2,065,561)	-1,309,471	(1,924,144)	-1,363.67	(1,090.81)	-1,059.80	(1,142.68)
Intercept	−242832.4**	(125856.6)	−470315.9***	(205511.9)	−92.03***	(20.90)	−200.69***	(39.36)
Time dummies	Yes		Yes		Yes		Yes	
R^2	0.77		0.62		0.86		0.77	
N	121		121		121		121	

Note 1: Standard errors in brackets (robust to heteroscedasticity and autocorrelation).
* Statistical significance at 10%.
** Statistical significance at 5%.
*** Statistical significance at 1%.

The estimation has been performed using Stata software. The change in predicted likelihoods has been obtained using the prchange command, while elasticities have been obtained using the mfx command. The change in the predicted likelihoods and elasticities provide evidence about the magnitude of the impact that each explanatory variable has on the dependent variable.

The R2 of the estimations is generally high. This is particularly true in the regressions for the second set of equations, while in the regressions for the first equation the R2 is not high when we do not include all explanatory variables. Thus, the explanatory power of the model can be considered generally good. All variables have the expected arithmetical sign except the number of hotels per capita variable in the first equation, and the islands variable in the second equation when we consider all variables and the dependent variable is cruise passengers. The high correlation between traffic at airports in the province and general goods traffic and the islands dummy could explain why the arithmetical sign that had been expected was not obtained in the regression with all the variables that use the number of cruise passengers as dependent variable.

Concerning the second set of equations, differences in results for the two dependent variables that we use to capture the amount of cruise traffic (passengers and ships) will be related to the size of the ships and the load factors with carriers operating in the market. Hence, we could expect results substantially different only in case of a high variability in the size of the ships and load factors.

In this regard, results reported in Tables 5 and 6 are quite similar regardless we use the number of cruise passengers or the number of cruise ships as dependent variable. In fact, they are qualitatively identical when we exclude the non-containerized general traffic and airport traffic as explanatory variables. We only find different results for two variables in the regressions that use all explanatory variables. First, the variable for container traffic is negative and statistically significant

Table 6
Results of estimates of the traffic equation (elasticities).

Explanatory variables	Dependent variable: cruises passengers Elasticities evaluated at sample means		Dependent variable: cruises ships Elasticities evaluated at sample means	
	OLS with all variables (3)	OLS with all variables (3)	OLS with all variables (3)	OLS excluding some variables (4)
Number Hotels Per Capita	0.28**	0.63***	0.25***	0.50***
Population	0.93***	1.89***	0.56***	1.22***
D^{island}	−0.16	0.25***	0.50**	1.62***
General Traffic	0.33**	–	0.15**	–
Container Traffic	−0.14**	−0.06	−0.04	−0.01
Ferry Passengers	0.18**	0.24**	0.08***	0.13***
Airport Traffic	0.65***	–	0.51***	–
Charges per Passenger	−0.014	−0.011	−0.019	−0.015

* Statistical significance at 10%.
** Statistical significance at 5%.
*** Statistical significance at 1%.

when we use cruise passengers as dependent variable, while it is negative but not statistically significant when we use the number of cruise ships as dependent variable. Second, the dummy variable for islands is negative but not statistically significant in the regression that use the number of cruise passengers as dependent variable, while it is positive and statistically significant in the regression that use cruise ships as dependent variable.

On the basis of the results of the empirical analysis, an area's general tourist appeal can be stated to have a significant effect on cruise traffic. Thus the coefficient for the population variable is positive and statistically significant in all the regressions. The coefficient linked to the number of hotels per capita variable is also positive and statistically significant in the regressions that refer to the volume of cruise traffic (either passengers or ships). Finally, the coefficient for the islands dummy variable is positive and statistically significant in most of the regressions for the volume of cruise traffic. The latter result is particularly clear when we use the number of cruise ships as dependent variable.

Strong complementarity can also be seen between cruise traffic and traffic at the airports in the province. The coefficient linked to this variable is positive and statistically significant. Additionally, strong complementarity can also be seen between cruise traffic and other types of traffic at the port: non-containerized general goods traffic and regular ferry passenger traffic. However, to the contrary, container traffic has a negative effect on cruise traffic although this latter result is less clear when we consider the number of cruise ships as dependent variable.

With respect to the Port Authority-specific variables, the coefficient for prices is negative but not statistically significant. However, we must be cautious when interpreting the results of the price variable due to the limitations of the data available. In fact, if we look at the results without correcting for autocorrelation, the price variable is statistically significant at 1%. Regarding other variables, such as population or general non-containerized traffic in the first equation with all variables, and number of hotels per capita and ferry passengers in the second set of equations with all variables, the change in the statistical significance is modest when we make the estimation without correcting for autocorrelation (namely from 5% to 1% or conversely).

Finally, the likelihood of having cruise vessels seems to be linked to ports having a minimum 12 m draught.

The positive change in the predicted likelihood in the first equation is high for the airport traffic variable, while these likelihoods (positive or negative) increase substantially for the remaining variables when we exclude airport and non-containerized general traffic. Thus, it seems that these two variables could be distorting the individual effect of the other variables. Variables for population, regular ferry passenger traffic and depth of berth and channels have a strong positive impact on the likelihood of having cruise traffic, while containers and hotels per capita have a strong negative impact. This negative impact is surprising for the hotels per capita variable.

Concerning the elasticities obtained in the regressions for the second set of equations, these are particularly high for the population and airport traffic variables when we consider all variables, while the elasticities for the number of hotels per capita also increase in the regression that excludes airport and general port traffic. For all these mentioned variables, elasticities are always positive. The impact of container traffic and prices on cruise traffic is negative but the estimated elasticities for prices are low and not statistically significant. Note that the estimated impact of the variable for islands is quite different dependent on the dependent variable used (passengers or ships). Overall, we may expect that the real effect of the dummy variable for islands is positive.

4. Conclusions

The way that cruise traffic has developed has turned it into one of the niche markets that has most grown in the international tourism sector as the product has spread throughout the world. The contribution that this paper makes to the literature is to provide the first empirical analysis of the determinants of cruise traffic, controlling for several explanatory factors. In order to do this we focus on a relevant case, the Spanish port system, which includes Barcelona as the largest cruise European port.

The results of our study are readily transferable to other cases that have similar characteristics to Spain, such as the rest of the Mediterranean port systems. It should be recalled here that Mediterranean ports are currently the Second World Market in cruise traffic after the Caribbean. At the same time, we would like to state that our study adds to the few analyses that have been done on cases outside the Caribbean.

Using a robust methodological focus we obtain a series of necessary conditions that influence both the viability that a port will be able to attract some cruise vessel, and the evolution of this traffic at the ports where it is found.

Overall, the likelihood of having cruise traffic seems to be linked to ports located in populous areas and close to large airports, and to ports not specialized in container traffic but sharing facilities with regular ferry passenger traffic and having a minimum depth of berth and channels. The amount of cruise traffic that ports are able to generate is also related to the population and availability of air connections in the areas where they are located, and to the tourist appeal of the area (as the hotels and being located on an island variables show) and the facilities shared with other types of port traffic (namely roll-on roll-off and ferry passengers).

In this way we can see that the large cities that can provide services and attractions to efficiently manage the simultaneous arrival of thousands of tourists (from a large number of air connections to numerous taxis and buses to facilitate embarkation and disembarkation, without forgetting the swift supply required to satisfy all the vessel's needs for goods and services) are those that are destined to take a leading role as far as this type of traffic is concerned. The importance that the findings give to air transport should be emphasized in this respect. The spread of the low cost carriers throughout Europe in general, and across the Mediterranean and, more specifically, in Spain in particular (see Castillo-Manzano et al., 2012) with a great increase in the number of connections at regional and secondary airports (see Francis et al., 2004, on the hundreds of airports that had been underused in Europe before the LCCs) has boosted the potential of Mediterranean ports for cruise traffic many times over.

Apart from the size and population of a city, the findings clearly show that it is also important that it should be attractive for tourists and, more particularly, that islands seem to possess a certain mystique for this type of tourism. The empirical claim that "Island fever" exists among cruise passengers is a major strength of the many islands that are dotted around both the western and the eastern Mediterranean.

Many conclusions are also drawn that are of use for the strategy that Port Authorities must follow to attract new cruise vessels. Firstly, it is quite striking that the demand that we are dealing with is not very elastic, at least as far as the differences in charges that existed between Spanish ports during the study period are concerned. And yet we see that any incompatibility with a port's normal activities seems to be limited to container traffic, whereas – as was anticipated – certain synergies clearly seem to exist with passenger transport by ferry and roll-on/roll-off traffic. Apart from this, any strategy followed by a Port Authority must include the port having a deep enough draught. This is an aspect that we feel certain is currently even more important given the increasing size of the vessels that have operated in the Mediterranean in recent years.

To sum up, the hope and desire may be there, as the growing number of Port Authorities that each year flock to beat their drums at Seatrade or Medtrade illustrates, but not all ports have the potential to receive this traffic, and much less the potential to develop it in depth. Additionally, a "Lone Ranger" strategy of the type usually rolled out by the Spanish Port Authorities at Seatrade does not seem to be the optimal approach.

Cruise traffic is a complex tourism product and its management is equally complex. Cruise traffic management is complicated as we not only found evidence of signs of conflict with container traffic, but also synergies with ferries and ro–ro traffic. Indeed, cruise traffic alone does not allow the profitable infrastructure to be constructed that shipping firms need. However, cruise traffic may not be compatible with the traffic of reference at many ports, which is container traffic.

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