OPORTO'S TOURISM SEASONALITY IN THE CONTEXT OF INCREASED PRESENCE OF LOW-COST AIRLINES

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Biographical introduction

Born in 1993, the author of this study has lived almost all his life in Oporto. His studies started with a 3-year bachelor course in Economics, between the academic years of 2011/2012 and 2014/2015, and are now ending, for the time being at least, with this dissertation, the last requirement for his master in Management program.

When deciding on the dissertation's theme, many factors contributed: the will of taking advantage of the learnings from both the bachelor and master courses, namely of the statistical and econometrician background provided by the bachelor; the preference to deal with quantitative data instead of qualitative; the perceived easiness of collecting the data; among others. But the main motivation for this particular theme was the visible changes that Oporto has gone through during the author's lifetime, since he is very passionate about travelling, mobility of people nation- and world-wide, city dynamics and planning, cultural exchange, and related subjects. When launching this research, the author's intuition was that the introduction of low-cost airlines in the city's airline market in late 2004 served as a key driver of those changes, which explains the approach taken in the dissertation.

Having had a short professional experience in a consultancy firm in corporate finance, the author is now integrating the tech industry in a software house, in a functional analysis function that involves requirement analysis, Ux, Cx, business analysis and design thinking.

Abstract

EN The growth of tourism in cities has been huge, which may explain the relatively recent increase of attention by researchers, political actors and economic agents to this phenomenon. The same phenomenon is visible in Oporto, and this study contributes to its understanding in this local scale by focusing on one dimension: the behavior of tourism' seasonal character in the context of the introduction of low-cost carriers in Oporto's airline market. This linkage between the evolution of seasonality and air transportation is, to the authors' knowledge, a novelty. The study also contributes with a new perspective on the subject's literature, based on the approaches taken by researchers and not on their chosen methodology, although a full description of the methodologies employed is also made. Concerning methodology, the study adapted a tested framework to the case at hand, and includes grounded techniques not yet found in the literature. Among other results, it was found that seasonality accounts, on average between 2000 and 2014, for 77% of foreign (non-resident in Portugal) guests' total variability between actual inflow and trend, and 50% of domestic guests' total variability. In the same period, only slight changes can be identified in foreign guests' seasonal character: some in pattern, a slight decrease in amplitude and increase in intensity. Among domestic guests, however, seasonality has changed more severely, particularly in pattern but also in decreasing amplitude and increasing intensity. No dispersion of volume of guests from the peak season to the off-peak can be identified for both guest types. Also, no relationship can be established between the increasing presence of low-cost airlines in Oporto and these changes in seasonality.

Key-words: low-cost airlines, urban tourism, seasonality, case-study, Oporto

JEL codes: L83, R11, R41

PT O crescimento do turismo urbano tem sido enorme, o que poderá explicar o recente aumento de atenção prestada por investigadores e agentes políticos e económicos para este fenómeno. Este fenómeno é visível no Porto, contribuindo o presente estudo para o entendimento do mesmo numa escala local, focando numa dimensão: o comportamento do carácter sazonal do turismo no contexto da introdução de companhias aéreas *low-cost* no mercado aéreo do Porto. Esta ligação entre sazonalidade e transporte aéreo é, ao conhecimento dos autores, uma novidade. O estudo também contribui com uma nova perspetiva sobre a literatura, baseada na abordagem tomada pelos investigadores e não nas suas metodologias, apesar de também incluir uma descrição completa destas. Relativamente à metodologia, este estudo adaptou ao caso em mão uma *framework* testada e inclui técnicas fundamentadas ainda não encontradas na literatura. Entre outros resultados, descobriu-se que, em média entre 2000 e 2014, 77% de toda a variabilidade entre o fluxo de entrada de hóspedes estrangeiros (hóspedes não residentes em Portugal) e a respetiva tendência é atribuída a sazonalidade, e 50% para hóspedes domésticos. No mesmo período, apenas podem ser identificadas alterações ligeiras no carácter sazonal de hóspedes estrangeiros, algumas no padrão, uma diminuição ligeira na amplitude e aumento na intensidade de sazonalidade. Por outro lado, entre hóspedes domésticos, o carácter sazonal alterou-se mais notavelmente, particularmente em padrão, mas também em diminuição de amplitude e aumento de intensidade. Nenhuma dispersão de volume de hóspedes da época alta para o restante do ano pode ser identificada em ambos os tipos de hóspedes. Ainda, nenhuma relação pode ser estabelecida entre a crescente presença de companhias aéreas *low-cost* no Porto e estas alterações na sazonalidade.

Palavras-chave: companhias aéreas *low-cost*, turismo urbano, sazonalidade, estudo de caso, Porto

Códigos JEL: L83, R11, R41

Table of contents

Table of figures

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1. Introduction

1.1. Introduction to the tourism seasonality phenomena

Since the 80s/90s, researchers and policy-makers have been drawing increased attention to the subject of tourism in cities, which may be explained by the steep growth of this kind of tourism in the past few decades (Edwards, Griffin, *et al.*, 2008; Pearce, 2001). Given the large volume of research conducted since 2001, we argue that this attention has not diminished since then. Furthermore, the stance on the subject has been increasingly proactive, in the sense that tourism is more and more seen as a strategic sector for the development of cities, as well as reactive, arising from the problems of coping with increased visitation (Pearce, 2001). Among these problems, tourism seasonality is regarded as one of the most protracted facing managers in the tourism sector (Coshall, Charlesworth, *et al.*, 2015). It constitutes a temporal imbalance caused by climactic and socio-structural cycles of both destinations and markets (Fernandéz-Morales, Cisneros-Martínez, *et al.*, 2016), that has implications that can greatly shape the local society and way of life (Andriotis, 2005).

Research on tourism seasonality is particularly developed around 5 general topics, as defined by Koenig and Bischoff (2005): its definition, causes and impacts, policy-related issues, studies into consumer behavior and approaches to measuring seasonality. The effort of modelling and forecasting tourist flows, including their seasonal fluctuations, also accounts for a significant portion of the literature, but this line of research can be regarded as distinctive because of its particularly advanced technical nature. These topics are often addressed in a local or regional scale through case-study approaches, which are of relevance not only to the literature, but also to the interested agents in the destination covered by the study, since a clearer understanding of the concentrations of demands can lead to their more effective year-round management. This management is made by individual enterprises and business analysts, who make efforts to estimate the seasonal swings (Kuznets, 1933), by policy-makers who design and implement policies directed toward lessening the burden of these swings (also Kuznets, 1933), and made by marketeers who look for profit enhancement and loss minimization opportunities (Yan & Wall, 2003). All these interests are best served when the case-study is built from sufficiently disaggregated data, allowing deeper insights on markets, causes of seasonality, among other subjects.

1.2. Purpose and contributions of this research

Oporto is also enjoying a strong growth in international and domestic tourism, with all its implications: a change in policy-makers' prioritization and stance towards tourism and city branding, creation of new and adaptation of old businesses to this growing market, increased locals' awareness and researchers' interest on the phenomenon... These visible changes constitute the main motivation for the present study, since the authors feel that a clear understanding of the phenomenon is necessary for interested agents (policy-makers, entrepreneurs, workers, students…) to support their decisions. Moreover, we find that the literature on tourism seasonality as a whole is still far from reaching its full potential, reason why we are also motivated to contribute with this local study.

Naturally, due to the complexity of urban tourism research (see Ashworth & Page, 2011; Edwards, Griffin, *et al.*, 2008; Pearce, 2001), only a small contribution is possible with the authors' resources. Acknowledging this fact, we define the purpose of the present work as follows: to analyze the behavior of tourism' seasonal character in the context of the introduction of low-cost carriers (LCCs) in Oporto's airline market, practically in 2005. Our initial thesis is that this seasonal character has changed, possibly due to the impact of the presence of LCCs. This research purpose has both scientific and socio-economic interest. Scientific because the work attempts to establish the possible links between two areas of interest – the introduction of the LCC as a new business model in the airline market and seasonality in tourism – which to our knowledge was never attempted in such manner, even though the airline market has been identified in the literature as a major cause for tourism seasonality (for instance, in the case of Crete, Greece, studied by Andriotis, 2005). Socio-economic because the work leads to a clearer understanding of tourism seasonality in Oporto, and thus ultimately to its more effective year-round management by the interested parties, contributing to the lessening of the burdens caused by it.

The work achieves its goal by first offering a literature review that briefly covers many related areas, but deepens on the most relevant issues, namely the approaches taken and methodologies used to describe seasonality. In this regard, the review of the approaches constitutes a particularly important contribution since such review was, in our view, lacking and constitutes a great tool for structuring further research on the subject. Afterwards, the work includes a complete description of the seasonal character present in Oporto's tourism industry, and its evolution in 15 years. Such a description, or even the data required to build it, was not found publicly available, and constitutes a requirement for much of the applied work in the subject of tourism seasonality (Koenig & Bischoff, 2005). The description includes the use of various metrics applied to the original data; the application of a time series decomposition procedure in order to isolate, quantify and describe the different components, namely the trend, cycle, seasonal factors and irregular component; and finally, the use of other metrics and techniques, now applied to the seasonal factors. Some of these techniques can be found in the literature, but others not even though they are technically grounded.

Among the results obtained, the study finds that seasonality accounted, on average between 2000 and 2014, for 77% of foreign (non-resident in Portugal) guests' total variability between actual inflow and trend, and 50% of domestic guests' total variability. In the same period, only slight changes can be identified in foreign guests' seasonal character: some in pattern, a slight decrease in amplitude and increase in intensity. Among domestic guests, however, seasonality changed more severely, particularly in pattern but also in decreasing amplitude and increasing intensity. No dispersion of volume of guests from the peak season to the off-peak can be identified for both guest categories. The seasonal pattern of their arriving passengers was compared to that of arriving passengers carried by full-service carriers (FSCs). From this exercise, we learn that the seasonal character of LCCs changed drastically with the increase in volume of passengers carried, in such a way that it became increasingly similar to that of FSCs. Nevertheless, differences can still be observed, namely in seasonal pattern and in a lower seasonal amplitude and intensity, although they are not in conformity with the changes identified either in foreign and domestic guests' seasonal character. In face of these results, we find that no relationship can be established between the increasing presence of LCCs and seasonality in tourism activity.

After the next subsection (1.3), which presents a brief presentation of Oporto in order to contextualize the empirical study, this dissertation is structured as follows. Section 2 reviews the literature on several related subjects, starting with generalities on the relationship between urban tourism and air transportation (subsection 2.1) and on tourism seasonality (2.2). Afterwards, the discussion on seasonality in tourism is narrowed to the topics of its definition, causes and impacts (2.3), which brings awareness to the socio-economic importance of the issue at hand in this dissertation. From these three subsections, a starting point is built so that every reader can share the same evidences about the subjects that this dissertation includes. Subsections 2.4 and 2.5 are of particular relevance in order to understand the different approaches and methodologies used by researchers to measure and describe seasonality. For each approach, a set of metrics and techniques are preferred, so these two subsections shed light on how each approach should be pursued, useful for the analysis of any research piece and to guide future research. Our decisions concerning data and methodology, based on the findings in these subsections, are explained in detail in section 3. The empirical study is developed in section 0, in steps: subsection 4.1 and 4.2 show the quantitative analysis and description of the yearly evolution of Oporto's air transportation and accommodations' business respectively; in subsection 4.3, the series selected to be the basis of the study on the seasonal character in accommodations' businesses are decomposed in order to quantify and analyze each component separately, namely the seasonal factors; these seasonal factors support the detailed analysis made in subsection 4.4 of each facet of seasonality – pattern, amplitude and intensity – which takes the whole period into consideration; finally, subsection 4.5 takes this analysis and attempts to relate it with the increase of presence of LCCs in Oporto's airline market. Section 5 concludes the study with a synthesis of the whole work and a discussion of the study's limitations. .

1.3. Brief presentation of Oporto

In research, tourism is often segmented in (1) pure "sea and sun", (2) pure cultural or (3) a combination of both (see, for instance, Cuccia & Rizzo, 2011). Asserting which segment of tourism a destination most attracts is relevant since cultural tourism, commonly associated with urban centers with more diversified offerings, are less afflicted with seasonality (Corluka; Cuccia & Rizzo, 2011). However, to characterize a city as a cultural destination, one needs to take into account tourists' initial motivation to travel, rather than whether cultural resources are visited or not, since this exposure to cultural aspects may only constitute a secondary or incidental motivation (Hughes, 1996). Nevertheless, this should only apply to destinations where cultural and "sea and sun" elements are both similarly on offer. Concerning Oporto as a touristic destination, although no information on tourists' initial motivation to travel is analyzed in this study, we expect that the city most attracts the pure cultural segment due to the high disproportion between the city's abundant cultural character comparing with its limited "sea and sun" offering, disproportion most likely known by tourists. Moreover, the city's branding and marketing campaigns to attract visitors are focused on its cultural elements. The behavior of incoming travelers (described in subsections 4.3 and 4.4) also indicates that Oporto is regarded has an urban destination, because there are relevant inflows of travelers all-year round and stays in the city are very short-term (not reaching 2 nights on average).

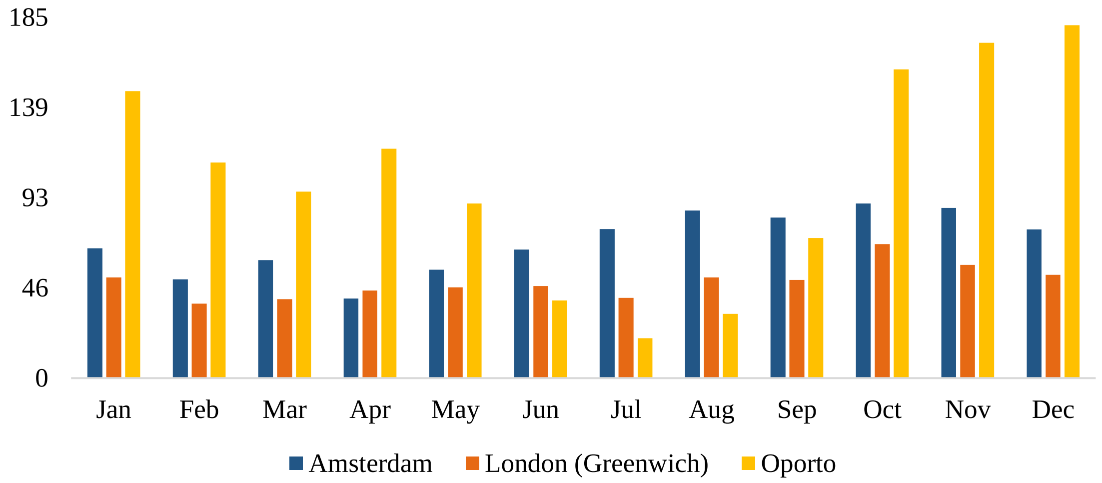
Francisco Sá Carneiro Airport (FSCA), located 11km from Oporto, is the only airport in Portugal's northern region, rendering it a crucial infrastructure for the region's accessibility and connectivity, specially taking into consideration Portugal's position in the EU's periphery (Esteves, 2014). Of all competing airports, including the national ones and those located in the Spanish region of Galicia, FSCA has the largest catchment area (Esteves, 2014), currently of 1,4M, 2,9M and 3,9M people for time distances of 30, 60 and 90 minutes, respectively (ANA, 2015a). This catchment area can still be increased by 4.4M if the total emigration flow of the region under FSCA's influence is considered (ANA, 2015b). This substantial emigration flow may explain why "Visiting Friends and Relatives" (VFR) is the largest motivation for travelling among full-service carriers' (FSCs) passengers and second largest among LCCs' passengers (Table 1). FSCA now satisfies many requirements that are documented in the literature to be determinant in LCCs' choice of airports (Carballo-Cruz & Costa, 2014), which may justify Ryanair's decision to open an operational base there in 2009.

Oporto suffers from severe climate changes from winter to summer, especially when it comes to rainfall. Graph 1 compares the seasonal pattern of rainfall in Oporto with that of Amsterdam and London, cities commonly perceived to suffer from heavy rain. Not only is it visible that, considering the year as a whole, the amount of rainfall is much higher in Oporto than in the other two cities (by 47.6% to Amsterdam and 108.9% to London), the seasonal pattern is also much more intense. Similar conclusions may be drawn when analyzing the average number of days with precipitation. For this reason, the city is likely to experience a pronounced influence of natural seasonality on their tourism businesses. But such exposure to seasonality is only fulfilled if tourists have this perception of Oporto. It is possible that, because Oporto is located in Southern Europe, uninformed tourists associate it with the stereotype of "good weather", limiting in this way the impact of climate in tourism seasonality. Nevertheless, such considerations are not supported by any research or reference made by the authors of this study, so the impact of these causes is still unknown and unquantified.

Table 1 - Motivation for travelling among passengers in FSCA
Source: ANA (2015b)

	Motivation for travelling			
%, 2015	VFR	Leisure	Business	Other
LCCs	41,5	42,0	14,3	2,2
FCCs	45,2	35,7	16,6	2,5

Graph 1 – Monthly average precipitation in millimeters, 1981-2010
Note: "precipitation" here means any product of the condensation of atmospheric water vapor that falls under gravity, including drizzle, rain, sleet, snow, graupel and hail; source: Wikipedia, which refers to each geography's meteorological institute



2. Literature review

2.1. On urban tourism and air transportation

Since the 90s, researchers and policy-makers have been drawing increased attention to the subject of tourism in cities, which may be explained by the steep growth of this kind of tourism in the past few decades (Edwards, Griffin, *et al.*, 2008; Pearce, 2001), although this attention may still be considered disproportionately low (Ashworth & Page, 2011). Despite this growing attention and the multitude of perspectives taken on the topic, the concept of urban tourism is still currently used with imprecisions on its definitions (Ashworth & Page, 2011), and research has been conducted in an unstructured and fragmented manner (Pearce, 2001). Research frameworks are therefore needed, such as those proposed by Pearce (2001) and Edwards, Griffin, *et al.* (2008). A research agenda, which is important to guide researchers on the topics that most require to be addressed, is also provided by Edwards, Griffin, *et al.* (2008). This agenda comprises the research priorities according to academics and industry representatives, in which the topic "the influence that transport to cities has on tourist access and numbers" ranked fourth among academics and first among industry representatives. A city's accessibility for tourists is naturally not only assessed concerning air transportation, but in this literature review we focus on this means of transportation.

Tourism (in general, now not only considering in cities) and air transportation have long since developed interactively, and today's phase of mutual evolution is marked by the emergence of the LCC as a new business model (Bieger & Wittmer, 2006). LCCs, through their aggressive pricing policies, have boosted demand, leading to the emergence and development of specific forms of tourism (Bieger & Wittmer, 2006). They also transformed supply (Carballo-Cruz & Costa, 2014), namely leading airports to change their positioning and take on active attitudes so as to respond to the new market demands and trends (Almeida, 2011), ensuring the fit with LCCs' operating model in order to attract them. The set of requirements that airports need to satisfy to ensure this fit has already been documented in the literature (Barret, 2004; Graham, 2013; Warnock-Smith & Potter, 2005). Moreover, combined with the greater choice and flexibility offered by the Internet, LCCs brought about major irreversible changes in the behavior of leisure travelers in relation to air transport (Iatrou & Tsitsiragou, 2008). One of such behavior changes is the reduction in seasonality, as people now take shorter and more frequent breaks to accessible urban destinations (Brilha, 2008; Iatrou & Tsitsiragou, 2008). One should note, however, that different "business models" of destinations fit different models of air transportation (Bieger & Wittmer, 2006) and never all of them, and that even if LCCs travel to specific destinations, the expected consequences, namely in reduction in seasonality, may not occur (as happened, for instance, in most of the small and remote islands of Greece, as found by Papatheodorou & Arvanitis, 2009).

2.2. On general topics of tourism seasonality

Seasonality is one of the main determinants of the tourism industry, and since this industry is, in many cases, very significant to the local economy and labor market, tourism seasonality can greatly shape the local society and way of life (Andriotis, 2005). For this reason, the subject is very much addressed in the literature, yet problems still exist in identifying the basic causes of the phenomenon, the reasons for its persistence, and in its measurement (Butler, 2001). Lundtorp (2001) argues that one of the problems in really understanding tourism seasonality is the lack of in-depth and longitudinal research.

BarOn (1975) is often regarded as the first comprehensive study on the subject (Koenig & Bischoff, 2005). Koenig and Bischoff (2005) made a scoping review of the literature on tourism seasonality, concluding that it is mostly addressed over 5 general topics: definitions of seasonality, its causes and impacts, policy-related issues, studies into consumer behavior and, last but not least, approaches to measuring seasonality. The authors opted to not cover the research focused on tourism demand modelling and forecasting, which accounts for a substantial part of the literature in tourism seasonality, precisely due to its extension and highly technical character, considered inappropriate for a report that is aimed at the general audience. There are, however, various authors that made the effort of synthetizing this part of the literature. Witt and Witt (1995) are frequently made referenced to, since they made a scoping review discussing the main methods used to forecast tourism demand, respective empirical findings and the forecasting accuracy of different techniques. Song and Li (2008) can also be mentioned, as they made a scoping review on the more recent developments in tourism demand modelling and forecasting, starting from 2000. Other less covered topics include, not extensively, the effect of climate changes to the seasonal character of destinations, particularly the global warming phenomenon on the ski tourism segment (Pegg, Patterson, *et al.*, 2012); the impacts of seasonality on the environmental sustainability of destinations, concerning their carrying capacity[1] (Martín, Aguilera, *et al.*, 2014); the role of interactive learning tools in improving students' motivation and ability to understand statistical concepts in courses of statistical methods applied to tourism (Fernandéz-Morales, 2014); the distribution/concentration of global tourism, paying attention to regional competitiveness and other forces that contribute to determine international tourism flows (Lacher & Nepal, 2013).

2.3. On the definition of seasonality, its causes and impacts

Several proposals for defining seasonality, whether applied to tourism or not, are recurrently made reference to in the literature. Hylleberg's (1992, p. 4) is one of the most referenced, which defines seasonality (not applied to tourism) as "the systematic, although not necessarily regular, intra-year movement caused by changes in weather, calendar, and timing of decisions, directly or indirectly through the production and consumption decisions made by the agents of the economy. These decisions are influenced by the endowments, the expectations and the preferences of the agents, and the production techniques available in the economy." Another proposal, now applied to tourism, was made by Butler (2001, p. 1), who defined tourism seasonality as the "temporal imbalance in the phenomenon of tourism, which may be expressed in terms of dimensions of such elements as numbers of visitors, expenditure of visitors, traffic on highways and other forms of transportation, employment and admissions to attractions". Seasonality is intrinsically temporal, but it also has a spatial dimension (Cannas, 2012) since: seasonal peaking increases with distance from the "core" touristic attractions, be it urban or coastal areas (Butler & Mao, 1997); urban destinations tend to suffer less from seasonality than coastal "sun and beach" destinations (Andriotis, 2005); different forms of urban setting within the same destination country can show large temporal disparities (Butler & Mao, 1997).

Seasonal patterns can take many forms, but three basic patterns are the most recurrent: single peak, two-peak and non-peak, the last of which is characterized for having a low difference between the peak's seasonal indices and the non-peak's, although visitation is still affected by seasonal variations (Butler & Mao, 1997). Seasonality in a particular

[1] Carrying-capacity is defined as the maximum number of people that can visit a place at the same time without causing physical, economic, sociocultural or environmental damage, and without decreasing the satisfaction of visitors (extracted from Martín, Aguilera, *et al.* (2014)).

destination, concerning its amplitude, intensity and pattern, depends on the characteristics of both tourism demand and of the destination itself, in terms of location and service supplied (Cuccia & Rizzo, 2011). Although the causes of seasonality have been extensively covered in the literature, it is often stressed that they are still not well understood (Koenig & Bischoff, 2005), which hinders the capacity of interested agents, namely policy-makers and tourism managers, to identify, predict and manipulate them.

The causes of seasonality are often categorized in the literature, resulting in different categorizations to be built according to each researcher's perspective. BarOn's (1975) and Hartmann's (1986) distinction between natural and institutional causes of seasonality is very much applied in the literature. The first consists on the regular and recurrent temporal variations in natural phenomena, namely in climate, while the second is caused by human actions and policies, and is associated with tradition and legislation. Other groups can be obtained with the disaggregation of these two types of causes: Hylleberg (1992) defined weather, calendar effects and timing decisions as three distinguished categories; Butler (2001) defines 5 groups, namely climate, personal decisions in a social context, social pressures or pressures related to fashion, sports seasons and inertia or tradition. To these 5, Frechtling (1996) adds the effect of business trips and variations in the calendar (extracted from Martín, Aguilera, *et al.*, 2014). Naturally, the causes linked with human decisions (broadly referenced to as institutional) are more susceptible to external manipulation (Cuccia & Rizzo, 2011). Causes can also be distinguished, using a different categorization, between push and pull-factors. The former aggregates all factors present in a generating area that incites tourists from it to a specific receiving area, while the latter includes those present in a receiving area that attract tourists from a generating area (identified in Lundtorp, Rassing, *et al.*, 1999). A third categorization emphasizes the causes' predictability of occurrence and intensity, which range from stable (e.g. Christmas) to unpredictable (e.g. weather) (Hylleberg, 1992). Unpredictability leads to imprecision in the time of appearance of seasons, although it remains certain that they and their influences recur year after year (Kuznets, 1933). Interested agents should also mind predictable long-term changes in the causes or in their effect – for instance, some literature has already been developed on the effect of climatic changes, including global warming, on the natural seasonality in tourism, ultimately shifting significant flows of tourists to new destinations (examples are: Agnew, 2001; Giles & Perry, 1998; Smith, 1990). One should keep in mind that the tourism destination itself can also present restrictions that make it complicated or even impossible to receive high volumes of tourists in the off-season, for instance when key elements of supply, such as accommodations and labor, are not willing to be available during that season (Andriotis, 2005; Lundtorp, Rassing, *et al.*, 1999).

Seasonality in tourism is a complex social issue whose effects largely extend the tourism sector, so it should not be assessed only in economic terms and be isolated from its social and ecological dimensions (Hartmann, 1986; Martín, Aguilera, *et al.*, 2014). Its effects have been broadly addressed, identifying both advantageous and disadvantageous ones, although seasonality is mostly regarded as a problem that should be modified and reduced (Butler, 2001). Among the harmful effects of seasonality, one can mention the tourism establishments' loss of profitability in the off-peak and consequent low returns on capital that deter private investment and lending; the consequent incentives given to management to "milk" the high-season as much as possible, at the expense of quality standards; the inefficient use of resources and infrastructures, namely water, electricity and transportation, leading to their saturation during the high-peak and overcapacity in the low-peak; the creation of a temporary workforce that accepts seasonal work, regarded as an inferior form of professional occupation due to the lack of opportunities for career progression, job insecurity and low job training since management is aware that investment in training goes to waste when the high-peak is over; the obligation felt by this workforce to find other employment or even remain unemployed during the off-season; competition in the job market with other seasonal industries, such as agriculture; loss of the destination's cultural identity, resulting in lower quality of life for residents and level of satisfaction among tourists; the need of reinforcing some public services, such as police, health, sanitary, which are usually financially covered by the resident population; and damage to the environmental sustainability associated with damage to vegetation, disturbance to fauna, accumulation of waste and physical erosion of the area. On the positive side of seasonality, the off-peak season is seen as a time to recover from the hectic months of high season, appreciated by the local community (Andriotis, 2005), also as a time for maintenance work in buildings, for the community to properly participate in the social and cultural activities that constitute its identity and for ecological re-balance. Studies have also shown that seasonal workers regard the low-season as beneficial, as it allows them to engage in other compatible occupations such as studying or other seasonal work. It may also be argued that the judicious development of recreational/tourist interests can encourage, by contributing to the economic base of regions, conservation and wise management of the resources and the environment (Burger, 2000). For more detailed explanation and for other references, see Andriotis (2005); Cannas (2012); Fernandéz-Morales, Cisneros-Martínez, *et al.* (2016); Koenig and Bischoff (2005); Martín, Aguilera, *et al.* (2014); Pegg, Patterson, *et al.* (2012). Halpern (2011) analyzes the challenges that seasonality poses specifically to airports.

To conclude, one should keep in mind that a fuller understanding of tourism seasonality may contribute to a more efficient operation of tourism facilities and other resources and infrastructures, concretely through an effective planning and use of them during the off-peak and peak periods (Corluka). This is valued both by the destination's community and visitors, but also by visitors, thus leading to a positive long-term relationship between the destination and its tourists, which is crucial from a marketing viewpoint (Jang, 2004). In order to overcome the negative implications of seasonality in tourism, it is needed "awareness from all the involved institutions and mobilization of the factors that are related with tourism in order to plan the lengthening of the tourist period, having as a future objective the growth of tourism in all seasons." (Corluka, p. 37)

2.4. On the approaches for the measurement and description of seasonality

The full quantification and description of seasonality is generally regarded as a prerequisite for much of the applied work in the area of tourism seasonality (Koenig & Bischoff, 2005). In Kuznets' (1933, p. 2) words, "while statistical description by itself does not explain *why* seasonal variations have been met in this or that particular fashion, it indicates *how* and thus constitutes a basic point of departure for any intelligent consideration of the way in which seasonal disturbances work themselves out in the complex economic system". Kuznets (1933) is often referenced in the literature and can be regarded as a good starting point, despite the logical and methodological advances made since then (de Cantis, Ferrante, *et al.*, 2011) and the differences in study scope, since Kuznets studied seasonal variations in the USA's whole industry and trade sectors. Also frequently referred to is BarOn (1975), but as the first comprehensive study on seasonality applied to the tourism industry, since he analyzed the seasonal pattern of tourist arrivals at the borders of 16 different countries over a 17-year time frame (Cannas, 2012; Koenig & Bischoff, 2005).

Two tables are presented in the end of this subsection: the second summarizes the research theme and approach taken in various research pieces devoted to describe the seasonality present in a particular demand curve, while the first presents the measures used for that purpose and respective formulas. For more detail on the study methods most commonly employed in the literature, we refer to section 2.5 where they are analyzed in more depth. The majority of the studies in this topic has been conducted in the context of international tourism and have largely focused on the accommodation sector (Koenig & Bischoff, 2005). Some general approaches can be outlined: (1) Decompose the time series so as to isolate and quantify each of its components and build a description of each of them, including of seasonality based on the seasonal factors isolated. This approach may also entail the calculation of the Seasonal Indices in order to build an illustration of the series' "average" seasonal pattern. Examples of authors who took this approach, among those that we review, are Guzman-Parra, Quintana-García, *et al.* (2015); Yan and Wall (2003). (2) The application of measures on the original data and/or seasonal factors to quantify seasonality's characteristics. One of the best-known examples is BarOn (1975), who retrieved monthly seasonal factors through the moving average approach and applied the Seasonal Range, Seasonal Ratio and Peak Seasonal Factor (Koenig & Bischoff, 2005). Others include de Cantis, Ferrante, *et al.* (2011); Drakatos (1987); Hui and Yuen (2002); Koenig and Bischoff (2003). Sutcliffe and Sinclair (1980) can also be included, although they added a decomposition of the total change in seasonality between different years into two components: a pure change, consisting of a change in concentration in the same months of the year, and a pattern change, giving the fluctuations over time in the proportions of tourist arrivals which occurs in different months. Fernandéz-Morales (2003) used techniques, namely the decomposition of the Gini Coefficient and Cluster Analysis, to define the different seasons of the year in a more sophisticated manner. The approaches that go beyond what was discussed above tend to, as de Cantis, Ferrante, *et al.* (2011, p. 661) states "relate seasonal measures (of pattern, amplitude or amplitude change) to explanatory variables, to study spatial and temporal variations, differences among market segments or among destinations". Among these, one can identify the authors who analyzed (3) how different types of destinations are more or less prompt to seasonality. Urban and cultural destinations tend to be opposed to pure “sun and sea” ones or rural ones, although other typologies can be defined. Examples are Coshall, Charlesworth, *et al.* (2015); Cuccia and Rizzo (2011); Martín, Aguilera, *et al.* (2014), the last two of which relied on the same metrics as the ones used in the second approach to quantify and compare each considered destination’s seasonality. The former, on the other hand, performed a Principal Components Analysis, simultaneously assessing how different regions of Scotland were affected by seasonality and able to attract different segments according to motivations to traveling. One can also identify the authors who analyzed (4) the role that motivations to travel and markets of origin have on the amplitude of seasonality, which is commonly assessed through decomposition analyses of the Gini Coefficient and/or Theil index. Authors that pursued such approach include Cisneros-Martínez and Fernandéz-Morales (2015); Duro (2016); Fernandéz-Morales, Cisneros-Martínez, *et al.* (2016); Fernandéz-Morales and Mayorga-Toledano (2008); Halpern (2011). (5) There is also an interest in relating the characteristics of accommodations with their seasonality, drawing conclusions on how managers can actively diminish their establishments’ seasonality. This entails crossing large datasets to find patterns and ultimately segment those accommodations based on the patterns they share. Examples of authors are Jeffrey, Barden, *et al.* (2002) and Koenig and Bischoff (2004), who used Factor Analytics and a Principal Components Analysis, respectively. (6) Regression analysis are also built to identify and analyze factors, mostly of economic nature, that determine seasonality, namely by Gonzáles and Moral (1995); Nadal, Font, *et al.* (2004). (7) Other approaches are also taken for specific research purposes, such as the extraction of qualitative information surveys. Examples are Andriotis (2005) and Pegg, Patterson, *et al.* (2012).

Despite the wide range of approaches used, relatively few authors have closely examined ways to conduct such analysis (Koenig & Bischoff, 2005) and the measures applied, namely their properties and adequacy according to the research aims (de Cantis & Ferrante, 2008). “No general guidelines exist of how seasonality or demand fluctuations in the wider sense can and should be measured and which available data sources should be used. The resulting lack of standards in quantification methods, in turn, makes comparisons of demand fluctuations between different regions or sectors particularly difficult.” (Koenig & Bischoff, 2005, p. 18). Two research pieces that reflect the effort of examining the adequacy of methods used in the literature, in themselves from a theoretical point of view and in relation with the research purpose at hand, are de Cantis, Ferrante, *et al.* (2011) and Koenig and Bischoff (2005), where the former offers a comprehensive framework to guide future research. Concerning the measures applied in the literature, de Cantis and Ferrante (2008); Koenig and Bischoff (2003); Lundtorp (2001) together make up a good summary of them, their merits and limitations and the research purposes to which they are adequate for application.

An important part of the literature review is to know and compare the data sets (or series) that are collected and analyzed in the literature. Therefore, we summarize the data sets of the pieces of research that we review, according to the series included, time unit of analysis and time period covered. Before presenting the summary, some remarks should be made: first, the summary does not aim to provide a complete description of the data used by each piece of research, as other factors should also be included for that purpose, for instance whether the data was collected for one or several destinations, or whether they are disaggregated by whatever criteria or aggregated, or whether it corresponds to the whole population or just a sample. Second, in some cases more than one set of data is used in a piece of research – in these cases, only the most relevant one is mentioned. Third, the data set is normalized into three categories – accommodation nights, tourist arrivals (also including tourist departures when the focus is on the outbound tourist flow) and occupancy rates in accommodations – in order to facilitate the comparison, although such normalization may have hidden details. For instance, a series with data only concerning hotels, disregarding other types of accommodations, was considered to fit the "accommodation nights" category. Lastly, only the pieces of research that we review and with data sets and research purposes comparable with ours are included in the summary. Having made these remarks, we can move on to the summary, which includes 26 research pieces. Concerning the series included in them, tourist arrivals accounts for 15, occupancy rates in accommodations for 5 and accommodation nights for 8. Concerning the time unit, the month accounts for 23, the quarter for 3, the day for 2 and the midweek/weekend for 1. Concerning the time period covered in the research pieces, 10 include 10 or less years, 9 between 11 and 20 years, and 7 more than 20 years. Note that some research pieces may include more than one series or time units.

METRIC		FORMULA
For the seasonal amplitude		
(2.1)	Coefficient of Variation	$CV_i = \frac{s_i}{\bar{x}_i}$
(2.2)	Peak Seasonal Factor	$PSF_i = \max(y_{ti})$
(2.3)	Seasonal Indicator	$SInd_i = \frac{\bar{x}_i}{\max(x_{ti})}$
(2.4)	Seasonal Intensity	$SInt_i = \max(x_{ti}) - \bar{x}_i$
(2.5)	Seasonal Range	$SRan_i = \max(x_{ti}) - \min(x_{ti})$
(2.6)	Seasonal Ratio	$SR_i = \frac{\max(x_{ti})}{\bar{x}_i}$ or $SR2_i = \frac{\max(x_{ti})}{\min(x_{ti})}$
For the seasonal pattern		
(2.7)	Coef. of Variability	$CVb_t = \frac{s_t}{\bar{y}_t}$
(2.8)	Concentration Index	$CI_{gi} =$ % of a_{ti} in group g over all the year i
(2.9)	Index of Similarity	$IS_{\alpha,\beta} = 1 - \sum_{i=1}^{I} \left\| \frac{d_i^{\alpha}}{\sum_{i=1}^{I} \left\| d_i^{\alpha} \right\|} - \frac{d_i^{\beta}}{\sum_{i=1}^{I} \left\| d_i^{\beta} \right\|} \right\|$
(2.10)	Peak Season's Share	$PSS_i = \frac{a_{p,i} - a_{p,i-1}}{a_{o,i} - a_{o,i-1}} \cdot 100$
(2.11)	Seasonal Indices	$SIx_t = \frac{\sum_{i=1}^{I} y_{ti}}{I}$
For both		
(2.12)	Amplitude Ratio	$AR_i = \frac{\sum_{t=1}^{T} d_{ti}^{a} d_{ti}^{y}}{\sum_{t=1}^{T} d_{ti}^{y}}$

Where x_{ti} can either denote the actual value (a_{ti}) or seasonal factor (y_{ti}) in time unit t (for $t = 1, 2, \dots, T$) of year i (for $i = 1, 2, \dots, I$); s denotes the standard deviation; $\bar{x}$ and $\bar{y}$ the mean; g a group of t; α and β two different seasonal patterns; in IS, d_i^{α} denotes the deviation of α's seasonal factors from 100; in PSS, p the peak season and o the off-season; in AR, d_{ti}^{a} denotes the percentage deviation of a_{ti} from the moving average in t and d_{ti}^{y} denotes the deviation of y_{ti} from 100 in t;

Two metrics are referred to as Seasonal Ratio since both appear in the literature with that denomination.

Note that there are several approaches to calculate the Gini Coefficient and a Theil index of the Theil family of indexes, reason why we didn't insert them in this table.

GLOSSARY OF METRICS AND TOOLS

AR:	Amplitude Ratio	GC:	Gini Coefficient	SInt:	Seasonal Intensity
BP	Biplot (graph)	IS:	Index of Similarity	SP:	Seasonal Plot (graph)
CA:	Cluster Analysis	LC:	Lorenz Curve (graph)	SRan:	Seasonal Range
CI:	Concentration Indices	PSS:	Peak Season's Share	SR:	Seasonality Ratio
COR:	Correlation (Coefficient)	RME:	Relative Marginal Effect on GC	SR2:	Seasonality Ratio 2
CV:	Coefficient of Variation	SIx:	Seasonal indices	T:	Theil family of indices
CVb:	Coefficient of Variability	SInd:	Seasonality Indicator		

STUDY	RESEARCH THEME	EXTRACTION OF SEASONAL FACTORS	METRICS AND GRAPHS	MODELS, TESTS AND OTHER TECHNIQUES
Andriotis (2005)	How society in Crete, Greece have taken the seasonality in tourism.	*The research was built based on mostly based on qualitative information gathered through surveys.*		
de Cantis, Ferrante, *et al.* (2011)	Scoping review and proposal of a methodological framework to investigate seasonality, with application to a case.	Wiener–Kolmogorov filters (SARIMA)	CV, CVb, GC, LC, SIx	–
Cisneros-Martínez and Fernandéz-Morales (2015)	Description of seasonality in the Spanish region Andalusia and role of origin markets and motivation.	Moving Average	GC, RME, SIx	Decomposition of GC by origin and motivation for travelling.
Coshall, Charlesworth, *et al.* (2015)	Description of seasonality in Scotland through a spatial and temporal analysis in vacation, VFR and business trips.	Moving Average	GC, AR	Principal Components Analysis
Cuccia and Rizzo (2011)	Assess the role of cultural tourism in Sicily's tourism seasonality.	Census X-12	COR, CV, SInt	*F* test for total and moving seasonality.
Drakatos (1987)	Description of seasonality in Greece.	Moving Average	AR, CVb, IS, SIx	–

Duro (2016)	Analysis of the amplitude of seasonality in Spanish provinces and role of origin markets.	–	CV, GC, T	Decomposition of T by group (seasons) and source (origin markets).
Fernandéz-Morales (2003)	Description of seasonality in 3 Spanish destinations.	–	GC	Decomposition of GC by group (seasons) and CA.
Fernandéz-Morales and Mayorga-Toledano (2008)	Analysis of the amplitude of seasonality in Costa del Sol, Spain, and role of origin markets.	–	GC, RME	Decomposition of GC by source (origin markets)
Fernandéz-Morales, Cisneros-Martínez, *et al.* (2016)	Description of seasonality in the 9 regions of England.	Census X-11	BP, GC, RME	Decomposition of GC by source (origin markets and motivation).
Gonzáles and Moral (1995)	Analyze the major factors that determine tourism demand in Spain and forecast short-term evolution of the sector.	–	–	Regression analysis.
Guzman-Parra, Quintana-García, *et al.* (2015)	Description of the trend and seasonality in Spanish rural tourism.	Moving Average	SIx	–
Halpern (2011)	Analysis of the seasonal concentration of passenger demand at airports in Spain, with particular focus on Ibiza.	–	GC, LC, RME	Decomposition of GC by source (type of airline and origin markets) for Ibiza.
Hui and Yuen (2002)	Description of the seasonal pattern of tourists from Japan to Singapore.	Moving Average	–	Graphical illustration of the SIx calculated for different periods and *T* test on an equation designed to assess the stability of the pattern.
Jeffrey, Barden, *et al.* (2002)	Identification of the features in accommodations' characteristics and management that foster success.	–	–	Factor Analytics and qualitative survey.

Koenig and Bischoff (2003)	Description of seasonality in Wales and comparison with England, Scotland and the UK as a whole.	Extracted, although with no reference to the method used.	AR, CI, CV, GC, IS, PSS, SInd, SP	–
Koenig and Bischoff (2004)	Segmentation of accommodations in Wales based on their performance.	–	–	Principal Components Analysis and CA.
Martín, Aguilera, *et al.* (2014)	Analysis and comparison of the seasonal amplitude between different types of destinations in Andalusia.	–	GC, SRan, SR2	COR calculated and tested between domestic and foreign travelers.
Nadal, Font, *et al.* (2004)	Analysis of the amplitude of seasonality, also by establishing causal relationships with key economic variables	–	GC	Regression analysis with the GC as dependent variable.
Pegg, Patterson, *et al.* (2012)	How accommodation providers and ski operators in the snow industry of New South Wales have dealt with seasonality.	*The search was built on qualitative information gathered through interviews.*		
Sutcliffe and Sinclair (1980)	Description of seasonality in Spain.	Moving Average	–	The total change in seasonality is decomposed into its “pure” and pattern components.
Yan and Wall (2003)	Description of seasonality in China.	Ratio to the average number of visitors for each year	SIx	Estimation and description of the time series’ components, namely the cyclical and irregular components

2.5. On the methodologies for the measurement and description of seasonality

As said earlier, Kuznets (1933) can be regarded as a good starting point for defining one's method to be employed for the measurement and description of seasonality in tourism or any other industry, even if more advanced methods have been developed since then. Chapter II of his work explains the method employed to measure seasonality in the USA' whole trade and industry, and chapters X and XI explain how the temporal changes in the seasonal pattern and amplitude are measured, respectively. Still, relevant more advanced techniques were in fact developed since 1933 and many authors employed, in their research, different approaches from Kuznets'. de Cantis, Ferrante, *et al.* (2011) made a scoping review of how researchers have analyzed seasonality in tourism and concluded that, notwithstanding the generally admitted importance of conducting one's research under tested guidelines and the large volume of empirical studies conducted, the theoretical appreciation of methods is still limited. Therefore, they proposed a framework to be followed in future research that brings back Kuznets' logics and methodologic considerations, updated of the most recent developments. This framework takes seasonality essentially as a distributional imbalance which can be measured synthetically, with two main facets to be described: intensity (also called degree or level) and pattern. These facets need to be considered in dynamic terms, as they may change over time. Analyzing the evolution of the intensity of seasonality may provide relevant insights, namely for policy-makers who want to assess the effectiveness of contra-seasonal policies implemented in a specific destination, or rank destinations in priority of need of such policies, for instance. Analyzing the evolution of the seasonal pattern may lead to a more complete understanding of the phenomena, ultimately supporting more effective policy and management by the interested agents. In any case, these facets should be regarded as interrelated rather than independent, as this leads to a grounded use of measures and methods when analyzing each facet and to their reliable interpretation. For instance, the comparison of the intensity of seasonality between different destinations is only reliable if it is proven that they show similar seasonal patterns, as very different patterns may result in a similar measure of concentration and vice-versa (de Cantis & Ferrante, 2008). In fact, the literature often recognizes that the suitability of some methods to analyze one facet depends on the characteristics of the other, reason why researchers should take care of how they conduct their research. In the following paragraphs, our literature review enters in greater detail on how seasonality has been being measured and described, uncovering the logics behind the choice of each method. In order to facilitate the reading, we do not mention the research pieces that employed each method, referring to the table already presented in section 2.4 for this end.

2.5.1. Methods to extract seasonal factors, namely by decomposing the time series

Depending on the approach taken by the researcher, the extraction of seasonal factors may or may not constitute an important step prior to analyzing the facets of seasonality. This step is important when the approach counts on the employment of metrics and techniques that provide a specific interpretation or are only reasonable with seasonal factors as input.

There are numerous procedures that enable the extraction of seasonal factors, either by assuming a deterministic or stochastic structure of the series. The simplest consists on considering the ratio between each monthly value and a value whose evolution grossly reflects the series' trend-cycle movements, namely the sum or average of each year's monthly values, or each year's value for a given month (basic notion given in Lundtorp, 2001). This kind of procedure, namely employed by Yan and Wall (2003), cannot be considered a time series decomposition procedure as it only isolates and quantifies the seasonal factors. Time series decomposition procedures thrive to achieve a better understanding of the behavior of a time series by breaking it down (decomposing it) into underlined patterns that identify and quantify each of its components separately, usually the trend-cycle, seasonal and irregular components, the last of which accounts for the series' random variability. In mathematical notation, for month t, the time series value is given by $A_t = f(T_t, S_t, I_t)$, where T_t denotes the trend-cycle, S_t the seasonal and I_t the irregular components. One should note that researchers sometimes distinguish the trend from the cycle, namely Yan and Wall (2003) who estimated the cyclical fluctuations through 5-month weighted moving averages, but this distinction is considered by Makridakis, Wheelwright, *et al.* (1998) somewhat artificial and difficult to accomplish, reason why most decomposition procedures leave both as a single component. One can specify the above equation either through an additive specification, given by $A_t = T_t + S_t + I_t$ through which the extracted seasonal factors are expressed in the same unit as the original series, or a multiplicative one, given by $A_t = T_t \cdot S_t \cdot I_t$ through which the seasonal factors are pure numbers. The multiplicative model is generally considered more appropriate than an additive one when the seasonal fluctuations increase and decrease proportionally with increases and decreases in the level of the series (Makridakis, Wheelwright, *et al.*, 1998), which is the case with tourism-related series (BarOn, 1975). An interesting by-product of this procedure is the ability to derive seasonally adjusted data, which is calculated, when using the multiplicative model, by dividing the actual data by the seasonal components. Seasonally adjusted data consist of estimates of the values that the series would have presented in the absence of seasonality in the data.

Within this general conceptualization of the time series decomposition procedure, there are numerous approaches that one can take. One of the most common consists on isolating the trend-cycle component through moving averages, which are then used to obtain the seasonal factors by calculating the ratios of observation-to-moving averages (divide the time series' actual values by the moving averages), often called "ratio-to-moving averages". These "ratio-to-moving averages" should only account for the seasonal factors, although they in fact contain not only the seasonal element but also the random changes and whatever parts of the cyclical movements not eliminated by the moving average (Kuznets, 1933). More sophisticated approaches include the Census Bureau X-13-ARIMA-SEATS method (or previous versions), which generally leads to improved accuracy in comparison with most alternative methods (Makridakis, Wheelwright, *et al.*, 1998). Other less common procedures are covered in de Cantis, Ferrante, *et al.* (2011), which we do not reproduce here. Some researchers include in these approaches the use of dummy variables in a multiple regression model, nevertheless since this approach only provides globally-calculated seasonal indexes and not seasonal factors, we find that they are not suited here.

2.5.2. Methods to describe the seasonal pattern

The seasonal pattern should be analyzed before the seasonal amplitude and intensity, for logical reasons pointed out by Kuznets (1933). It is important for researchers to acknowledge that seasonal patterns in tourism demand evolve over time, even if quite slowly, namely according to the life cycle of the destination (Cuccia & Rizzo, 2011) and as natural and/or institutional causes change (Butler, 2001). Nevertheless, changes to seasonality are likely to be minor unless significant changes are enforced, such as the introduction of year round school operations (Butler & Mao, 1997). Still, researchers shouldn't build their research on the assumption that the seasonal pattern they are attempting to describe is stable, although they often do so. Acknowledging their variability leads researchers to take care to ensure the reliability of their description of the seasonal pattern by interactively analyzing it with its stability. In this regard, seasonality is either treated as a deterministic or a stochastic component in the time series, since empirical studies showed inconclusive evidence to how seasonality should be treated (Song & Li, 2008).

In order to analyze the intra-year pattern of seasonality, Seasonal Indexes are a desired tool because they build a one and only "average seasonal pattern", much easier to visualize than several patterns, one for each year, built directly through the seasonal factors. These Indexes can either be expressed in pure values, when given by each month's mean seasonal factors, or in the same unit as the original series, for instance when extracted through dummy variables in non-casual linear regressions[2]. Both approaches estimate single indexes for each month that attribute the same weight to all included observations. Since Seasonal Indexes tend to be globally-calculated, i.e. include the whole period for which data is available, and researchers tend to gather data for relatively long periods (see last paragraph of subsection 2.4), this estimation procedure fails to accommodate varying seasonal patterns that may be present in the data (Lim & McAleer, 2000), implying that their description is only accurate under the assumption that the seasonality present in the series is implicitly deterministic (Goh & Law, 2002). All in all, although this metric is appreciated, it is only reliable if the yearly variability of the seasonal factors is low. To assess this variability, de Cantis, Ferrante, *et al.* (2011) suggests using Coefficients of Variability, which basically consists on the Coefficient of Variation (explained further below) in the way through which it is computed, although using several of a particular time unit's (henceforth month) seasonal factors in several years as input rather than the twelve factors in a year. In this way, it provides a single scalar measure of the variability of the seasonal factors in each month rather than in each year. When variability is high, a workaround is to break the considered period into smaller

[2] Regression models are usually linked with attempts to explain the behavior of a given time series (the dependent variable) with that of the independent variables, thus establishing causal relationships. In this case, however, the purpose of their use is to describe the behavior of the series throughout time and its seasonal fluctuations. Therefore, they are non-casual time-series models.

ones where the changes in pattern are milder, as did Yan and Wall (2003) when describing seasonality in international arrivals to China, so as to reflect the moving Chinese New Year and changing seasonal pattern.

Single scalar measures are also of use to discover in which periods or years the seasonal pattern has changed the most. The Amplitude Ratio, first introduced by Kuznets (1933), simultaneously measures the intensity of seasonal fluctuations and serves as a tool for testing the persistence of a seasonal pattern from year to year, as it tests whether a year's seasonal amplitude was narrower (if $AR < 1$) or wider (if $AR > 1$) than the amplitude for the whole considered period (Koenig & Bischoff, 2003). The Index of Similarity, also first introduced by Kuznets (1933), can also be used and shows the following advantages: while the Amplitude Ratio can only be computed for 12-month periods, the Index of Similarity can assess the stability of a seasonal pattern between longer periods (Kuznets, 1933); it involves only first moments while the former involves second moments, which exaggerate the importance of the larger deviations from the arithmetic mean (Kuznets, 1933); it is well suited to compare seasonal patterns between regions, while the former is not (Koenig & Bischoff, 2003). Single scalar measures are not they only measures useful to discover periods or years of change in the seasonal pattern. Others techniques include graphical representation, namely the seasonal plot (Koenig & Bischoff, 2003), which plots the values that each month assumes every year of a considered period in relative terms, thus offering a visual description of the pattern and its evolution over time, evidencing possible changes. Others also include statistical tests. A widely used one in the literature, although some deficiencies have been pointed out by some authors (see Song & Li, 2008), was suggested by Hylleberg, Engle, *et al.* (1990). It is called the HEGY test and it tests for seasonal and non-seasonal unit roots in a univariate series. Another commonly used test is the Augmented Dickey-Fuller one, which also determines the nature of the seasonal variation in the series (Goh & Law, 2002). Other tests can be employed. Hui and Yuen (2002), for instance, used a technique which tests whether the yearly changes in the seasonal factors of a particular month in a considered period are the result of random disturbances, in which case the pattern is deemed stable, or not.

Going back again to the methods applied to analyze the seasonal pattern, there are several which can be used as a complement or alternative to the Seasonality Indices. The Concentration Indices (CI), for instance, presents itself as an appropriate method when the seasonal pattern is proved to be very unstable (Koenig & Bischoff, 2003). It consists on defining, through trial-and-error, the groups of months that best capture the intra-annual differences in tourism activity, or in other words, the different seasons. A group's concentration index is calculated by adding the series' relative values, in percentage, of the months that compose that group. Another method which ultimately returns groups of months as different seasons takes advantage of the decomposition property of the Gini Coefficient and Theil family of indices, which measure the intensity of seasonality, in order to perform a group decomposition. These indices are decomposed into two components: a between-group component, which measures the average dissimilarity of tourism concentration between groups; and a within-group component, which reflects the internal differences in the groups and, in fact, is a weighted average of the inequalities between the months that compose each group. Therefore, a more accurate definition of seasons would result in a higher between-group component (lower within-group component). How the researcher defines the groups is both the result of experimentation to find out which grouping returns the highest between component and of other factors, such as the practicality of the seasons defined. Whereas Fernandéz-Morales (2003) considered that groups could include not consecutive months, Duro (2016) preferred to only define groups with consecutive months in the belief that this would be more useful for policy-making. Having defined the seasons, namely the peak season, one can compute the Peak Season's Share to obtain information on the impact that a growth or contraction of the overall tourism demand has on the peak season (Koenig & Bischoff, 2003). In this way, the index sheds light on whether there is a tendency of dispersion of the tourism activity from the peak to the off-peak or not.

2.5.3. Methods to describe the seasonal amplitude and intensity

So as to measure seasonal amplitude in a particular time span (usually the year), researchers use various indicators that provide a single scalar measure. These indicators and respective formulas are enumerated in a table inserted at the end of the previous subsection (2.4). Some indicators may be calculated with either actual data or seasonal factors expressed in pure numbers, sometimes providing different interpretations accordingly: when actual data is used as input, the seasonal variation is expressed in the same unit of measure as the original series, while when seasonal factors are used, the seasonal disturbances are expressed in relative terms. Both interpretations may be, according to Kuznets (1933), of interest, depending on the researcher's purpose. Note that the Peak Seasonal Factor indicator only makes sense using seasonal factors.

The Coefficient of Variation (CV) stands out as one of the most recurrently used metrics in the literature, and it measures the spread of a series' values for a given year around that year's mean. Attention should also be drawn to the Gini Coefficient (GC) and the Theil family of indexes (T), indicators that researchers often extract from the literature on inequality and apply to seasonality studies. Nadal, Font, *et al.* (2004, p. 700) describe the Gini Coefficient as "the most attractive yearly seasonal indicator", which may explain why it is clearly predominant in the literature. Reasons for this have been pointed out by Fernandéz-Morales and Mayorga-Toledano (2008), citing others: (1) the Gini Coefficient is less dependent on the highest fractile and is more sensitive to variations outside the peak season than Yacoumis (1980)'s Seasonality Ratio; (2) it shows greater stability; (3) and is less influenced by extreme values. Another reason consists on the fact that it allows, as well as the Theil family of indexes, different approaches to be taken based on their decomposability property (namely the decomposition by groups explained above). Despite this popular use of the Theil Index and even more of the Gini Coefficient, de Cantis, Ferrante, *et al.* (2011) find that they may be rendered unsuitable for seasonality studies because of the fact that they fully satisfy the axioms produced by the literature on inequality, namely the anonymity and scale independence axioms. On the other hand, Duro (2016), for instance, explicitly supports the use of these indicators arguing that the concepts of seasonality and inequality are aligned, as they both essentially constitute "temporal imbalances" which can be measured synthetically.

In any case, the fact of the matter is that many indicators are used in the literature, despite the fact that they usually return similar results: Sutcliffe and Sinclair (1980) found in their work correlations higher than 0.989 between the results supplied by the Standard Deviation, Gini Coefficient and Theil index, while Fernandéz-Morales (2003) found correlations higher than 0.99. The reason why many indicators are employed, sometimes in the same research piece, is twofold: first, there is no universally preferred indicator over the rest, so each researcher uses a set of indicators based on their personal preference;

second, the use of a broad set of indicators in a single research piece allows researchers to overcome each's limitations, at least partially. Various limitations have been identified. The Peak Seasonal Factor, Seasonal Range and Seasonal Ratio 2 only include each year's extreme values, which means that they only provide information on the magnitude of seasonal peaks, i.e. the seasonal amplitude. Duro (2016) draws awareness to the fact that the Coefficient of Variation, Gini Coefficient and Theil family of indices have different sensibilities to the data: the Gini index attributes a larger weight to central observations, the Theil to those with lower values and the CV is neutral. Because of this, he argues that "the researcher either needs to explain his or her evaluation in this respect or otherwise deal with a broad set of indicators to obtain a comprehensive overview of the situation" (Duro, 2016, p. 53). More importantly, all these metrics do not take into account the natural order of the months, rendering them incapable of providing information on the pattern of seasonality (de Cantis & Ferrante, 2008; Koenig & Bischoff, 2003). Moreover, the Gini Coefficient, which is derived from the Lorenz curve and shares the same failing as it requires a specific ordering of months, can only provide comparisons if two conditions are met: (1) the ranking of months are the same for both the series being compared; (2) the respective Lorenz curves do not intersect (de Cantis & Ferrante, 2008).

2.5.4. Methods to establish causal relationships between the facets and their explanatory factors

More than merely describing the facets of seasonality, the literature also includes research on the causal relationship between these facets and their explanatory factors, which requires another set of methods. One method consists on building causal multivariate models which relate different series about tourism, namely volume of passenger arrivals or total expenditure, with independent variables usually of economic nature, such as income, price and substitute price. Another approach consists on decomposing an index that measures the intensity of seasonality, isolating and quantifying the contribution of each source, i.e. market defined as nationality, region of source, motivation for travelling, or other. This approach allows the ranking of the source-markets according to their contribution to the overall intensity of seasonality, to identify those that might be more susceptible of manipulation and to thus define more targeted policies and marketing strategies to specific markets. This is particularly true when each source-market's contribution is further decomposed, namely to quantify the effects that the source-market's own seasonal intensity and weight in the overall volume of tourism have on the destination's total seasonal intensity. The indexes used in the literature for such decomposition purposes are the Gini Coefficient and the Theil index, although the Theil index has the advantage over the Gini of being additive (Cisneros-Martínez & Fernandéz-Morales, 2015). Jeffrey and Barden (1999) proposed a seasonal indicator that could be decomposable by markets and that could yield the contributions to the total concentration ratio of individual markets as well as potential effects of increasing/decreasing them (extracted from Fernandéz-Morales & Mayorga-Toledano, 2008). Several techniques are available to decompose the Gini Coefficient (see Cisneros-Martínez & Fernandéz-Morales, 2015). Two techniques can be included to complement this approach: Relative Marginal Effects (RME), which quantifies how much a marginal increase in proportion of a source-market impacts the overall seasonal intensity; and biplots, which allows clusters of destinations to be found based on how much and in which way they contribute to the overall seasonal intensity (see Fernandéz-Morales, Cisneros-Martínez, *et al.*, 2016).

Still, all these decomposition exercises mentioned until now (including the time series decomposition ones) decompose the original series in pre-determined, or restricted, structural components. However, the research purpose may entail the simultaneous assessment of the relative intensity and pattern of variability of individual subjects, such as markets or accommodation units, either compared to other specific individual subjects or to the population/sample as a whole. For such research purposes, the Principal Components Analysis (PCA) is usually preferred, as it identifies major underlying components (also referred to as dimensions) of common variance with no predetermined structure, leading to a set of dimensions that, when identified and measured, constitute distinct performance indicators that can serve as benchmarks for assessing each individual subject's relative performance. To give an example, if one of such dimensions identified through PCA was the length of the high-seasons in tourism accommodations' occupancy rate (not a pre-determined component of any conventional method), then accommodations that compare well with the benchmark are perceived as having a better-than-average performance in this dimension, i.e., longer high-seasons. Naturally, one only has interest in assessing individual subjects' performance if some kind of information on them is known, since only then conclusions on what influences performance can be derived. For this end, as well as for others, cluster analysis is a good tool to group individual subjects according to some criteria.

Other approaches are also taken, such as the gathering and treatment of qualitative and quantitative data through surveys. One particularly different approach was taken by Jang (2004), who used the Financial Portfolio Theory so as to build a new theoretical and quantitative perspective on the issue of mitigating seasonality.

2.5.5. Methods to model and forecast demand, namely its seasonality

Another approach to describe tourism demand and its seasonal character is through series modelling and forecasting. On this topic, a complete literature review would require a more extensive coverage of the existent research, since we only read a limited number of research pieces. Still, our understanding is that research on this topic focuses on comparing different modelling and forecasting methods in order to find which performs best. Three conclusions seem to be recurrent: there is little consensus on how seasonality should be treated in empirical applications with aggregate data (Cunado, Gil-Alana, *et al.*, 2005); there is no single method that systematically outperforms the rest; assuming stochastic structures generally returns better performances than deterministic ones (Gonzáles & Moral, 1996); and even when only taking a single case, the best model does not significantly outperform the simplest ones, namely the Naïve "no-change" model (Kulendran & Witt, 2001; Witt & Witt, 1995). The forecasting accuracy of both multivariate and autoregressive models, the last of which only describes a time series through its past values, not allowing any causal relationships to be analyzed, are extensively assessed in the literature, although it seems that more research has been conducted on the forecasting performance of autoregressive models. Gonzáles and Moral (1995) compared the multivariate model described in the previous paragraph (the STSM) with three others, including an ARIMA model. In the following year (1996), they built a new model to describe the tourism total expenditure in Spain, although through a simpler specification: a Basic Structural Model (BSM), which consists on a univariate model that includes only the trend and seasonal pattern, stochastically specified again to make them flexible enough to respond to general changes in the series. They then compared its forecasting performance with a regression model (deterministic) and an ARIMA one, concluding that the BSM performed best, and the regression model worse. Still, one may state that the integrated autoregressive moving-average models (ARIMAs) and its variations (Goh & Law, 2002; Gonzáles & Moral, 1995, 1996; Lim & McAleer, 2000, 2001) are the ones tendency preferred in the literature. In ARIMA processes, a series is transformed to a condition of covariance stationarity, which arguably renders it more suited for series description (and forecast) in the presence of changing seasonal patterns. Different versions of these time series processes have been applied, including the seasonal ARIMA (SARIMA) which, according to Song and Li (2008, p. 210), has gained popularity over the last few years. Another is SARIMA with intervention analysis (Goh & Law, 2002), which is used to recognize the interventions of some independent variables on a dependent variable of interest. Periodic autoregressive (PAR) models (Rodrigues & Gouveia, 2004) allow parameters to vary according to the seasons of the year. They assume that the observations can be described following specific autoregressive models. One particular problem of PAR models is the high parametrization, i.e., high number of parameters, that it entails. Nevertheless, some procedures may be put in place in order to reduce the model by reducing the number of seasons and eliminating insignificant regressors. As mentioned before, Song and Li (2008) make a more extensive scoping review on the recent developments in tourism demand modelling and forecasting, starting from 2000.

2.6. Critical analysis of the literature reviewed

Because of the complex and interdisciplinary nature of the tourism phenomena, the literature on it is extensive, covering a wide range of issues which, although clearly related, are generally addressed separately. Even when only considering the seasonality issue of tourism demand, the literature is also fragmented. Naturally, due to the diversity of research purposes and methods, the limits of each subject are unclear, and many times it is difficult to assert whether a research piece should be inserted in one group or another. Still, the following paragraphs attempt to explain the subjects that attracted our attention the most.

First, the phenomena of (urban) tourism as a whole. This subject is briefly addressed mainly through scoping reviews, frameworks and research agendas developed by researchers who explored the existent literature on it. More than understanding the phenomena itself, which would require a much more extensive literature review, the research pieces that compose our literature review enabled us to develop a mindset ready to establish links that stretch beyond the core of our research purpose and to acknowledge the usefulness of scoping reviews to make more sense of the existent literature. The concept of cultural tourism is explored since we believe that it helps characterize the kind of tourism Oporto most attracts.

Second, the relationship between the tourism industry and air transportation. After searching for generalities over this linkage, we turn to the work of Bieger and Wittmer (2006), which offers a good synthesis over this relationship, including a historical perspective that inserts the 1970s and 80s' deregulation of the air transport industry and the emergence of the LCC model as the marking factors of the current stage in that relationship. From that point, we focus on finding the main transformations brought by LCCs in tourism demand and supply that are identified in the literature.

Afterwards, we move to the third subject, which attracted most of our attention: seasonality in tourism. Because this subject is addressed in greater depth, we address it in different stages, although often overlapped. The first stage focuses on general topics on tourism seasonality and synthesize the literature on the subject. This stage is particularly important to make sense of the existing literature since, as said before, the wide range of approaches and methodologies would have otherwise been overwhelming. Many topics of research addressed in the literature are left aside, even though they are pertinent and curious perspectives on the subject. The second stage includes specific topics, namely the definition, causes and impacts of seasonality in tourism on different levels of the destination' paradigm, that are of interest since they serve to argue the importance of conducting case-study oriented research on the subject and to build the proper grounds for conducting that research. The third stage focuses on measuring tourism seasonality. This entails reviewing many research purposes and methodologies employed in various published articles, to which we add two books that offer a more explanation-oriented description of common and grounded methodologies to analyzing seasonality (de Oliveira, Santos, *et al.*, 2011; Makridakis, Wheelwright, *et al.*, 1998). It is at this time that the blueprint for our own methodology is decided, taking into consideration what is possible with the available data. The fourth and last subject consisted on building a general and mostly qualitative description of Oporto (inserted in subsection 1.3), including the situation of FSCA, which involve some literature review, but also the search of information through other means including reports produced by ANA.

When choosing the research pieces to read, we consider not only their relevance but also year of publication, since we want to include the literature's most recent advances in our review. This is particularly true concerning the research pieces focused on measuring and describing seasonality, among which 40% of those read were published in the last 5 years. We also attempted to include different perspectives and methodologies, preferring broadness of researchers over depth of research pieces conducted by one researcher.

Some gaps can be identified in this work's literature review: only a small portion of the research conducted on tourism time series' modelling and forecasting is considered; because of access restrictions, a few of the research pieces are not entirely read, but only partly such as the case of Lundtorp (2001), or are referenced through references made in other research pieces; more literature could have been reviewed on the more general subjects introduced in this literature review, namely on the relationship between urban tourism and air transportation, or on the LCC model and its implications.

3. Data and methodology

3.1. Data

Two datasets are used, the first (A) concerned with air transportation, and the second (B) with the activity/business of tourism accommodations as a proxy of the tourism industry as a whole (Table 2). The option to take tourism accommodations to reflect the seasonality in the tourism industry is common in the literature (Koenig & Bischoff, 2005). The (A) dataset was provided by ANA and (B) by INE. Still, the series marked by an asterisk (*) were not explicitly supplied by INE, but the result of calculations made on the other series, concretely: (B3) = (B2) / (B1); (B6) = (B4) · (B5); (B7) = (B4) – (B6); (B9) = (B8) / (B4); and (B11) = (B10) / (B8). All series consist of data in flows rather than stocks, with the exception of (B1) and (B2). The term "foreign" means derived from a country other than Portugal, regardless of nationality, while "domestic" means derived from Portugal, also regardless of nationality. In this study, the time span considered to

Table 2 - Data description

	DESCRIPTION	UNIT	PERIOD	TIME UNIT
(A1)	Passenger arrivals at FSCA, by airline	No.	2000-2014	Month
(A2)	Passenger and aircraft arrivals and seats offered in arriving flights to FSCA, by airline and origin (airport)	No.	2000-2014	Year
(B1)	Number of accommodation establishments	No.	2000-2014	Year
(B2)	Total capacity of guests at a given moment	No.	2000-2014	Year
(B3)	Average capacity*	No.	2000-2014	Year
(B4)	Guests	No.	2000-2014	Month
(B5)	Proportion of foreign guests	%	2000-2014	Month
(B6)	Foreign guests*	No.	2000-2014	Month
(B7)	Domestic guests*	No.	2000-2014	Month
(B8)	Stays (over-night)	No.	2000-2014	Month
(B9)	Average length of stay*	No.	2000-2014	Month
(B10)	Total income to accommodations from stays	€	2009-2014	Month
(B11)	Average price of stay*	€	2009-2014	Month

hold the full seasonal cycle is the calendar year and seasonality is assessed considering months as time units. The definition of the time unit was predetermined by the availability of data, although the authors recognize that a smaller time unit would be preferable, namely weeks. These decisions concerning data are based on the considerations made by Lundtorp (2001) on the distinction of flow and stock data, and on time span and unit.

3.2. Methodology

de Cantis, Ferrante, *et al.* (2011) proposed a 5-step framework that is based on the methodology employed by Kuznets (1933), updated of the improvements made since then from both logical and methodological stand points. Our research methodology is based on this framework, as it presents itself as a tested and grounded guideline, although alterations to it are made as deemed adequate for the research purpose and case at hand. Our research methodology is detailed in the following paragraphs.

Step 1: Analysis of the evolution of Oporto's airline market and accommodations' business. In order to frame our analysis on seasonality in Oporto's airline and tourism markets' general paradigm, an exploratory analysis is conducted highlighting the situation and most significant changes that occurred in the considered period. This analysis is made by presenting the data collected without any statistical manipulation, through the use of plots and tables, so as to identify its main features.

For *Step 1*, the entirety of both datasets, concerning air transportation and accommodations' business, is used to offer a global perspective. However, the analysis from *Step 2* onwards is conducted on the series total, foreign and domestic guests, i.e. (B4), (B6) and (B7). These were the ones chosen because: the data on the airline market does not distinguish passengers who reside in Oporto from those who don't, nor does it provide any information on passengers' nationality, rendering it unsuitable for analyzing tourism-related issues; the chosen series include data for the full length of the considered period; they are volume series, and are therefore not influenced by factors such as price, contrary to the series on income; they are strongly correlated with the series on stays, although they are preferable because they allow specific conclusions to be drawn regarding the performance of the domestic and foreign markets. Moreover, this choice goes along the common practice in the literature since the tourist arrivals variable is still the most popular measure of tourism demand over the past few years (Song & Li, 2008).

Step 2: Series' decomposition (seasonal adjustment) and analysis of the components. The trend-cycle, seasonal and irregular components of the selected series are extracted through the Census Bureau X-13ARIMA-SEATS method, employed in a multiplicative specification. It is a sophisticated method as it delivers the results for the time series' components isolated one by one, after several iterations which are conducted to refine and improve the estimation results. This procedure generally leads to improved accuracy in comparison with most alternative methods, as those tend to isolate the randomness and seasonal factors simultaneously. Moreover, it adjusts extreme values of the irregular component and accommodates changes in the seasonal components throughout the considered period, as these are estimated through moving averages and not simple averages. Finally, a series of diagnosis tests are also performed in order to determine whether the decomposition has been successful or not (full description of the X-12ARIMA available in Makridakis, Wheelwright, *et al.*, 1998, pp. 113-121). Afterwards, the trend-cycle component is split into trend and cycle: the trend is found by the curve that provides the best fitting from either linear or exponential; the cycle component consists on the deviations of the trend-cycle component from the trend, expressed in index. All components – trend, cycle, seasonal and irregular, are analyzed, and the weight of each on the series' total variability around the trend is measured. Decomposition plots, which depict the actual data and each of its components in a singular panel chart, are inserted to illustrate the decomposition procedure.

Step 3: Specific facets of seasonality – pattern and amplitude. The following aspects, also enumerated by de Cantis, Ferrante, *et al.* (2011), are analyzed with the use of several measures: (i) the pattern of seasonal swing; (ii) its intensity; and (iii) the persistency or the variations in the seasonal pattern and (iv) in the seasonal intensity. Such analysis is done in an interactive manner, as the pattern and intensity should be considered as interrelated, which implies that we characterize one while taking into account the others. As we are aware, there are several causes for seasonal patterns to occur in tourism. In general, those that determine the pattern itself tend to be more stable over time than those that determine its intensity. Still, it is important to analyze the changes in both, even in a yearly basis. Note that the analysis of the pattern will precede the analysis of intensity, for logical reasons pointed out by Kuznets (1933). Concerning the pattern of seasonal swing, seasonal sub-series plots are built showing the overall seasonal pattern and how the seasonal component has changed over time, thus providing a first approach all aspects from (i) to (iv). Seasonal indexes calculated globally, i.e. given by the mean of seasonal factors in each month over all the years considered, are also presented in these plots. Monthly standard-deviations of the seasonal factors are computed to assess the reliability of these seasonal indexes. There is no standard value for the standard-deviations from which a month's volatility is considered low or high, so some degree of subjectivity is present when making such considerations. Due to relatively high volatility in the seasonal factors, three seasonal indexes for 5-year periods are calculated for each series, which leads to a significantly more robust depiction of the seasonal pattern and allows a visualization of its evolution. With these results, the current peak-, shoulder- and off-seasons of the year are identified for each class of guests, and most of the description of the seasonal pattern and its evolution is made. Indexes of similarity are used to draw conclusions on which class of guests most determines overall seasonality, and how patterns have converged or diverged. With the different seasons identified, the Peak Seasonal Share is computed so as to assess whether the inflow of guests in the peak-season has dispersed to the rest of the year or remained concentrated. Because the seasonal indexes computed are expressed in pure numbers, non-casual OLS regression models (mainly supported on de Oliveira, Santos, *et al.*, 2011, pp. 189-201) are built to complement the analysis with indexes expressed in number of guests and with an approach that accommodates (even if poorly) long-term movements and changes in the seasonal pattern. Comparable models were not found in the literature, even though such models are technically grounded and have great potential. In building these models, more value is attributed to their ability to provide simple and useful interpretations than on their goodness-of-fit. In both models, Easter is treated separately since it is a moving holiday with. Finally, in order to measure and describe (the evolution of) the seasonal amplitude and intensity, the Peak Seasonal Factor, Seasonal Range and Coefficient of Variation are computed for each year.

Step 4: Relate the seasonal behavior of guests with the presence of LCCs. Having made the descriptions of paradigm and seasonality, the seasonal character of guests in accommodations is related with that of arriving passengers carried by LCCs (when compared with arriving passengers carried by FSCs). Two approaches are taken. The first consists on comparing the seasonal factors of passenger arrivals carried by FSCs and

LCCs, identifying the months where differences are most visible and assessing if they correspond to the months where guests' seasonal character changed the most. However, this approach is affected by the poor definition of the data concerning passenger arrivals. The data includes residents in Oporto and Portuguese passengers that reside abroad, who both may account for a significant portion of total arrivals, have no or little impact on the city's accommodations and/or present a different seasonal structure from that of foreign non-residents. The second approach is significantly less affected by this limitation. It consists on first identifying the years where LCCs increased their presence in Oporto most significantly. Then, indexes of similarity on the series concerning guests are computed to identify the years where seasonality changed the most. If both coincide in the same years, then it is reasonable to conclude that the seasonal character present in LCCs' arriving passengers and in tourism are related.

4. Empirical study: analysis and description of the case

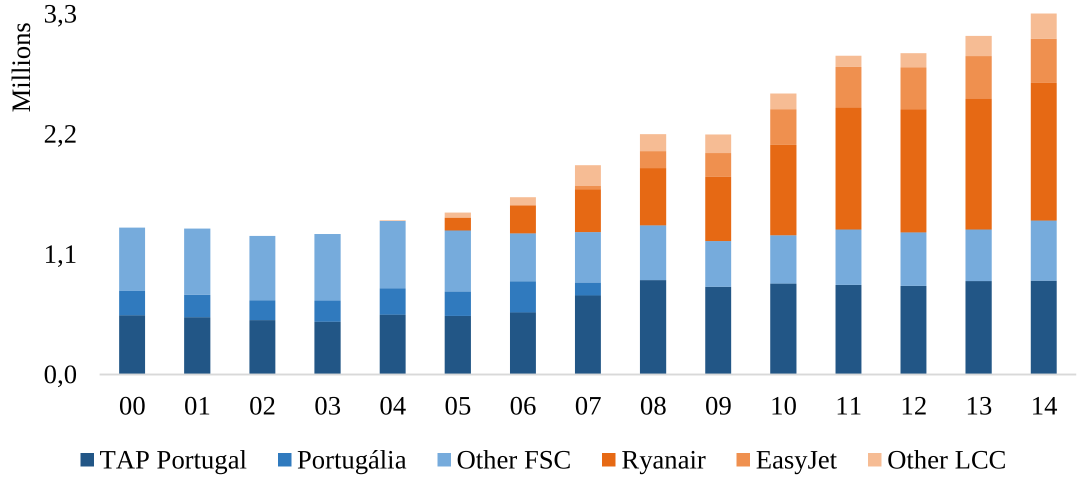
4.1. Analysis of the evolution of Oporto's airline market

Between 2000 and 2014, there was a strong trend-cycle upward movement in Oporto's inbound passenger flow, generated in part due to the introduction of LCCs in 2005 (Graph 2). Besides the almost continuous growth in passenger arrivals throughout the period, with only some interruptions and slowdowns, other evidences are also visible: first, the volume of inbound passengers carried by FSCs suffered little change in the considered period. Secondly, the volatility in total number of FSCs' passenger arrivals was relatively low not only for the whole period, but also after LCCs entered the market, both periods registering a coefficient of variation of just above 0.035. These two first points go to show that the presence of the LCCs did not undermine FSCs' business as much as it might be thought. According to ELFAA (2004, p. 7), this is generally the case[3]. How did LCCs manage to drive such traffic if not by capturing some of FSCs' market? This is the question that this subsection attempts to answer, reviewing the most relevant changes in Oporto's air transportation.

First, focus is drawn on the connections operated. Higher number of connections translates to a higher service to passengers through the extension of choices and accessibility. The data gathered is aggregated annually by carrier and place of origin

Graph 2 - Passenger arrivals at FSCA

Note: The airline Portugália was integrated in TAP Portugal in mid-2007

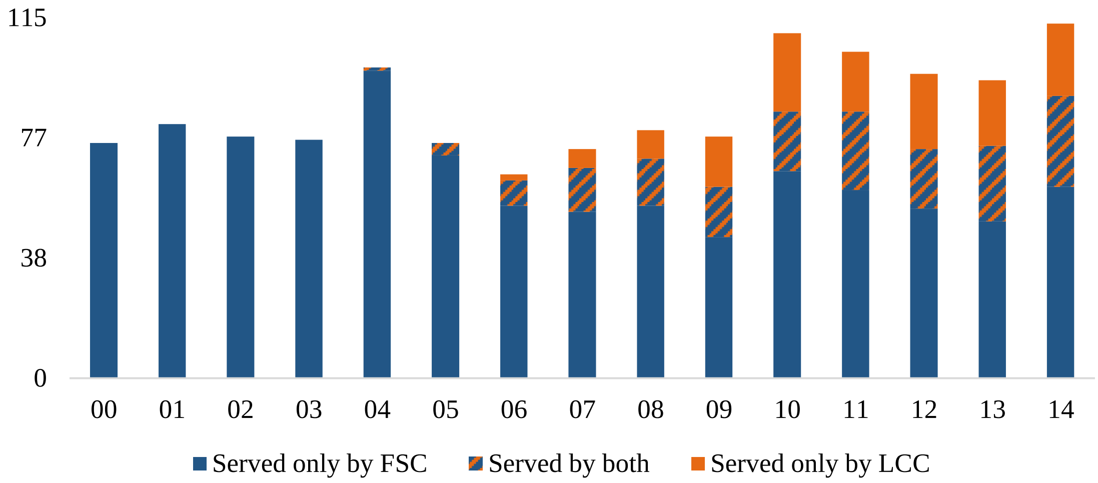


[3] ELFAA (2004) makes a reference to a study conducted by Infratest that finds that 59% of LCCs' traffic consists in new demand, and only 37% in a shift within the airline market. They even state that "passenger numbers for traditional airlines have generally increased as they have been forced to reduce their fares and improve service due to competition".

(airport), with reference to the type of carrier between LCC and non-LCC. Specialized services, such as charters, helicopters or private airplanes, are recorded as non-LCC. For this reason, this category includes innumerous records, that stretch from a 1-passenger annual inflow to an over 218k. In order to exclude inflows that are irrelevant, although able to mislead insights by, for instance, exacerbating the number of connections, we exclude from all following calculations the annual inflows that do not reach 75 passengers. Although small, we find that this value removes erratic inflows while keeping recurrent ones (proven by the relative stability of connections visible in Graph 3).

There were two one-shot increases in the number of connections: the first in 2014 and the second in 2010. The former should be related by the UEFA Euro Championship held by Portugal, since it was not sustained in following years. The latter, on the other hand, was grossly sustained. LCCs addressed routes that are simultaneously served by FSCs and others that are in each year only operated by them, both at a relatively even level. Of these last, not all can be considered new connections, since around 20% had been previously considerably operated by FSCs. In 2014, out of the 23 connections that LCCs operated alone, 15 were introduced by these carriers. In order to test whether these conclusions are distorted by the inclusion of connections with small volume of passengers, a similar analysis is made but now only including connections from which at least 300 passengers arrived, resulting in the graph inserted in annex 6.2. Some differences are evident: removal of more than one third of the total number of connections; the connections removed are in the greater part only served by FSCs (96%),

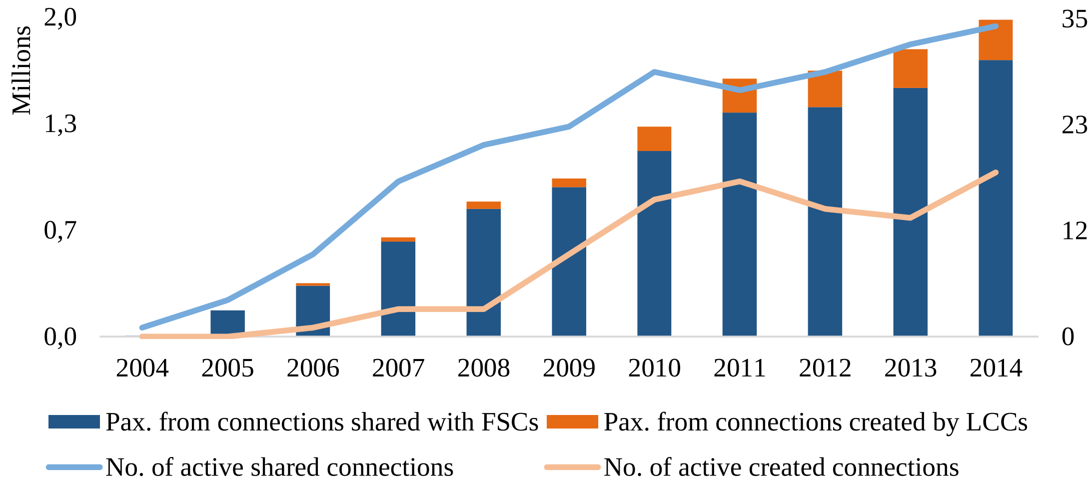
Graph 3 - Number of connections (cities) with 75+ pax arrived.
Note: a type of carrier is considered to have served the connection if it carried 75+ pax.



resulting therefore in a more expressive importance of LCCs on the number of connections; the peak number of connections is also reached in 2014, but the second peak is now reached in 2011 and not 2010, and the evolution since 2005 to that peak is much smoother, without any one-shot increase.

Even having established that the number of connections has increased, the question is still unanswered since connections differ greatly in terms of volume of passengers carried, as evident by the difference in results between the analyses with the minimum number of arriving passengers set at 75 and 300. So as to clarify where the volume of arriving passengers carried by LCCs comes from, we identify 24 connections that can be considered to have been introduced by these carriers since they were not considerably served by FSCs before and after the year of introduction. The bulk of arriving passengers transported by LCCs came from the same connections as those carried by FSCs, in a much higher proportion than the difference between shared and new connections created by LCCs (Graph 4). The last page of this subsection contains a "treemap" graph (Graph 5) depicting the passenger inflow of every connection operated by LCCs in 2014. Powerhouses such as, enumerated in decreasing order of importance, Paris, London, Geneva, Barcelona, Brussels, Madrid and Basel are clearly prominent, all reaching more than 100k passenger arrivals and together accounting for more than 50% of the total. None of them are connections created by LCCs. Among those that are, Eindhoven, Saint Etienne, Tours, Dusseldorf Weeze and Memmingen are the largest, also in decreasing scale, reaching all between 25k and 38k passenger arrivals.

Graph 4 - Decomposition of LCCs' passengers and connections

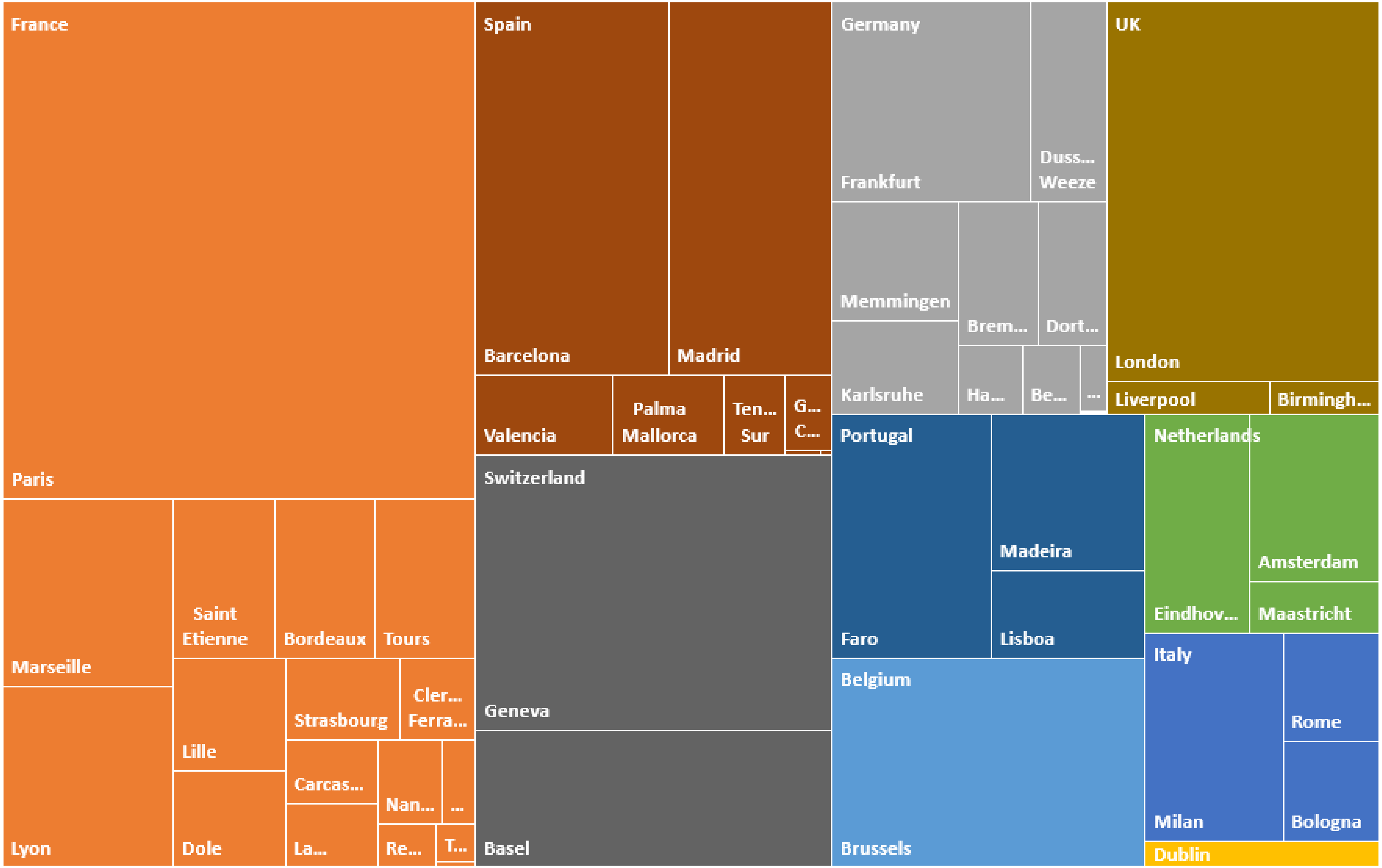


All in all, the entrance of LCCs allowed a sharp growth in the volume of passenger arrivals and an increase in the number of connections, although the latter is far from determining the former, since the bulk of the passenger arrivals brought by LCCs came from the connections that were also operated by FSCs. One last matter of interest is how the competition in connections evolved with this change of paradigm, with it being measured by the number of carriers that serve a single connection. No particularly expressive change can be identified in competition, other than a decrease of frequency of connections being served by 5 or more airlines, contrasting with the increase of frequency of connections served by 2 and only 1 carrier (Table 3). Competition in the considered period has, therefore, decreased.

Table 3 - Frequency of connections served by different numbers of carriers, in %

No. carriers	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
1	55	51	61	43	51	57	42	47	51	55	66	57	65	61	60
2	17	25	13	29	19	18	28	27	27	28	20	23	22	20	23
3	12	8	5	9	5	11	17	10	9	7	3	13	8	8	7
4	4	4	11	4	3	3	3	1	5	1	5	2	3	5	2
>4	12	13	11	14	23	12	9	14	8	9	5	6	2	5	8

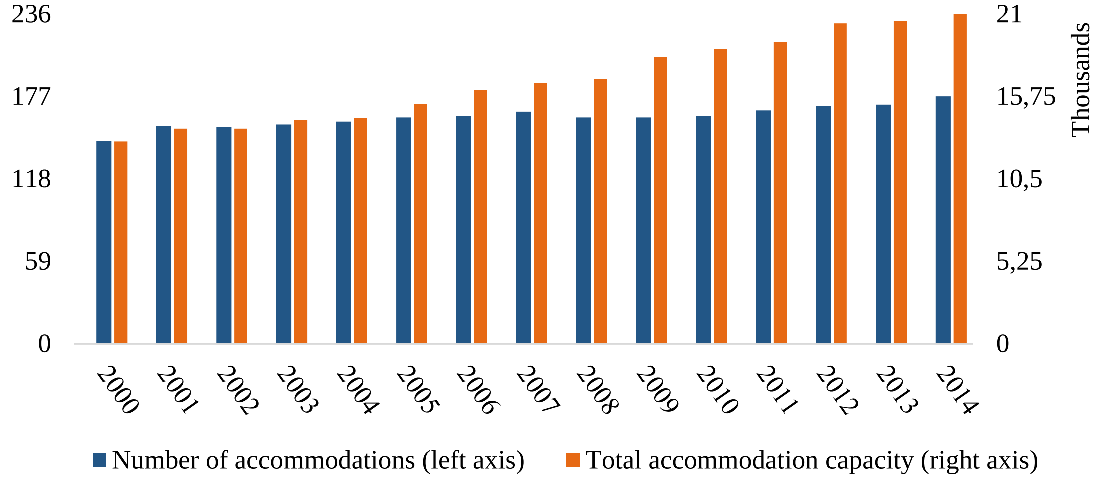
Graph 5 - Passenger arrivals carried by LCCs in 2014, sorted by connection



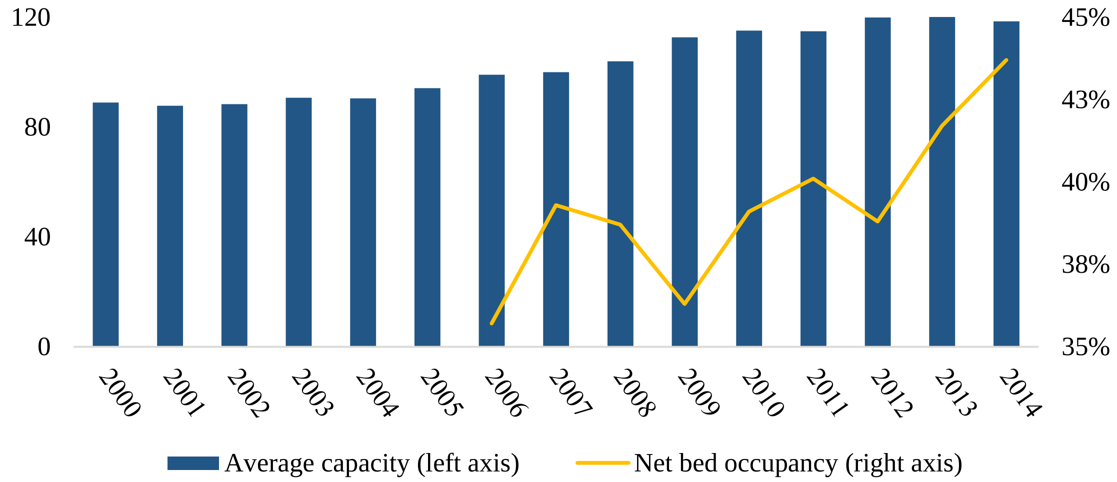
4.2. Analysis of the evolution the business of Oporto's accommodations

Concerning the accommodations' business, there are four main topics that can be addressed with the data obtained: accommodations' number and capacity, guests, stays and revenues. Starting with the first topic, the total number of accommodations between the period's extremes increased significantly, by 22% or 32 establishments, and the total capacity grew in an even higher proportion, by 63% (Graph 6). The difference in growth rhythms between the above two variables leads to the conclusion that total capacity was also driven by an increase of size, measured in terms of capacity, of new accommodation

Graph 6 - Tourism accommodations: number of and capacity
Note: This data consists of the number of accommodations in each year's month of July, since INE's survey only covers this month



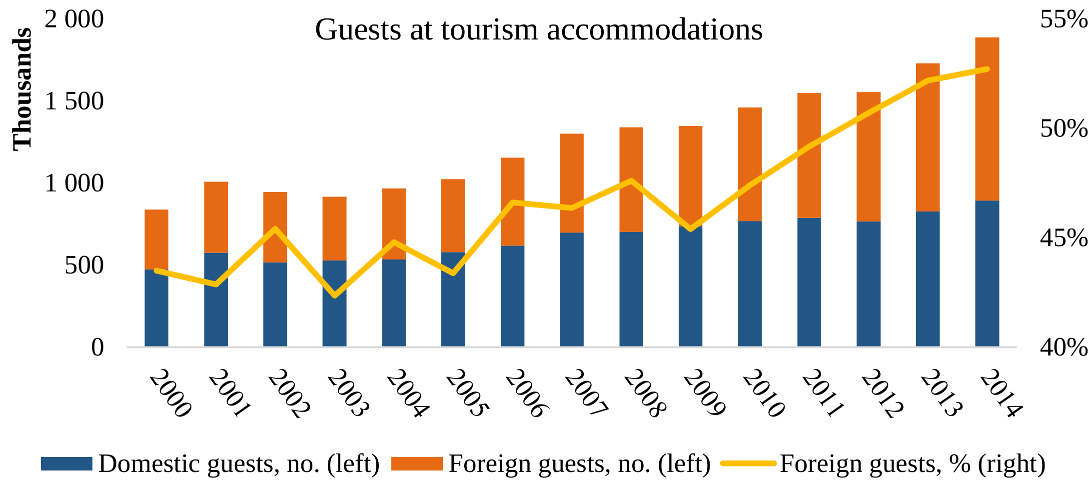
Graph 7 - Average capacity of accommodations and net bed occupancy
Note: This data is based on the number of accommodations in each year's month of July, since INE's survey only covers this month. Average capacity is calculated through the ratio of total capacity and total number of accommodation units.



units compared to older ones and/or an effort of increasing the capacity of already existing units. Isolating this effect, the average capacity of tourism accommodation units is shown in Graph 7. The period from 2005 to 2009 stands-out as where the increase of average capacity of accommodation units was particularly noticeable. In fact, during that period, the growth in total capacity was almost fully driven by the increase in accommodations' size. Higher capacity may allow accommodations to benefit from economies of scale, but only if the extra capacity is not left idle or, in other words, if the increase in capacity is not offset by a decrease in bed occupancy. Apart from a heavy drop in 2009 and a milder one in 2012, net bed occupancy had a clear upward trend between 2006 and 2014 (due to data restrictions, the analysis cannot include previous years).

In regard to the second topic, on accommodations' volume of guests, Oporto enjoyed a strong growth of total number of guests in tourism accommodation along the considered period, with a CAGR of 5.98% between extremes (Graph 8). Two periods can be distinguished: first, 2000 to 2005 marked by a milder growth of foreign and domestic guests, growing at similar pace (CAGR 4.02 and 4.12%, respectively); second, from 2005 to 2014, marked by a stronger growth led by a strong acceleration of foreign guests' growth in volume (CAGR 9.40%, while domestics' CAGR moved only to 4.93%). This difference in growth rhythm between foreign and domestic guests led to the former's consistent increase of importance in accommodations' business, having their yearly volume surpassed the volume of the latter in 2012.

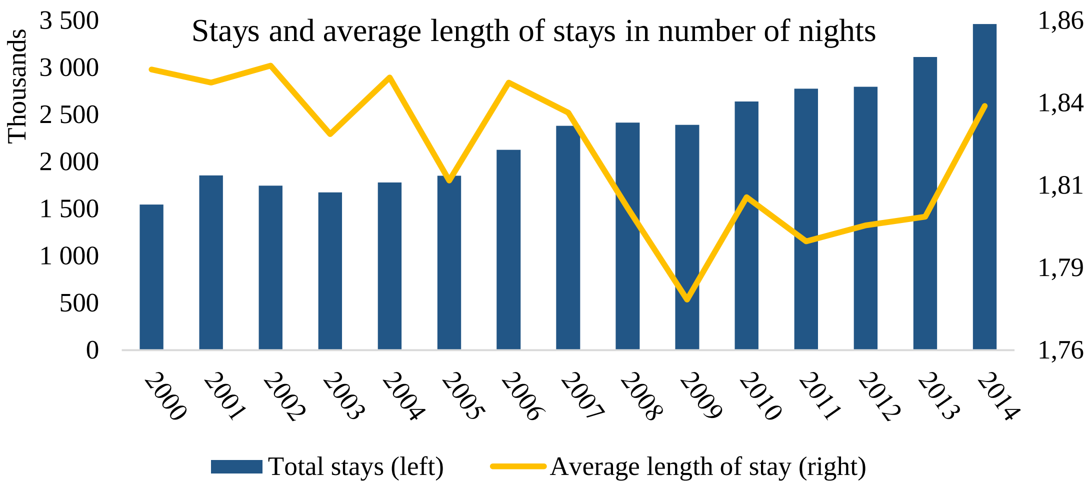
Graph 8 - Guests at tourism accommodations



The third topic is concerned with the number of stays in tourism accommodations. This is naturally related to the number of guests (correlation of 99%), but having both time series proves to be important to analyze the evolution of the average length of stay. Length of stay is relevant since the occupancy of tourism accommodations is dependent not only on the number of guests it attracts, but also the length of their stay in Oporto. Average length of stay in the city was always quite low, not reaching 2 nights per visit (Graph 9). Although this value is affected by typically short trips, such as business-related, it also reflects the type of tourism that is made: urban instead of sun-and-sea. Moreover, it evolved with volatility with a downward trend that, although apparently not too significant, cumulatively accounts for a loss of more than 350,000 stays between 2008 and 2013 comparing to the scenario in which the average length of stay would have been the same as the average value between 2000 and 2007.

Moving on to the final topic, total revenue that is generated in accommodations merely by the offer of accommodation to guests increased significantly between the period's extremes, evolving quite consistently with the previous indicators as it would be expected (Graph 10). However, one difference should be remarked: while the previous indicators benefitted from continuous growth between 2009 and 2014, only stalling in 2012, revenue stalled between 2010 and 2012, reflecting the negative change in average revenue per stay in 2011. In fact, the average revenue per stay had a descendent tendency, only beginning to reverse in 2014, although not entirely. One reason may be the change in the pricing strategy practiced by tourism accommodations, reflecting an increasing

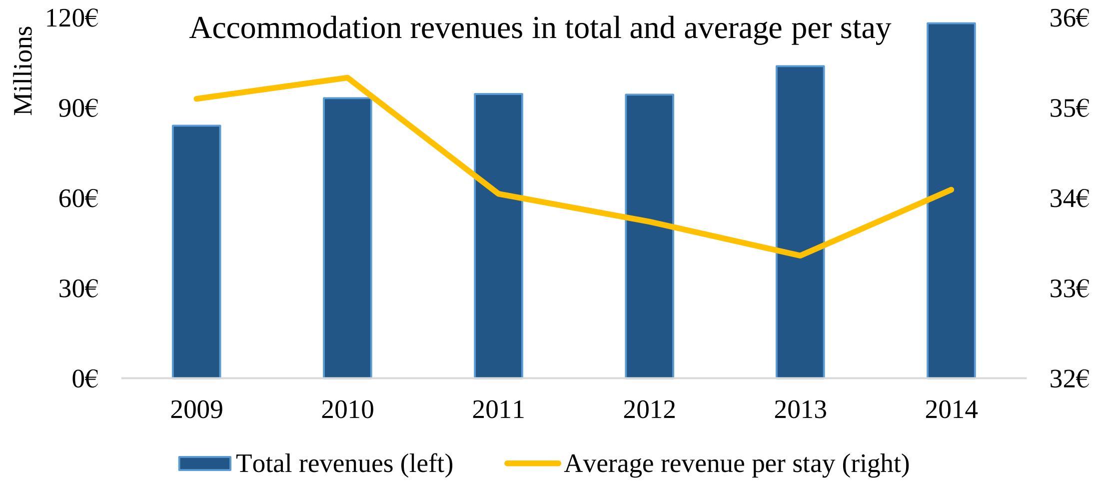
Graph 9 - Stays and average length of stay



prominence of price-sensitive tourists. Another reason may be the increase of average capacity among accommodations, discussed earlier in this subsection, which allows higher profits with more competitive prices though economies of scale. Nevertheless, the authors admit that, in order to support these statements, deeper research with a wider data set would have to be pursued. Average revenue per accommodation had, between 2009 and 2014, an upward trend. One should keep in mind, though, that the consequences of the 2008 financial crisis were felt in 2009 and following years. This positive trend of profitability was only fueled by the performance of total stays, which may be related with the discussion made previously in this subsection about accommodations' capacity and occupancy. This positive performance was much more than proportional to the growth of the number of accommodation units on offer, resulting in an increase of the average number of stays per accommodation, in index, by 33 points in 2014 when compared to 2009, which more than compensates the decrease in average revenue per stay in the same period.

All in all, relevant changes can be identified between the period prior to 2006 and after that year, not only in the airline market but also in tourism accommodations' business, which arguably may be extrapolated to Oporto's whole tourism industry. As said before, further research with more extensive and disaggregated data would allow a more insightful description of these structural changes, but the data gathered is enough to draw the following summarized remarks: accompanying a clear boost in growth of passenger

Graph 10 - Accommodation revenues in total and average per stay
Note: The variable *Estimated revenue* was calculated by multiplying the estimated stays, calculated for Graph 9, with the average revenue per stay in each year.



arrivals at FSCA, there has also been a consistent increase of guests at tourism accommodations (COR 97.35), especially foreign ones. The total amount of stays grew at a less than proportional pace, since the effect of the increase of guests was partially offset by a decrease in their average length of stay. Still, the number of stays has increased even when averaged by accommodation, which leads to increased total revenue in the sector.

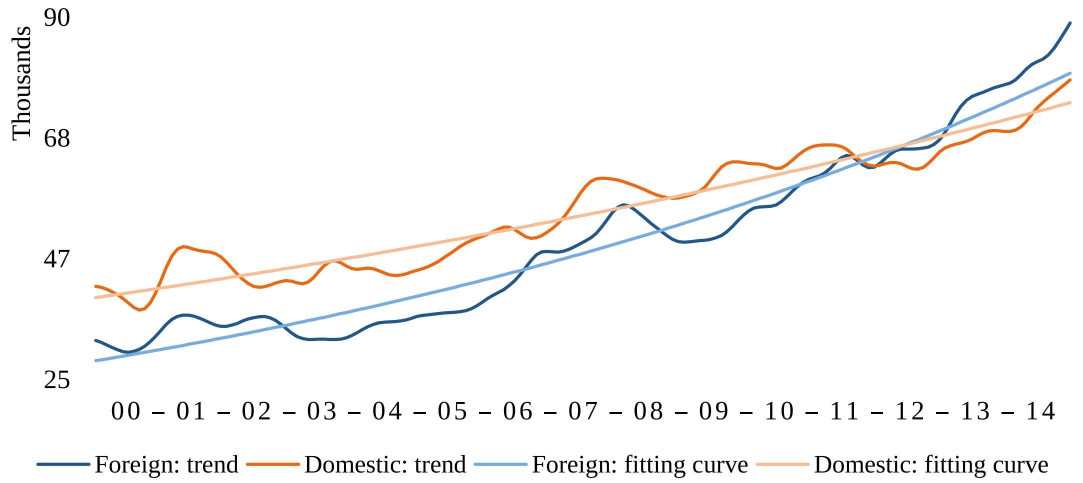
4.3. Seasonal adjustment and further exploratory analysis

The seasonal adjustment procedure through the Census Bureau X-13ARIMA-SEATS method allows the isolation and quantification of the trend-cycle, seasonal and irregular components of our chosen three series: total, foreign and domestic guests. It also allows the adjustment of seasonality for these series. Decomposition plots that illustrate the results of this procedure are inserted in the end of this subsection.

Yan and Wall (2003, p. 193) describe the trend component as the long-term upward or downward movement in the time series which “might be explained by such factors as growth of disposable income in origin areas, growth of population in origin areas, changes in tourists’ preferences, improvement of accessibility to the destination area, and greater recognition of tourism products of the destination area”. They refer to Witt and Witt (1992) who reviewed various studies that used regression analysis to study the trends and roles of such variables influencing trends for many countries. We can also refer to Witt and Witt (1995). Concerning our selected series, a simple visualization of the three series’ trend-cycle components allows us to conclude that all three are positive and not so in a decreasing rate, reflecting sustained long-term upward movement of both foreign and domestic guests. In order to assess whether the rate of change of each trend was relatively constant or increasing, we try fitting linear and exponential curves to their trend curves through an OLS regression analysis with time as the only independent variable. If the linear proved to provide the best fitting, the rate of change would be rendered constant, or increasing if the exponential proved to be best. These curves may be interpreted as the trends themselves, as they smooth the trend-cycle component, eliminating short and medium-term movements. Yan and Wall (2003) performed such a regression analysis to obtain trend curves, but on the observed data. From our exercise (Graph 11), we conclude that the trend growth in volume of domestic guests in the considered period is best described as constant, since the linear model provided the best fit. Nevertheless, the fit is just barely more accurate and the exponential model estimated a monthly increase of 0.35%, which indicates that the trend growth of domestic guests was not only strong but sustained. Concerning foreign guests, the exponential model provides a considerably better fitting curve than the linear one, constituting evidence that the growth in their volume was increasing in pace. The model estimates a monthly increase of 0.58% in volume, indicating a higher growth than in domestic ones. This growth tendency pushed the volume of total guests to also show a similar increasingly growth trend (growing at 0.46%). Technical explanation of the exercise conducted along with details on the results are inserted in annex 6.3. The acceleration of the trend volume of foreign guests happened particularly since late 2009, although it may be argued that it begun in early 2006 with an interruption between mid-2008 and the third quarter of 2009, during the international economic crisis. This acceleration led foreign guests to tendentiously be more present in Oporto's accommodations than domestic ones since 2012.

Yan and Wall (2003, p. 198) defined cyclical fluctuations as "long-term, cumulative, self-generating, upward and downward movements around the general trend". Unlike seasonal fluctuations, that tend to occur with repetitive length and intensity, cycles are unpredictable concerning their characteristics, although they usually last for more than 1 year (Yan & Wall, 2003). Although we acknowledge that estimations of cycles are "somewhat artificial and difficult to accomplish", as Makridakis, Wheelwright, *et al.* (1998) put it, we calculate the deviations of the trend-cycle curves to the fitting curve, interpreted as the trend, both illustrated in Graph 11, and interpreted these deviations as

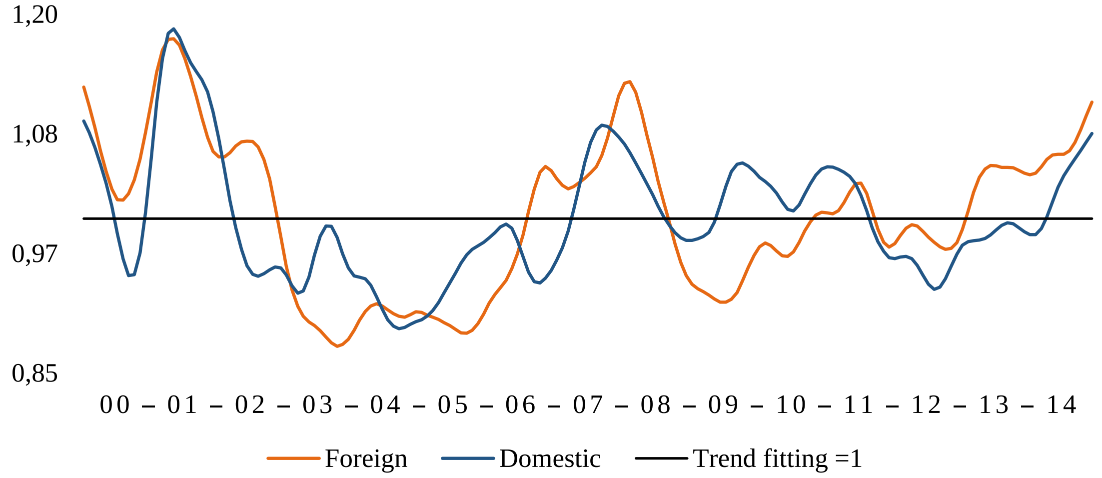
Graph 11 - Foreign and domestic guests' trend-cycle and fitting curves



cyclical fluctuations (Graph 12). Since the deviations are calculated by dividing each series' trend-cycle component by the respective trend fitting curve, they are expressed in index with the trend as base. The evolution of foreign and domestic guests' cyclical fluctuations are relatively aligned (COR of 0.686). Although the reasons for cyclical fluctuations are multifaceted and difficult to identify (Yan & Wall, 2003), this alignment suggests that, despite the obvious differences between the two markets involved, they reacted similarly to the causes of cyclical variation.

Concerning the seasonal component, each series' seasonal factors had a different behavior in the considered period: seasonality of guests in total seems to have relatively maintained the same pattern, although slightly increasing in amplitude (here defined as the difference between peak and bottom); seasonality among foreign guests also grossly maintained the same pattern, although decreasing in amplitude; and seasonality among domestic guests changed its pattern considerably into one with lower amplitude. This can be seen either in the decomposition plots (Graph 14-Graph 16) or in Graph 13, where the series' seasonal factors are overlapped to allow an easier comparison. The amplitude of foreign guests' seasonal pattern was much larger than that of domestic. Why seasonality in guests as a whole increased while seasonality in foreign and domestic decreased is, even if only partly, explained with the increase in weight of foreign guests over the whole volume of guests. Moreover, we find in the next subsection (4.4) that the seasonal pattern of domestic guests, which in the beginning was distinguished from that of foreign guests and thus contributed to smoothen total guests' seasonality, evolved in such a way that

Graph 12 - Foreign and domestic guests' cycles

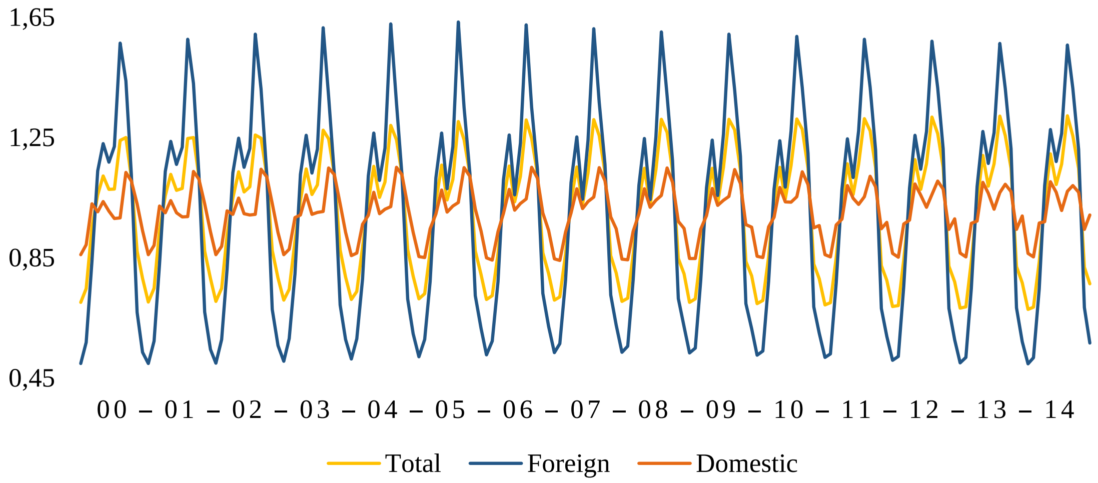


became increasingly less distinguished, thus contributing to intensify total guests' seasonality. These two points reflect the importance of defining different markets of origin, quantifying and describing the seasonal swings' intensity and pattern of each, so as to build more effective marketing strategies aimed at reducing seasonality in guests as a whole (see research pieces that pursue this line of work in section 2.4). More disaggregated data would allow much more insightful and useful information for this purpose.

The irregular component consists of "erratic variations that occur abruptly, in an unpredictable fashion, for no obvious reason (i.e. they are random)" (Yan & Wall, 2003, p. 201). Not much can be obtained from their analysis precisely because of their random nature, which explains why it is desired that they account for a small proportion of a series' total variability. In all three series, irregulars indeed decreased, particularly those of the foreign guests' series starting from mid-2006, although these still remained the highest of the three in the last years considered. The causes for these decreases are unknown to the authors, although we agree with Yan and Wall (2003) who found the same evolution in their series and explained them by arguing that larger variances in the early years may reflect the smaller number of tourists.

Now that all components have been isolated and quantified, we can assess the relative importance of each to the overall fluctuation around the trend curve. To this end, the annual average deviation from the trend curve induced by each component is calculated, expressed in index values. More detailed explanation of the calculations is inserted in

Graph 13 - Total, foreign and domestic guests' seasonal factors

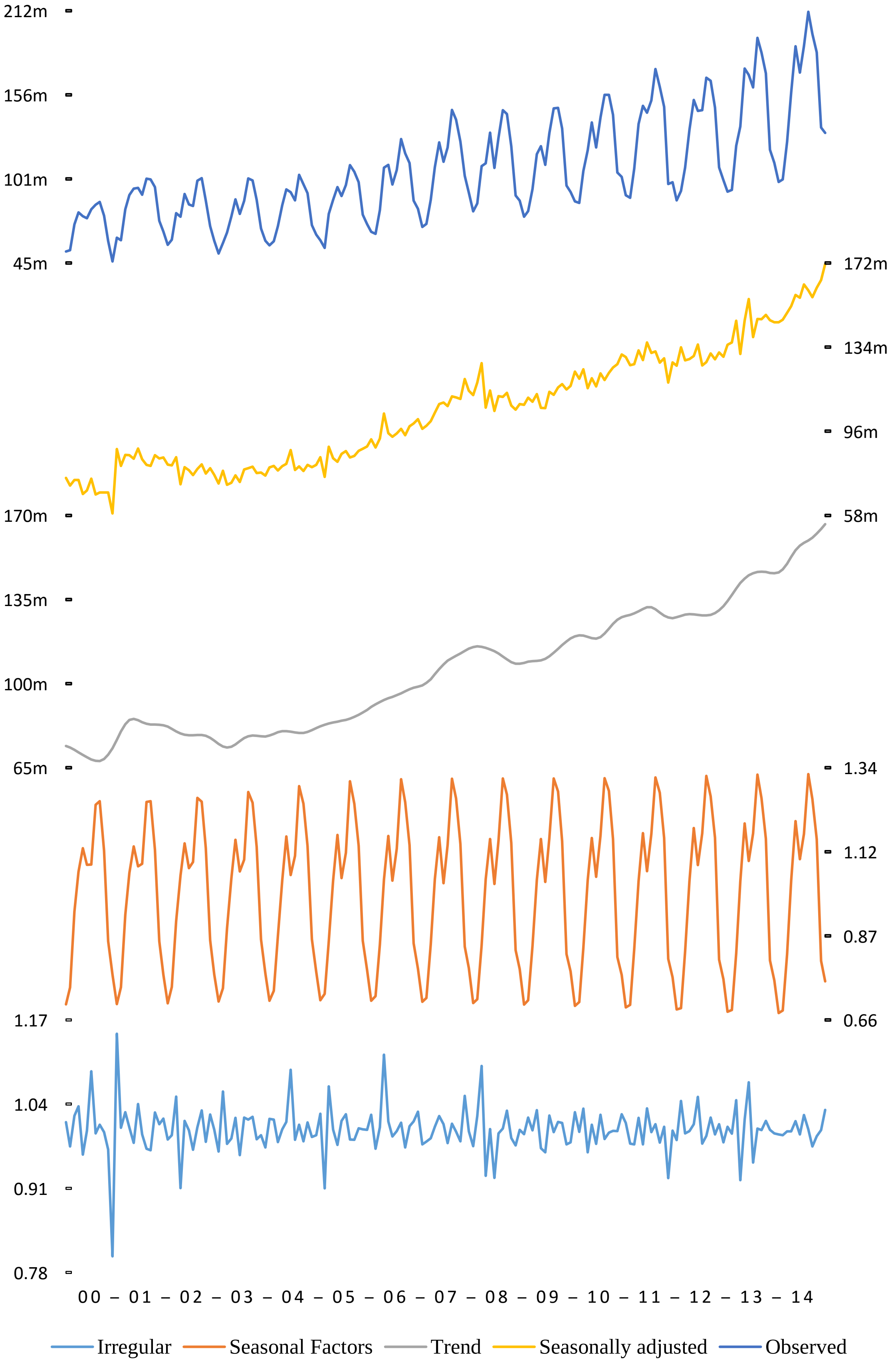


annex 6.4. The highest proportion of total fluctuation around the trend can be attributed, for both markets, to seasonality (Table 4). This is particularly expressive among foreign guests, whose seasonal nature accounts always for over 60% and has even almost reached 90% of the total variability between 2010 and 2012, years marked by a mild and stable cycle. Among domestic guests, seasonality accounts for a much smaller proportion of the total fluctuation, in a range between 25 and 70%, being twice surpassed by the cycle's contribution. In both markets, the fluctuation of seasonality has been increasing, more distinctively again among foreign guests. On the other hand, both the cyclical and irregular components have been accounting for a decreasing proportion of fluctuation, although the former is more irregular. All in all, seasonal variations are distinctively significant and responsible for the total fluctuation of the volume of guests around the trend.

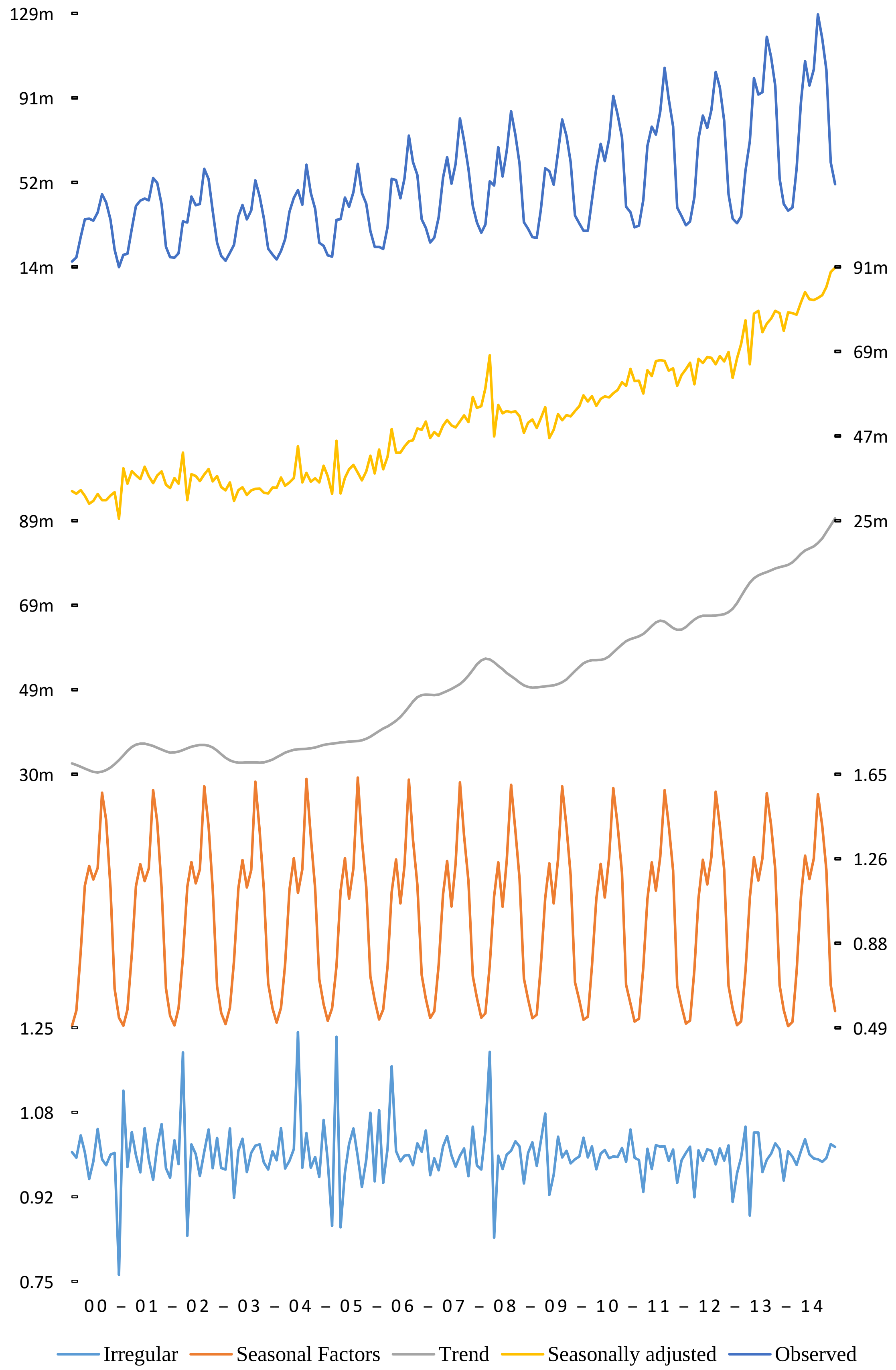
Table 4 - Components' size of variation, expressed in indexes of base 0

	Foreign guests			Domestic guests		
	Cycle	Seasonal	Irregular	Cycle	Seasonal	Irregular
2000	0.059	0.315	0.036	0.046	0.057	0.041
2001	0.132	0.314	0.041	0.140	0.057	0.042
2002	0.056	0.312	0.051	0.045	0.057	0.015
2003	0.101	0.308	0.028	0.041	0.060	0.029
2004	0.092	0.304	0.047	0.085	0.066	0.016
2005	0.101	0.299	0.071	0.059	0.069	0.035
2006	0.047	0.296	0.037	0.033	0.072	0.015
2007	0.055	0.296	0.024	0.057	0.074	0.011
2008	0.067	0.299	0.049	0.030	0.075	0.025
2009	0.068	0.305	0.029	0.031	0.075	0.025
2010	0.022	0.313	0.016	0.027	0.074	0.024
2011	0.018	0.319	0.023	0.033	0.072	0.019
2012	0.019	0.326	0.025	0.049	0.070	0.022
2013	0.039	0.329	0.036	0.015	0.068	0.015
2014	0.068	0.331	0.012	0.038	0.068	0.028

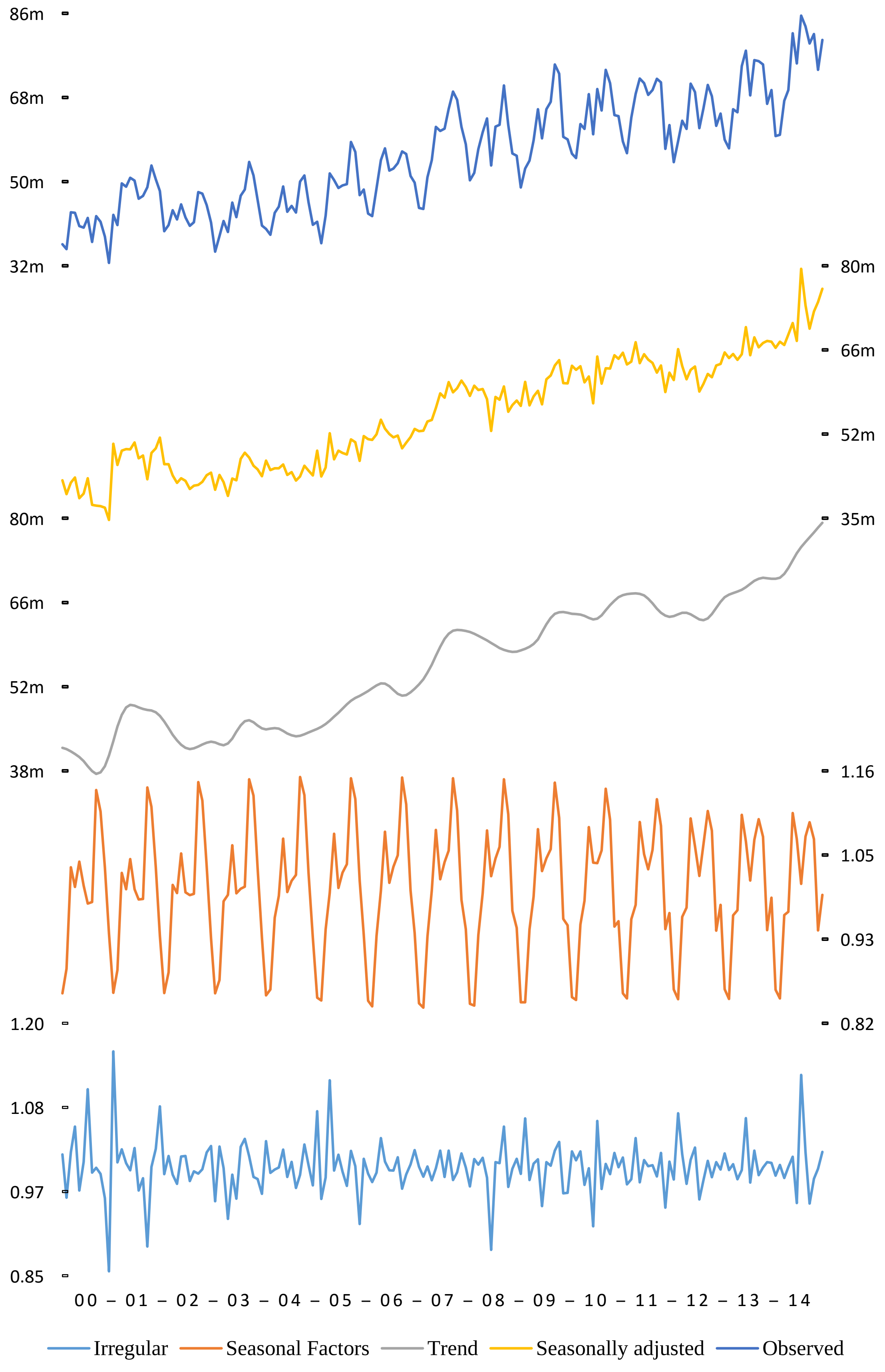
Graph 14 - Decomposition plot of total guests



Graph 15 - Decomposition plot of foreign guests



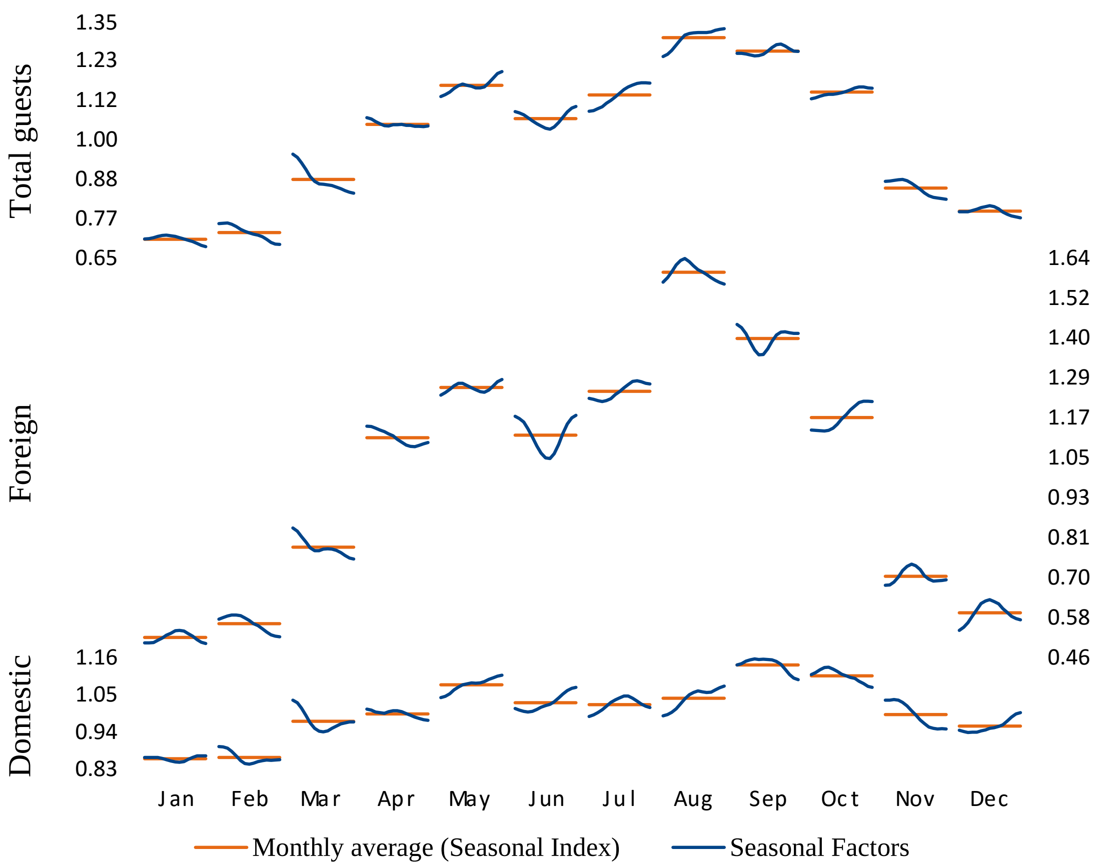
Graph 16 - Decomposition plot of domestic guests



4.4. Specific facets of seasonality – pattern, amplitude and intensity

As said in the methodology section (3.2), two facets of seasonality can be distinguished and analyzed: its (i) pattern and (ii) amplitude. Since both may change over time, the (iii) persistency or variation in the pattern and (iv) amplitude can also be analyzed. There are, therefore, four characteristics that need to be addressed in an interactive manner, as they are all interrelated. Generally, the analysis of the pattern precedes that of the amplitude, for logical reasons. However, this subsection begins with seasonal sub-series plots for each variable, which are jointly presented in Graph 17. Although we did not find any research piece that made use of such plots, they are particularly useful to offer a first impression on the four characteristics mentioned above. Plotting all seasonal factors by month instead of chronologically allows for immediate visualization of how each month's factors performed relative to those of other months, giving a sense of how the pattern has evolved over time. The plot allows the changes in seasonality to be directly comparable

Graph 17 - Evolution of total, foreign and domestic guests' seasonal factors
Note: the vertical axes are scaled in such a way that reflect the difference in seasonal amplitude of the variables, allowing direct comparison between them

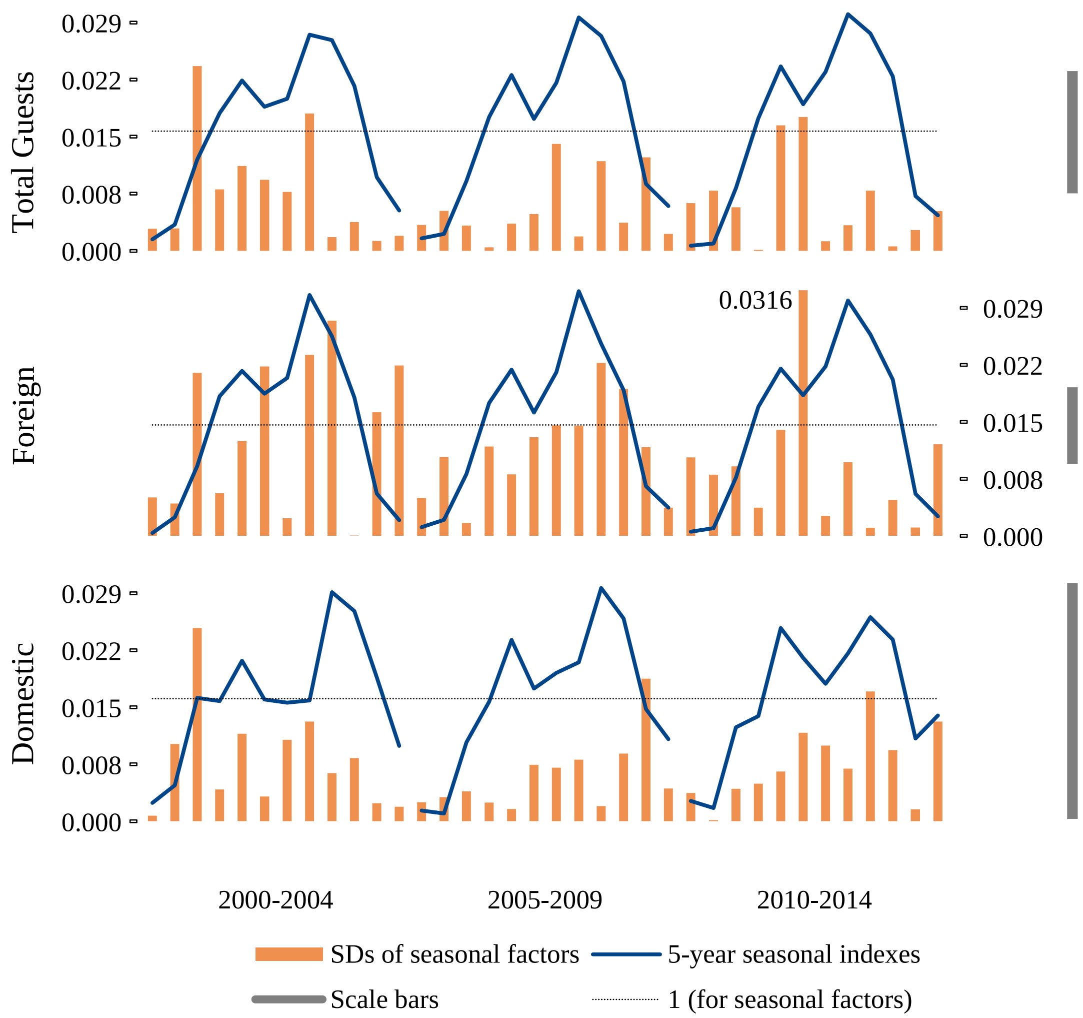


between variables. Observing the plot, the first thing that stands out is the difference in seasonal amplitude already established in the previous subsection (4.3). Considering the total volume of guests, and taking only an overview approach instead of describing each month's evolution, some sharp changes can be identified both in an upward and downward directions. While all months that originally had a seasonal factor lower than the unity saw them decrease, all except one with a value higher than the unity saw them increase, increasing the gap between them and thus suggesting a widening of the seasonal amplitude. Concerning foreign guests, a similar trend of distancing can be argued to exist, although not so clearly because a total of 5 months contributed to narrowing this gap. Volatility in a given month seems to be even higher among foreign than total guests. Lastly, the evolution of the seasonal pattern of domestic guests is harder to describe because of the significant changes in the seasonal factors that result in various different orderings of the months throughout the considered period. 5 months have moved from below unity to above or vice-versa and another 4 have moved closer to the threshold. Absolute volatility does not seem to be significantly lower than with foreign guests, which makes relative volatility among domestic guests more significant, given the smaller amplitude between the bottom and peak months, consistent with the changes in pattern established in the previous subsection (4.3).

Graph 17 also includes seasonal indexes calculated globally, i.e. given by the mean of seasonal factors in each month over all the years considered. Their interpretation must be made with caution, as they are only reliable when volatility of the seasonal factors is low, which seems not to be the case from the analysis just made. Notwithstanding, further study allows us to conclude that volatility in the seasonal factors is not great enough to prevent an adequate analysis of the seasonal indexes: maximum values for the coefficients of variability, which measure the extent of variability of a month's seasonal factors in relation to the respective seasonal index, are of 4.1, 4.8 and 3.6% for total, foreign and domestic guests, respectively. A graph matching each variable's monthly seasonal index with the standard deviation of the respective seasonal factors is inserted in annex 6.5. Although a global analysis could be considered adequate, we break the considered period into 3 sub-periods with equal length of 5 years, calculating seasonal indexes for each sub-period with the respective factors (Graph 18). We find that this representation technique, also not found in the literature, is a good compromise between allowing the visualization of "average" seasonal patterns and caring for the reliability of their interpretation, when relatively long periods of time are considered in the analysis. Compared to the alternative of considering the whole period, maximum values for the coefficients of variability drop to 2.6, 3.9 and 2.5% for total, foreign and domestic guests respectively, and total variability of the seasonal factors, measured by the sum of standard-deviations for all series and the whole period, decreases in 60%. Moreover, in our view what the technique may arguably lose in relevance of the seasonal indexes, because they no longer consider the whole period but only a third of it, is compensated with the ability to show changes in pattern. Concerning foreign guests, their seasonal pattern remained rather stable, with

Graph 18 - Seasonal patterns: seasonal indexes and standard-deviations

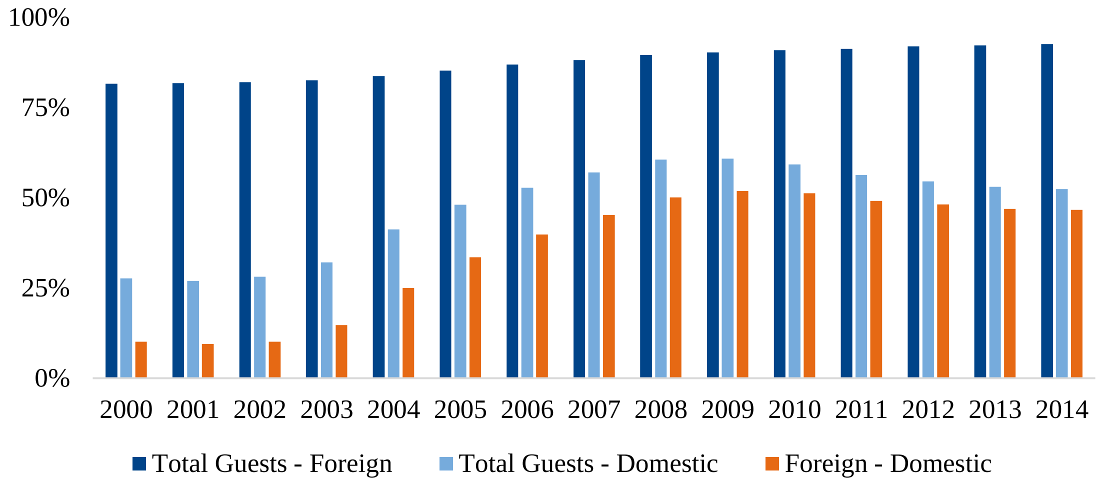
Note: the axis labels reflect SDs' scales; the scale bars represent the same seasonal amplitude, of 0.304, in each series' scale. Minimum and maximum values for each series seasonal factors: 0.69 and 1.32 for Total Guests; 0.50 and 1.61 for Foreign; and 0.85 and 1.15 for Domestic.



the months with above unity seasonal indexes, generally considered peak and shoulder periods, remaining the same: all between April and October. Nevertheless, some slight movements are still noticeable: leveling of the peak period, with the August peak decreasing in importance and July and September increasing; extraordinary volatility of June's seasonal factors, dropping steadily and strongly since 2000 to 2008, but then inverting the tendency and ultimately reaching the same initial value in 2014; shift to the "right" of the shoulder months, with October' and May's seasonal factors increasing considerably, but April's decreasing; the shoulder period remains confined to the same months since, on the left barrier, February and March register decreases in importance and, on the right, November remains with quite the same; increase in importance of the bottom months of January and December; as a whole, the months with favorable seasonality in 2000 increased in importance (measured by the sum of seasonal indexes) while the others decreased, further widening the gap between the two groups. One can also note that the pattern for foreign guests has been stabilizing, signaled by the lower values of the standard-deviations. Concerning domestic guests, their seasonal pattern suffered very significant changes over the considered period. In the beginning, the pattern could be characterized for only having one peak in September, although not anymore since May evolved to become a second peak, almost at an even level with the former which, in turn, has decreased significantly in importance. Before, the shoulder period could be considered to go from March until November (excluding the mentioned peak), with seasonal indexes slightly above or just below the unity; now, the period favorable to seasonality has become more leveled and shorter, consisting of the months between May and October inclusively. March, April and November are now unfavorably affected by seasonality, with seasonal indexes considerably lower than the unity. Off-season included January, February and December, with the first two months considerably less important than the last; currently, of these three months only January and February remain distanced bottoms, having December increased in importance and leveled with April. Between foreign and domestic guests' patterns, the pattern of total guests reflects that of foreign the most, which is natural given the fact that the proportion of these guests over the total was, for the whole period, between 43 and 53% and increasing (see section 4.2) and that they present a much higher seasonal amplitude. This result is visible in Graph 19, which plots the indexes of similarity of the three possible combinations of patterns: total with foreign and domestic guests and foreign with domestic guests. As Kuznets (1933, p. 282) states, "the index of similarity measures the percentage of deviations (…) that is common to the two seasonal swings compared". The graph shows that total and foreign guests shared, since the beginning of the considered period, above 80% of their total seasonal variation, while domestic guests only shared below 30%. This indicates that the shape of the seasonal pattern experienced in Oporto's overall tourism was mostly determined by foreign guests. Nevertheless, total and domestic guests' seasonal pattern became increasingly similar from 2004 to 2009, only to become more distinguished again afterwards. This suggests that, during this period, domestic guests' pattern evolved in such a way that it become more similar to that of foreign guests, which is confirmed with the orange columns in the graph. This must have contributed to the intensification of the seasonal swing among guests as a whole, already mentioned in the previous subsection (4.3) but further analyzed here: the seasonal pattern present in total guests remains one-peak, in August, with a shoulder period between April and October; of all these months only April evolved unfavorably, having July, August and May recorded the highest increases in importance; on the contrary, all months with unfavorable seasonality in 2000 further lost importance in the pattern, particularly February, March and November.

The above analysis is based on three 5-year periods to calculate seasonal indexes less affected by volatility in the seasonal factors. Nevertheless, other periods could be defined so as to further decrease volatility and thus increase the robustness of the indexes. In order to not base this definition on trial and error, since each trial involves various calculations,

Graph 19 - Indexes of similarity between total, foreign and domestic guests



indexes of similarity may be used to identify periods where the seasonal pattern remained rather stable, and thus where seasonal indexes are less affected by volatility in the factors. Table 9 (in the next section, 4.5) presents such indexes of similarity, from which we decided to experiment defining the sub-periods 2000-2002, 2003-2011 and 2012-2014, and see if the resulting seasonal indexes were reliable. We find that total variability of the seasonal factors, again measured by the sum of standard-deviations for all series and the whole period, decreases in 66% compared to the alternative of globally calculated seasonal indexes, more 6 percentage points than when defining three 5-year sub-periods. But we also find that this combination of sub-periods leads to the concentration of the variability in the middle (lengthier) sub-period, damaging the reliability of the seasonal indexes within it. It was for this reason that we presented the 5-year sub-periods.

Due to the importance of the peak season (on employment, capacity endowment, carrying capacity, among other factors succinctly enumerated in subsection 2.3), it is relevant to assess the impact that the growth or contraction of the overall tourism demand has on it. To this end, we use the Peak Season's Share (PSS), which quantifies the share of a year's increase or decrease in total volume (of guests, in our case) that is attributed to the peak season. Following the analysis made in the previous paragraphs, we consider

Table 5 - PSS and weight of peak season in total volume, both in %

	Guests		Foreign		Domestic	
	PSS	Weight	PSS	Weight	PSS	Weight
2000	-	20.2	-	35.1	-	26.3
2001	18.9	20.0	32.3	34.7	27.6	26.5
2002	1.0	21.2	-156.2	35.9	21.0	27.1
2003	-0.5	21.9	39.7	35.5	82.6	28.5
2004	-0.5	20.7	25.4	34.5	-14.5	28.1
2005	26.4	21.1	58.6	35.0	32.5	28.4
2006	22.2	21.2	35.1	35.0	11.2	27.4
2007	28.8	22.0	37.4	35.3	35.7	28.3
2008	9.2	21.7	33.4	35.2	-48.1	27.8
2009	69.3	21.9	17.9	35.9	51.1	28.9
2010	15.5	21.4	32.9	35.6	0.2	27.7
2011	25.4	21.6	46.7	36.6	8.1	27.2
2012	-29.2	21.4	14.7	35.8	25.5	27.3
2013	25.9	21.9	33.3	35.5	25.7	27.1
2014	18.5	21.6	31.2	35.1	25.8	27.0

the peak seasons of each series to be the following: August and September for total guests; between July and September for foreign guests; May, September and October for domestic guests. Values of PSS in Table 5[4] seem to be unrelated to changes in weight, but that is because of the volume of increase or decrease in guests involved. For instance, total guests' PSS value of 69.3% in 2009 is related to an only 0.2p.p. increase in weight, while the PSS value of 28.8% in 2007 is related to an increase in weight of 0.8p.p., which is explained by the fact that the increase in total volume of guests was 19x higher in 2007 than in 2009. The table shows that there was no clear trend of change in all three series, each showing a total amplitude of less than 3p.p. in the percentage weight of the peak season and seemingly random values for PSS. Therefore, one can conclude that there was no dispersion of the volume of guests from the peak season to the off-peak. Note that the weight of peak seasons are not directly comparable between series since the seasons are made of different months, and also different numbers of months.

The final approach consists on building non-casual OLS regression models, with the sole purpose of describing the series' behavior throughout time and seasonal fluctuations. Until now, we made such description through approaches which support on the seasonal factors and thus only provide results in pure numbers, with the exception of the Peak Seasonal Share which provides results in percentage. OLS models allow a "more real" sense of how critical seasonality is, since their results are expressed in the same unit of measure as the original series, in our case number of guests (total, foreign and domestic). In building these models, more value is attributed to their ability to provide simple and useful interpretations than on their goodness-of-fit. Two specifications are built, each providing different insights and thus being complementary rather than substitutable. The first is the following:

$$\text{Model I: } Y_t = \sum_{j=1}^{12} \beta_j D_{jt} + \beta_{13} EASTER_t + v_t$$

[4] PSS values should be interpreted as follows: in years where the total volume of guests for a certain series increased, negative values indicate an absolute decrease of guests in the peak season and values lower (higher) to the previous year's weight indicate a decrease (increase) in the season's weight; in years where the total volume of guests for a certain series decreased, which are filled in grey, positive (negative) values indicate an absolute decrease (increase) in volume of guests and if lower (higher) to the previous year's weight, lead to an increase (decrease) of weight.

where Y_t is the time series' actual data at *t*, where the series can be either total, foreign or domestic guests;

D_{jt} is the seasonal dummy for month *j* that is given the value of 1 when *t* corresponds to that month in any given year;

$EASTER_t$ is a series that reflects the position of Easter in the year. We define Easter holidays as a 5-day long period around Easter day; if the whole period falls in one month, the variable takes the value of 1 in it and 0 in the other months, whereas if the period is split between two months, a proportional value is attributed to each;

t is the number of the month considering the whole period, from 1 to 180;

v_t is the irregular (or remainder) component at *t*.

The idea behind Model I is to obtain globally-calculated seasonal indexes expressed in number of guests. Its specification reflects the following decisions: first, the use of dummies to capture the seasonal movements, which is a common practice in the literature. Each dummy assumes the value of 1 when *t* corresponds to the month *j* in any given year, and 0 in the other cases. Second, the inclusion of Easter as an independent variable since

Table 6 - Model I: OLS estimation results and respective seasonal indexes

Note: seasonal indexes are calculated by dividing the respective parameter by the parameters' average; total guests' parameters correspond to the sum of foreign and domestic guests' parameters; more detail on the results are shown in annex 6.6.

	Guests		Foreign		Domestic	
	Parameter	*S. Index*	Parameter	*S. Index*	Parameter	*S. Index*
Jan	72,154	*0.688*	25,009	*0.507*	47,145	*0.847*
Feb	73,670	*0.702*	26,531	*0.538*	47,139	*0.847*
Mar	90,285	*0.860*	37,048	*0.751*	53,238	*0.957*
Apr	101,408	*0.966*	45,653	*0.926*	55,755	*1.002*
May	121,873	*1.161*	62,314	*1.264*	59,560	*1.070*
Jun	112,738	*1.074*	56,506	*1.146*	56,232	*1.011*
Jul	119,945	*1.143*	62,498	*1.268*	57,448	*1.032*
Aug	137,859	*1.314*	79,777	*1.618*	58,081	*1.044*
Sep	133,504	*1.272*	70,777	*1.436*	62,728	*1.127*
Oct	121,448	*1.157*	59,914	*1.215*	61,534	*1.106*
Nov	90,447	*0.862*	35,666	*0.723*	54,781	*0.984*
Dec	83,975	*0.800*	29,891	*0.606*	54,084	*0.972*
Easter	8,176	-	9,480	-	-1,304	-

its effect cannot be captured by the seasonal component due to its mobility, where we take a similar approach of that of Gonzáles and Moral (1996). Third, to not capture the trend-cycle since trying to do so would disrupt the parameters of the seasonal dummies. In fact, we also built an alternative model which captured this element as a linear movement throughout time, i.e. with a constant absolute value of the parameter β_{13} being added to Y_t for every increment of t. Although it provided significantly better-fittings, the estimations of the parameters were unable to be read as seasonal indexes, reason why we do not present it in this study. The model presented here draws the already established difference in amplitude of seasonality between foreign and domestic guests (Table 6): while the difference between the peak and bottom among domestic adds to almost 15,600 guests, it almost reaches 54,800 for foreign guests. Because the peaks and bottoms occur in different months for foreign and domestic guests, the seasonal amplitude among total guests is lower than the sum of these two values, adding to 65,705 guests. We find that the seasonal indexes in pure numbers are quite similar with the ones computed from the seasonal factors: the average of absolute differences between them add only to 0.020, 0.039 and 0.010 for total, foreign and domestic guests, respectively. Concerning Easter, the estimation results should be interpreted with care, as they have p-values of 0.56, 0.28 and 0.81 for total, foreign and domestic guests, respectively. Still, the model estimates a relevant positive effect of Easter among foreign guests, and a curious small negative effect among domestic guests that can be rendered insignificant.

Because Model I estimates the parameters globally and its specification does not allow any change in the seasonal pattern to be endogenous, its parameters have the same problem of reliability as globally-estimated seasonal indexes. It also does not take into account the trend-cycle movements of the series, leading to "average" results that are much closer to the actual data in the middle years than on the considered period's extremes. In order to overcome these issues, a second model was estimated, which attempts to accommodate these long-term movements and changes in the pattern by replacing the month's parameter by two: a constant and one which allows a constant increment for each year. Mathematically, the specification is as follows and the results are presented in Table 7:

$$\text{Model II: } Y_t = \sum_{j=1}^{12} \left(\beta_j + \beta_{j+12} Year_t\right) D_{jt} + (\beta_{25} + \beta_{26} Year_t) EASTER_t + v_t$$

where $Year_t$ is a series that reflects the year of *t*, from 0 (in 2000) to 14 (2014)
all others have the same meaning as in Model I.

Because the variable $Year_t$ starts at 0 for all 2000 values, the constant parameters correspond to each month's estimated number of guests in that year. Comparing the constant parameters of both models serves to prove that the former significantly overestimates the impact of seasonality on guests at accommodations in the beginning of the considered period, which indicates that it also underestimates that impact in the end. A constant increment is added to this parameter, which accounts for the trend-cycle and, when analyzed relatively to that of other months, the average changes in the seasonal pattern. The results for these parameters uncover that even when seasonal amplitude remains relatively constant during a long period of time, the real effect of seasonality in the presence of strong trend-cycle movements is severe. Take, for instance, foreign guests, whose seasonal amplitude has been established as not increasing: a yearly 3,900 extra guests arrived in August comparing to in February, which obliges accommodations as a whole to offer plenty more accommodation capacity that is inevitably unused in the off-season. In order to facilitate this kind of analysis, we include in annex 0 a table with the difference of incremental value for each pair of months, for foreign and domestic

Table 7 - Model II: OLS estimation results

Note: total guests' parameters correspond to the sum of foreign and domestic guests' parameters; more details on the results are shown in annex 6.6.

	Guests		Foreign		Domestic	
	Constant	Increment	Constant	Increment	Constant	Increment
Jan	48,726	3,347	13,877	1,590	34,848	1,757
Feb	49,806	3,409	15,556	1,568	34,250	1,841
Mar	62,689	3,944	22,360	2,101	40,329	1,843
Apr	66,838	4,935	23,221	3,210	43,616	1,725
May	71,075	7,257	30,409	4,558	40,666	2,699
Jun	66,715	6,575	28,650	3,979	38,066	2,595
Jul	69,440	7,215	30,389	4,587	39,051	2,628
Aug	79,463	8,342	41,517	5,466	37,945	2,877
Sep	79,983	7,646	35,215	5,080	44,768	2,566
Oct	71,435	7,145	27,071	4,692	44,365	2,453
Nov	58,785	4,523	17,880	2,541	40,905	1,982
Dec	49,283	4,956	14,096	2,256	35,187	2,699
Easter	3,840	621	7,319	301	-3,479	320

guests. Concerning Easter, which again should be analyzed with caution for their low statistical significance, this model adds to the previous that its effect has become increasingly more positive both for foreign and domestic guests. More details on the estimation results of both models are presented in annex 1.1.

Until now, we focused our analysis on the seasonal pattern, making only some remarks on the seasonal amplitude as bi-products of the techniques used to make such analysis. Nevertheless, the intensity of seasonal variations is also a matter of concern, and the seasonal amplitude does not offer a complete picture on it. Intra-year seasonal fluctuations can, for instance, severely intensify without extending the seasonal amplitude, since amplitude only takes into consideration the peak and bottom months. Table 8 (inserted in the end of this subsection) shows the results for the Peak Seasonal Factor, Seasonal Range and Coefficient of Variation, computed for each series. The former two give insights on the seasonal amplitude, while the latter quantifies the fluctuation in all months of the year. From the table, one can conclude that the seasonal amplitude among total guests increased almost uninterruptedly throughout the considered period, as well as their peak's seasonal factor, particularly strongly from 2003 to 2005 and 2012 to 2013. Seasonal amplitude among total guests depends on that of foreign and domestic ones, their respective seasonal pattern and weight in the total volume of guests. Nevertheless, these cannot be measured separately, so it is inviable to quantify the impact of foreign and domestic guests' seasonal amplitude on that of total guests. The importance of the peak month reduced steadily among foreign guests starting from 2006, more than compensating the strong increase seen until that year. Similar directions are visible among domestic guests, although the reduction between the considered period's extremes is significantly more expressive, especially because the increasing period until 2006 was much milder than with foreign guests. Concerning the seasonal amplitude itself, the evolution is quite similar for the three series as that just described for the peak seasonal factor, with the tendency of movements to be expressed in greater intensity. Concerning the intra-year fluctuations, the Coefficient of Variation indicates a significantly different evolution: foreign guests' seasonality is the most intense, while domestic ones' is the least; all three series register increases between the period's extremes, with foreign guests increasing the least and total guests the most; there is no defined tendency, as fluctuations increases and decreases in a seemingly random way. All in all, the seasonal character of total guests presented an unfavorable evolution both in terms of amplitude and intensity, while both among foreign and domestic guests, when taken separately, showed decreases in seasonal amplitude but increases in intensity. Joining the fact that total guests' seasonal intensity increased more significantly than foreign and domestic ones', it is made evident that seasonality in accommodations was negatively affected by the increase in weight of foreign guests in the total.

Table 8 - Measures of seasonal amplitude and intensity

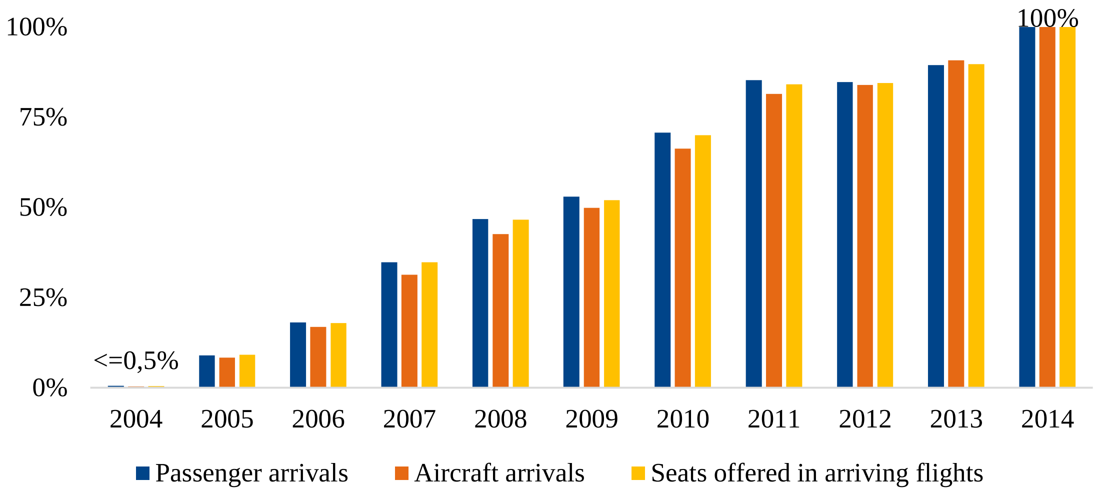
	Peak Seasonal Factor			Seasonal Range			Coefficient of Variation		
	Guests	Foreign	Domestic	Guests	Foreign	Domestic	Guests	Foreign	Domestic
2000	1.250	1.565	1.134	0.548	1.066	0.274	0.183	0.345	0.083
2001	1.250	1.577	1.138	0.547	1.078	0.277	0.172	0.352	0.069
2002	1.259	1.594	1.145	0.553	1.094	0.284	0.181	0.362	0.061
2003	1.274	1.615	1.149	0.565	1.109	0.288	0.204	0.350	0.121
2004	1.290	1.628	1.152	0.578	1.115	0.294	0.189	0.357	0.084
2005	1.304	1.634	1.150	0.590	1.113	0.299	0.195	0.334	0.118
2006	1.309	1.625	1.151	0.597	1.097	0.309	0.204	0.347	0.088
2007	1.310	1.612	1.150	0.601	1.077	0.309	0.222	0.340	0.136
2008	1.311	1.601	1.149	0.606	1.065	0.305	0.199	0.331	0.094
2009	1.311	1.594	1.144	0.610	1.061	0.296	0.213	0.339	0.123
2010	1.312	1.587	1.136	0.614	1.061	0.285	0.200	0.344	0.086
2011	1.314	1.577	1.122	0.620	1.059	0.269	0.227	0.379	0.088
2012	1.318	1.570	1.106	0.630	1.061	0.253	0.214	0.368	0.076
2013	1.321	1.563	1.101	0.639	1.062	0.248	0.238	0.379	0.095
2014	1.323	1.558	1.103	0.644	1.061	0.250	0.234	0.360	0.113

4.5. How tourism seasonality is related with LCCs' presence in Oporto

In order to relate LCCs' presence in Oporto with the seasonal character of accommodations' business, the first thing that needs to be quantified is the evolution of that presence throughout the considered period. Considering the data gathered for this study, three variables can be used for this purpose: passenger and aircraft arrivals and offered seats in arriving flights. The three indicate that LCCs' presence in Oporto's airline market was increasingly felt from 2005 to 2011, in a rather stagnant but already strong manner in 2012 and 2013 and again increasingly in 2014 (Graph 20). Due to the high correlation of the three variables, it is almost irrelevant which variable is used as a reference for LCCs' activity.

A full description of passenger arrivals carried by LCCs is not made since only poor or ungrounded insights could come of it, because the data supplied does not distinguish passengers who reside in Oporto from those who don't, nor does it provide any information on passengers' nationality. This is clearly a major limitation of the study, since it is possible that residents in Oporto, who have no residual impact on the city's accommodations and may present a different seasonal structure from that of non-residents, constitute a significant proportion of the total arriving passengers. Also, Portuguese passengers that reside abroad, which may also constitute a significant portion of total passengers, should only have a residual impact on the city's accommodations, as they most likely would stay with friends and relatives. Notwithstanding, we conduct the following analysis assuming that the seasonal character present in LCCs' and FSC's total

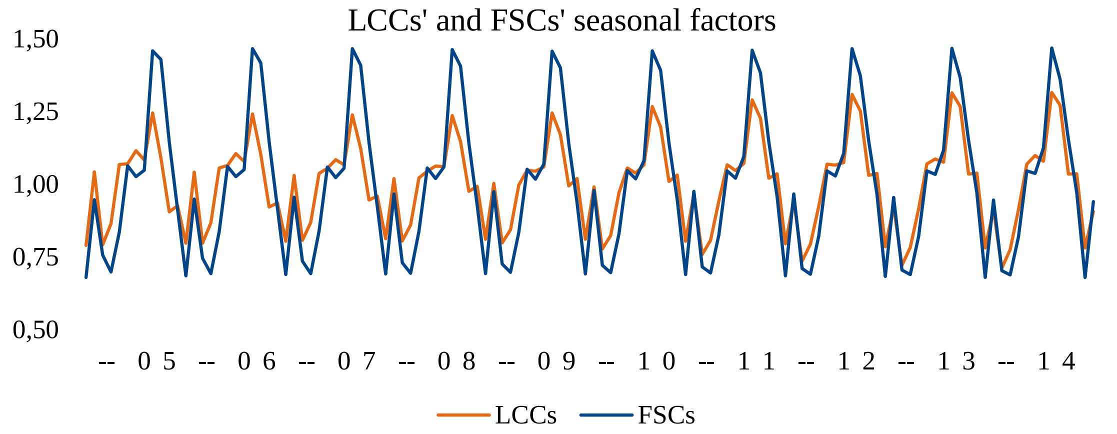
Graph 20 - Evolution of LCCs' activity in arrivals in Oporto



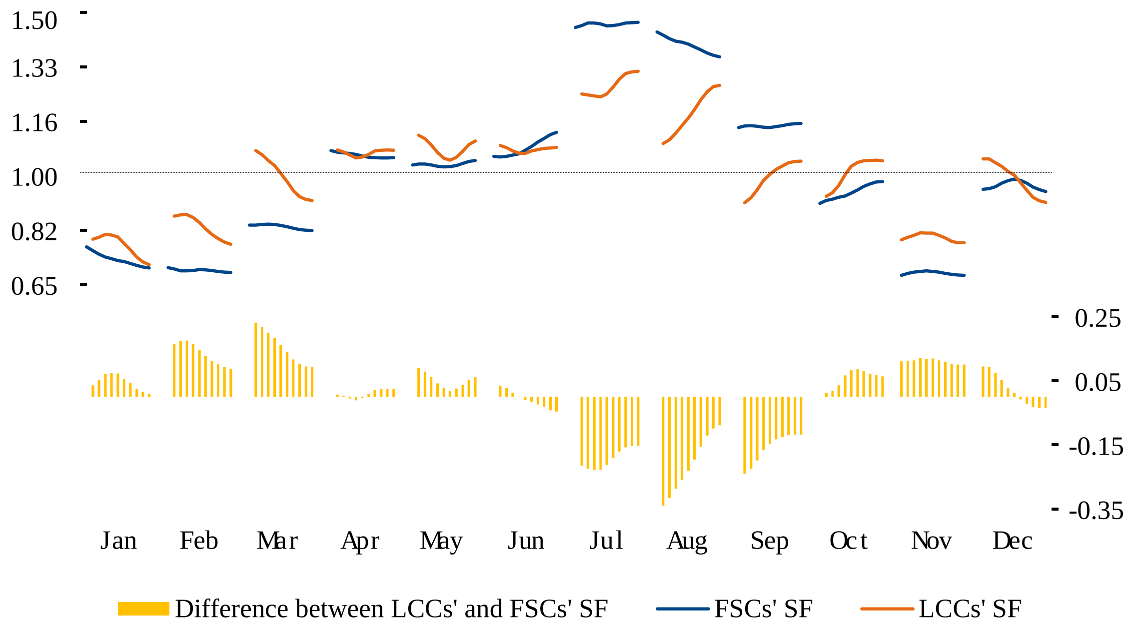
passenger arrivals reflects that of the passengers that affect the tourism industry in Oporto. We begin the analysis of these seasonal characters by decomposing the time series as done in subsection 4.3, retrieving seasonal indexes for both types of carriers (Graph 22). In order to obtain a clearer picture of the evolution of the seasonal intensity and pattern of both types of carriers, a seasonal plot is shown (Graph 21). This graph is designed differently from that built when analyzing accommodations' guests, in order to highlight the differences between the seasonal characters present in both types of carriers.

FSCs' seasonal intensity and pattern remained stable, whereas LCCs' seasonality changed sharply since these airlines entered in the market, which should be a natural

Graph 22 - LCCs' and FSCs' seasonal factors



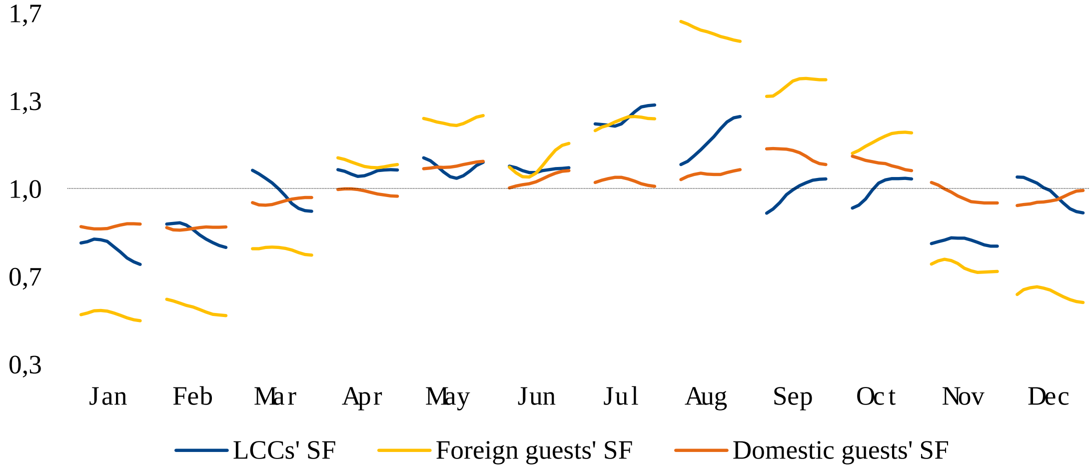
Graph 21 - Evolution of FSCs' and LCCs' seasonal factors



process as they mature and carry larger volumes of passengers. Seasonal amplitude was higher among FSCs than LCCs throughout the whole period, although the gap became increasingly thinner. Concerning the pattern itself, LCCs' differed greatly from FSCs' in the earlier years, although it evolved to become increasingly similar to FSCs' (the index of similarity between both types of carriers' patterns was of 33% in 2005 and of 72% in 2014). Still, some differences sufficed: higher seasonal factors for February, March and November and lower for July, August and September. All these differences were more expressive in the earlier years, except for November's. Still, one must also consider the increase in volume of passengers carried by LCCs throughout the considered period, which attributes more relevance to those differences in terms of passenger volumes. It is curious to see that the seasonal character among passenger arrivals carried by LCCs was substantially different from that of foreign guests (discussed in section 4.4 and visible in Graph 23), particularly in amplitude but also in pattern. The same can be said to domestic guests.

In order to identify the periods and years where the seasonal pattern of foreign and domestic guests (and total guests) changed the most, indexes of similarity are computed with the respective series' global seasonal indexes (taking into account the whole period) as the pattern for comparison (Table 9). The highest values for the indexes tend to be recorded somewhat in the middle of the considered period, which is natural given that we

Graph 23 - Evolution of LCCs' arriving passengers', foreign guests' and domestic guests' seasonal factors



are using seasonal indexes calculated globally, i.e. averages that take the whole period into consideration, and that seasonal patterns evolved in a relatively linear manner. The reason why domestic guests' seasonal indexes are always significantly lower than among total and foreign guests should be explained by the already drawn conclusion that their seasonal pattern was the most unstable, also visible when analyzing the annual changes in the indexes. Focusing on these changes, which allow us to retrieve the years where patterns changed the most, it can be seen that the first 6 years are marked by particular changes in the seasonal patterns for the three series, even for domestic guests although these also experienced a strong period of change from 2011 until 2013. So, the years where seasonality for all three categories of guests changed more significantly coincide with those where LCCs' presence changed the least. Therefore, no evident relationship between LCCs' activity and both foreign and domestic guests' seasonality is shown.

Table 9 - Indexes of similarity expressed in % and annual change in p.p.

	Guests (%)	Δ Guests (p.p.)	Foreign (%)	Δ Foreign (p.p.)	Domestic (%)	Δ Domestic (p.p.)
2000	85.4	-	89.3	-	54.0	-
2001	87.4	2.05	90.5	1.26	54.6	0.57
2002	90.5	3.10	92.8	2.31	58.4	3.79
2003	93.9	3.40	94.1	1.32	68.4	9.99
2004	95.9	2.02	94.1	-0.06	78.9	10.58
2005	95.5	-0.42	92.6	-1.48	84.7	5.79
2006	95.6	0.04	93.0	0.37	87.2	2.52
2007	95.2	-0.33	94.0	1.02	87.3	0.10
2008	94.3	-0.90	94.3	0.28	83.5	-3.85
2009	94.0	-0.30	94.1	-0.15	83.0	-0.50
2010	94.5	0.44	94.3	0.19	80.6	-2.44
2011	94.9	0.43	94.6	0.28	75.7	-4.83
2012	93.7	-1.17	94.3	-0.31	69.8	-5.92
2013	92.2	-1.48	93.7	-0.61	63.7	-6.15
2014	91.7	-0.52	93.3	-0.35	60.5	-3.17

5. Conclusion

5.1. Synthesis of the dissertation

This dissertation's research purpose is to analyze how the seasonal character present in the flow of visitors to Oporto evolved in the context of entrance of LCCs in the city's airline market. To achieve such understanding, the authors review literature on a relatively broad set of related issues, build a collection of approaches and supported methods that are often applied in the literature to the quantitative description of seasonality, from which they select those deemed most adequate to draw insightful conclusions in the case at hand. The following paragraphs synthetize the work done and main conclusions drawn.

Considering the literature, we find that much is still left to be explored on the topic of urban tourism, despite the growing attention drawn to it by interested agents including researchers and policy-makers. Research on the issue is fragmented and too narrow-sighted, limiting the ability of obtaining a wider understanding of the phenomenon. Still, there is no doubt that the emergence of the LCC model is transforming tourism, maintaining the long lasting relationship of interactive development between tourism and air transportation. Possibly the main determinant of the tourism industry, mostly regarded as a negative one, is seasonality, which is still not fully understood namely concerning its causes, reasons for its persistence and measurement. Various definitions of seasonality have been proposed, and taking them into consideration one can say that it is a temporal imbalance with various concurring causes and visible impacts, with also a spatial dimension as its character depends on the endowments of the location in which it occurs. The effort of identifying and explaining the causes materializes in several equally reasonable categorizations of them, highlighting how they relate to each other in different fashions. Most of the impacts attributable to seasonality are negative, which affect all agents involved – businesses, workers, public administration, the local population in general and the visitors themselves – although there is also an upside to seasonality, mainly associated with the recovery from the high-season possible in the low-season.

Still on the literature review, we then move to the issue of quantifying and describing seasonality, which is regarded as a prerequisite for much of the applied work in the area of tourism seasonality. Naturally, the approach taken in such exercises depends on the research purpose behind them. We identify 7 common approaches, of which two consist merely on the quantification and description of seasonality, while the other 5 aim to relate the seasonal character being studied to explanatory variables, in attempts to study spatial and temporal variations, differences among market segments or among destinations. Nevertheless, researchers are criticized for not examining with care the way they conduct their research, and a general lack of standards in research methodology is identified. After presenting the approaches taken in the literature, we describe the most used methods which can be divided into 5 different goals: extract seasonal factors, namely by decomposing the time series; describe the seasonal pattern; describe the seasonal amplitude and intensity; establish causal relationships between the facets and their explanatory factors; model and forecast demand, namely its seasonality. Except the last one, the others may all be stages in a single research piece.

Concerning the data used in the literature and taking the set of 26 research pieces that we review, we conclude that tourist arrivals is the preferred series, the month the preferred time unit and 10 or less years the preferred time period coverage. The data we gather and apply to our empirical study uses different series both concerned with air transportation and the activity/business of tourism accommodations, although the series selected for the analysis of seasonality are the volume of foreign and domestic guests. The time span considered to hold the full seasonal cycle is the calendar year, seasonality is assessed considering months as time units, and the considered period goes from 2000 to 2014.

The methodology employed is based on a 5-step framework proposed by de Cantis, Ferrante, *et al.* (2011), although altered as deemed necessary. Our first step consists on using metrics and graphical visualizations in order to contextualize our study's core focus (on seasonality) in the general evolution of Oporto's airline market and accommodations' business. In the second step, the selected series mentioned in the previous paragraph are decomposed through a seasonal adjustment procedure and its components are analyzed separately. In the third step, metrics, graphical visualizations and other techniques are employed to obtain a full description of the different facets of seasonality. In the fourth step, the scope of the empirical study is extended to include series concerned with air transportation, so that the seasonal character among the inflow of passengers and guests are compared.

To finalize this synthesis, the following paragraphs (including this one) discuss the main results obtained from the study. First, concerning the annual evolution of air transportation, the most remarkable result is the outstanding growth in the number of passengers arriving to Oporto. Between 2000 and 2014, this number grew 2.50 fold and most of this growth was accomplished after 2005, when LCCs entered the airline market – between 2005 and 2014 the number of arriving passengers grew by 2.27 fold. A noticeable increase in the number of routes operated is also visible, from 75 routes in 2000 to 113 in 2014, although this increase happened particularly after 2010. Still, most of the volume of arriving passengers carried by LCCs came from routes shared with FSCs instead of routes only operated by LCCs (in 2014, those routes accounted for 87.2% of the total passenger traffic).

Second, concerning the annual evolution of Oporto's accommodation sector, the total number of accommodations between the period's extremes grew 22% and total accommodation capacity by 63%, which was not offset by a decreasing net bed occupancy since it, in fact, showed a clear upward trend. This reflects the strong growth in accommodations' volume of both domestic and foreign guests throughout the entire period (at a CAGR of 5.98%), even if at different rates since the growth of the latter greatly accelerated since 2005. Average length of stay in the city was always quite low, never reaching 2 nights per visit, and evolved with volatility with a marked downward trend. Total revenue that is generated in accommodations merely by the offer of accommodation to guests, which was only analyzed between 2009 and 2014, increased by 40%, although the average revenue per stay had a very slight descendent tendency, only beginning to reverse in 2014 although not entirely.

After analyzing annual evolutions, our study focuses on tourism seasonality. First, we conduct a seasonal adjustment procedure to isolate and quantify the seasonal component and the others. From this procedure, we conclude that the trend growth of the number of domestic guests was positive and best described as constant. Among foreign guests, the trend growth was positive at an increasing pace of an estimated monthly of 0.58%. The evolution of foreign and domestic guests' cyclical fluctuations are relatively aligned (COR of 0.686), which suggests that both series reacted similarly to the causes of cyclical variation. The highest proportion of total fluctuation around the trend can be attributed, for both markets, to seasonality (between around 60 and 90% among foreign guests and

25 and 70% among domestic guests). During this exercise, we also conduct a preliminary analysis of the seasonal variations present in the series. The results from this analysis are not discussed here however, since more detailed ones are drawn when applying more precise methods and presented below.

The next stage in our methodology focuses on the analysis of the pattern, amplitude and intensity of seasonality. Starting with the first, we find that foreign and domestic guests present very different patterns. Foreign guests' pattern shows stable high- and shoulder-seasons, which go from April to October, although the months that compose the peak – July, August and September – leveled mildly throughout the entirety of the considered period. Henceforth, unless explicitly expressed otherwise, when mentioning changes we are considering the whole considered period. The shoulder period shifted to the "right", with October' and May's seasonal factors increasing considerably while April's decreased. The bottom months, January and December, increased in importance. The seasonal pattern of domestic guests was first one-peak in September and became two-peak, with May almost reaching the same importance as September. The shoulder and high season shortened, consisting of the months between May and October while before it also included March, April and November. All in all, the seasonal patterns became much more similar to one another, having the index of similarity between them increased from 10.1% in 2000 to 46.6% in 2014. We also build two OLS models, where the first draws seasonal indexes expressed in real values (in the same unit of measure of the original series) and pure numbers. Both isolate the impact of Easter, although it is not statistically significant even at a significance level of 0.25 in all series and models. The difference between the peak season and bottom among foreign guests reaches 54,800 guests, 15,600 among domestic and 65,700 among total guests. In pure numbers, the seasonal indexes are found to be very similar to those calculated directly as averages of the seasonal factors. Easter can be rendered insignificant for domestic guests, and its impact of 9,480 guests for foreign ones should be interpreted with care, as its p-value is of 0.28. The second model attempts to accommodate the trend-cycle movements and changes in the pattern, and returns very different results: it is proven that, when in the presence of strong trend-cycle movements, seasonal indexes calculated globally significantly overestimate the impact of seasonality on guests at accommodations in the beginning of a considered period, and underestimate that impact in the end; moreover, it is also proven that when the amplitude of a seasonal variation remains relatively constant during a long period of time, also in the presence of strong trend-cycle movements, the real effect of seasonality is severe. Moving on to the seasonal amplitude and intensity, foreign guests showed the highest amplitude and intensity. In dynamic terms, total guests presented an unfavorable evolution in both amplitude and intensity, while both among foreign and domestic guests, when taken separately, showed decreases in seasonal amplitude but increases in intensity, which means that seasonality in accommodations was negatively affected by the increase in weight of foreign guests in the total.

Finally, after the evolution of the seasonal behavior of guests in accommodations is fully analyzed, we attempt to contextualize it regarding the introduction and increase in presence of LCCs in the airline market. To this end, we first analyze how LCCs' presence in Oporto's airline market evolved, and conclude that it increased significantly in all years between 2005 and 2011, except from 2009, and 2014. Secondly, we analyze the seasonal character of FSCs and LCCs, from which we realize that FSCs' seasonal intensity and pattern remained stable, whereas every facet of seasonality changed sharply among LCCs' since they entered in the market. This change narrowed the difference between FSCs' and LCCs' seasonal character, with LCCs' seasonality increasing in amplitude, intensity and becoming more similar in pattern with that of FSCs. Notwithstanding, one should keep in mind that smaller differences observed in the end of the considered period have more impact on the tourism business as a whole since a larger volume of passengers is carried when compared with the volume of passengers carried in 2005 and following years. Thirdly, we analyze the indexes of similarity computed for total, foreign and domestic guests for the whole period between 2000 and 2014, which allow us to identify the years in which the seasonal pattern changed the most (and least). We conclude that the first 6 years are marked by particular changes in the seasonal patterns for the three series, even for domestic guests even though these also experienced a strong period of change from 2011 until 2013. So, the years where seasonality for all three categories of guests changed more significantly coincide with those where LCCs' presence changed the least. Therefore, no evident relationship between LCCs' activity and both foreign and domestic guests' seasonality is shown.

5.2. Discussion on the study's limitations, strongpoints and future work

This study was motivated by the visible changes that Oporto has gone through in the recent past, that are intuitively related by the also clear increase of presence of tourists. Although perhaps not a limitation *per se,* this study's specific scope could be regarded as a failure to reach a full understanding of Oporto's urban tourism phenomenon that motivated this study. Such understanding would require a prior understanding of the urban context in which the phenomenon is embedded (Ashworth & Page, 2011), an exploratory analysis of the phenomenon's impact on that context, also of the marketing, organizational and operational efforts developed to affect the phenomenon, among other elements which should all be explored at different geographical scales (Pearce, 2001).

There are, however, other issues that can be pointed out which constitute real limitations of the study, even considering its scope. The first, and perhaps the most important, is concerned with the data gathered. We were hoping to be supplied with data on monthly passenger arrivals disaggregated by nationality, or by geographical origin but distinguishing Portuguese people non-residents in Portugal from foreign non-residents. Data of these kinds have been used in the literature for seasonality analysis purposes, and would be enough to not only describe the seasonal behavior of short-term inflows of non-residents, but also to apply more sophisticated methods to distinguish markets based on their behavior. This would lead to a more insightful and consequential study since it would allow the identification of more adequate marketing policies on specific markets, with improved effectiveness. Such insights are not possible by only distinguishing foreign from domestic guests. Secondly, these series over accommodations' guests do not capture the whole inflow of tourists, particularly in nowadays' consumer behavior towards tourism where accommodation solutions such as "couch surfing" and staying with friends and relatives are growing in popularity, particularly among the passenger profile captured by LCCs. Thirdly, the period considered should also have been longer, since it only includes 5 years where non-LCCs constitute the whole airline market. This period may not be long enough to depict long-term movements and to isolate the data from the business cycle. Fourth, attention is only drawn to air transportation, when non-residents can use other means. We argue that because of Oporto's geographical location on Europe's periphery, the bulk of foreign non-residents should arrive by air transportation. Not only wasn't this assumption supported by any tested fact, it also ignores the volume of Spanish travelers to whom other means of transportation, such as the car or train, are competitive to air. It also leaves out the impact that Oporto's cruise platform, opened in April 2011, might have had in seasonality felt in accommodations.

Nevertheless, the analysis of seasonality is supported on guidelines developed by researchers concerned with building high standards for the literature, as well as on tested methodologies, rendering it a full and accurate description of the seasonal character present in guests in Oporto's accommodations and passenger arrivals in the city's airport, which in itself has great value for marketers, researchers and policy-makers. Moreover, the description of these series' seasonal behavior is put into context about the general evolution that passenger traffic and the sector of accommodations went through during the same time period. We also offer a novel literature review that details the approaches taken by researchers when studying seasonal variations, which greatly facilitates the understanding of the different possibilities that lead to the extraction of insights from those variations. Our literature review also draws awareness to key criticisms that are directed to the literature on the phenomenon of seasonality and urban tourism, which contains the former.

In our view, Oporto would benefit greatly from more research that uses more disaggregated data in order to build and analyze different market segments, contrasting them according to their contribution to the seasonal phenomenon present in the city's tourism industry. This can guide and empower the interested agents in their effort of minimizing the negative effects of seasonality, capitalizing the full potential of research on seasonal variations. Also, it would be of great interest to take a broader view on Oporto's tourism phenomenon to obtain an understanding of the impact that it has been having on the city, including the local population's perspective on that overall impact. This should be done, however, having into consideration the concerns of Edwards, Griffin, *et al.*, 2008, of Pearce, 2001 and of Ashworth & Page, 2011.

6. Annexes

6.1. List of acronyms

ANA – Business group responsible for the management of Portugal’s airports

CAGR – Compound Annual Growth Rate

COR – Correlation (Coefficient)

CV – Coefficient of (seasonal) variation

FSC(s) – Full Service Carrier(s)

FSCA – Francisco Sá Carneiro Airport (Oporto’s airport)

GC – Gini Coefficient

INE – Instituto Nacional de Estatística / Statistics Portugal

k – Thousand(s)

LCC(s) – Low-cost Carrier(s)

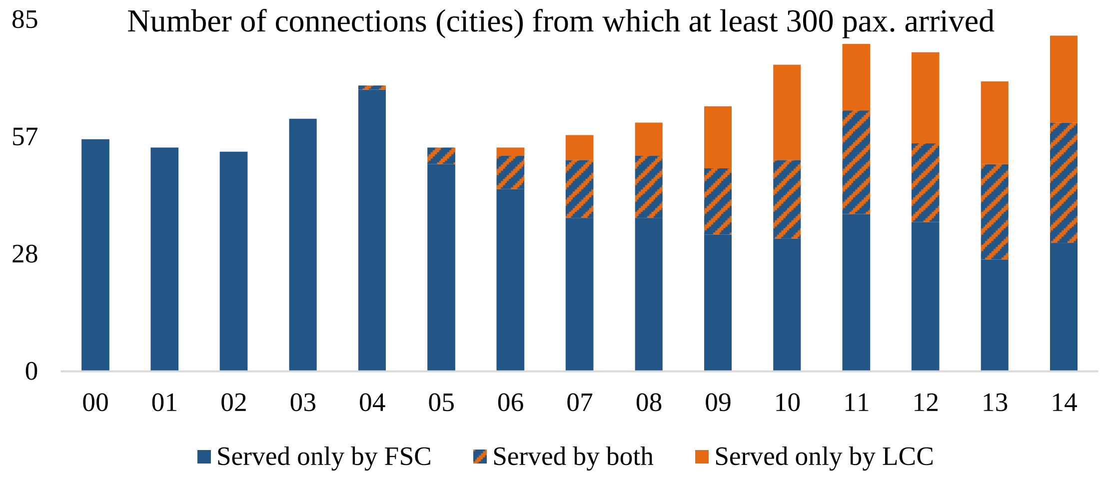
M – Million(s)

p.p. – Percentage Point(s)

SD – Standard Deviation

6.2. Airline market analysis: results with 300 pax. minimum

Graph 24 - Number of connections (cities) with 300+ pax. arrived
Note: a type of carrier is considered to have served the connection if it carried 300+ pax.



6.3. Foreign and domestic trend and fitting curves

Two models were tested to fit the trend curves of total, foreign and domestic guests: the linear and exponential models. There are others that translate a positive trend, but these two were rendered the most adequate.

The linear model best describes the cases where an absolute variation of the each of the independent variables leads to a constant absolute variation of the dependent one, *ceteris paribus*. The model applied in our context was defined by the following equation:

$$Series'\ trend_t = \beta_1 + \beta_2 t + \varepsilon_t$$

where t goes from 0 to 180, i.e. the number of observations included in the models, β_1 corresponds to the value of the trend when $t = 0$, i.e. on December 1999, and β_2 translates a constant slope, i.e. how much the series' trend varies per month. The series can be either total guests, foreign or domestic ones.

In an exponential model, the dependent variable is related to the independent ones through an exponential function. When applied to our context, it is given by the following equation:

$$Series'\ trend_t = e^{\beta_1 + \beta_2 t + \varepsilon_t}$$

In order to be able to apply the linear regression model to this particular model, a logarithmic transformation was conducted, resulting in the following equation to be estimated:

$$\log(series'\ trend_t) = \beta_1 + \beta_2 t + \varepsilon_t$$

where e^{β_1} corresponds to the value of the trend when $t = 0$, i.e., on December 1999, and β_2 translates a varying slope. In this case, β_2 corresponds to how much in relative terms (i.e., in percentage) the series' trend varies per month.

The results are summarized on the next page.

Number of observations included in each model: 180

	Linear Model			Exponential Model		
	Coeff.	**t-Stat.**	**p-value**	**Coeff.**	**t-Stat.**	**p-value**
Guests						
Constant	61 585	60,9085	0,0000	67 492	1 286,6880	0,0000
β_2	484	9,6891	0,0000	0,459%	55,4249	0,0000
R^2	0,9334			0,9452		
Foreign						
Constant	23 592	33,9241	0,0000	28 217	921,1869	0,0000
β_2	292	43,8013	0,0000	0,579%	54,2863	0,0000
R^2	0,9151			0,9430		
Domestic						
Constant	37 957	83,2769	0,0000	39 571	1 234,0920	0,0000
β_2	193	44,2749	0,0000	0,353%	42,9233	0,0000
R^2	0,9168			0,9119		

6.4. Comparison of intensities of fluctuation, or significance, of the components

From the decomposition procedure, the components are isolated and quantified maintaining the following relationship:

$$Observed_t = Trend\_Cycle_t \cdot Seasonal\ Factor_t \cdot Irregular_t$$

We isolated the cycle component by dividing the trend-cycle component by the trend fitting's values. The cycle values are, therefore, expressed in index. Now, the above relationship is changed to the following equation, where each component is expressed as an index fluctuation around the trend:

$$Observed_t = Trend_t \cdot Cycle_t \cdot Seasonal\ Factor_t \cdot Irregular_t$$

In order to make each component comparable, they were transformed into absolute numbers with base 0 instead of 1. Afterwards, in order to obtain a single average scalar for each year, the ones relative to the same year were summed and divided by 12. So to, for instance, calculate the fluctuation intensity of the cycle component for the year 2000, the following operations were made:

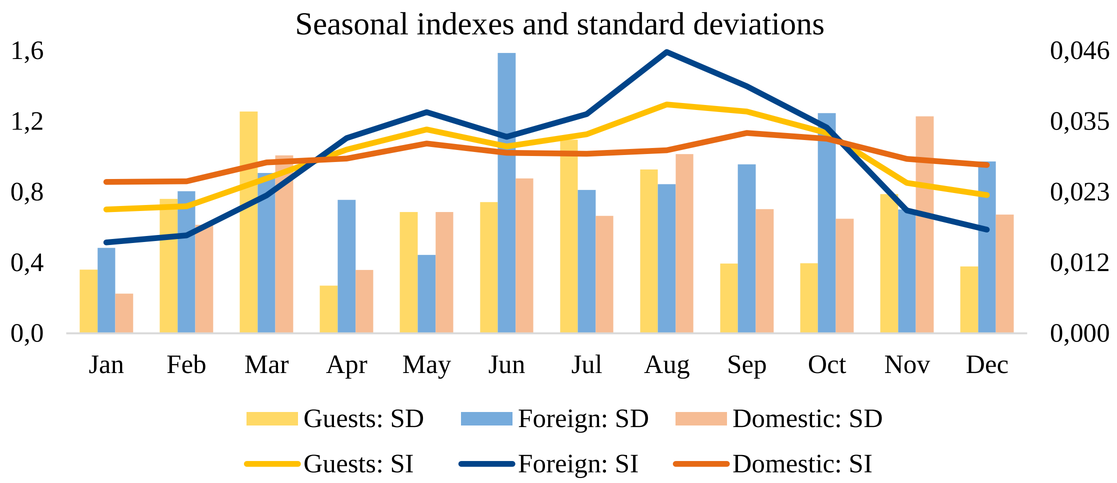
$$Cycle'_{2000} = \frac{\sum_{t=1}^{12} |Cycle_t - 1|}{12}$$

where $t = 1, 2, \dots, 12$ correspond to the months of the year 2000.

Percentage proportions of each component in the total variability, which are not presented in table but are referred to in the text, are calculated by dividing their fluctuation intensity for each month by the respective total fluctuation. Using the same example as above,

$$Proportion\ of\ Cycle'_{2000} = \frac{Cycle'_{2000}}{Cycle'_{2000} + Seasonal\ Factor'_{2000} + Irregular'_{2000}}$$

6.5. Support for the analysis of the seasonal pattern and intensity (subsection 4.4)



6.6. Estimation results of the OLS models

$$\text{Model I: } Y_t = \beta_1 + \sum_{j=1}^{12} \beta_j D_{jt} + \beta_{13} EASTER_t + v_t$$

	Guests			Foreign			Domestic		
Variable	**Coeff.**	**t-Statistic**	**p-value**	**Coeff.**	**t-Statistic**	**p-value**	**Coeff.**	**t-Statistic**	**p-value**
Jan	72 154	9,8796	0,0000	25 009	5,4759	0,0000	47 145	16,2054	0,0000
Feb	73 670	10,0872	0,0000	26 531	5,8091	0,0000	47 139	16,2034	0,0000
Mar	90 285	11,4409	0,0000	37 048	7,5072	0,0000	53 238	16,9359	0,0000
Apr	101 408	7,6690	0,0000	45 653	5,5209	0,0000	55 755	10,5852	0,0000
May	121 873	16,6873	0,0000	62 314	13,6439	0,0000	59 560	20,4729	0,0000
Jun	112 738	15,4365	0,0000	56 506	12,3722	0,0000	56 232	19,3290	0,0000
Jul	119 945	16,4233	0,0000	62 498	13,6842	0,0000	57 448	19,7468	0,0000
Aug	137 859	18,8761	0,0000	79 777	17,4677	0,0000	58 081	19,9646	0,0000
Sep	133 504	18,2799	0,0000	70 777	15,4969	0,0000	62 728	21,5618	0,0000
Oct	121 448	16,6291	0,0000	59 914	13,1184	0,0000	61 534	21,1515	0,0000
Nov	90 447	12,3843	0,0000	35 666	7,8092	0,0000	54 781	18,8302	0,0000
Dec	83 975	11,4981	0,0000	29 891	6,5448	0,0000	54 084	18,5905	0,0000
Easter	8 176	0,5835	0,5604	9 480	1,0818	0,2809	-1 304	-0,2336	0,8156
R^2		0,3875			0,5154			0,1583	
Obs. no.		180			180			180	

$$\text{Model II: } Y_t = \beta_1 + \sum_{j=1}^{12} (\beta_j + \beta_{j+12} Year_t) D_{jt} + (\beta_{25} + \beta_{26} Year_t) EASTER_t + v_t$$

	Guests			**Foreign**			**Domestic**		
	Coeff.	**t-Statistic**	**p-value**	**Coeff.**	**t-Statistic**	**p-value**	**Coeff.**	**t-Statistic**	**p-value**
Constants									
Jan	48 726	12,2342	0,0000	13 877	4,9202	0,0000	34 848	17,8841	0,0000
Feb	49 806	12,5054	0,0000	15 556	5,5154	0,0000	34 250	17,5769	0,0000
Mar	62 689	14,6563	0,0000	22 360	7,3818	0,0000	40 329	19,2716	0,0000
Apr	66 838	7,5664	0,0000	23 221	3,7121	0,0003	43 616	10,0921	0,0000
May	71 075	17,8458	0,0000	30 409	10,7817	0,0000	40 666	20,8694	0,0000
Jun	66 715	16,7511	0,0000	28 650	10,1577	0,0000	38 066	19,5352	0,0000
Jul	69 440	17,4352	0,0000	30 389	10,7746	0,0000	39 051	20,0406	0,0000
Aug	79 463	19,9518	0,0000	41 517	14,7200	0,0000	37 945	19,4735	0,0000
Sep	79 983	20,0824	0,0000	35 215	12,4856	0,0000	44 768	22,9747	0,0000
Oct	71 435	17,9363	0,0000	27 071	9,5979	0,0000	44 365	22,7678	0,0000
Nov	58 785	14,7599	0,0000	17 880	6,3394	0,0000	40 905	20,9922	0,0000
Dec	49 283	12,3743	0,0000	14 096	4,9978	0,0000	35 187	18,0580	0,0000

(table continues on next page)

	Guests			Foreign			Domestic		
	Coeff.	**t-Statistic**	**p-value**	**Coeff.**	**t-Statistic**	**p-value**	**Coeff.**	**t-Statistic**	**p-value**
Increments									
Jan	3 347	6,9127	0,0000	1 590	4,6381	0,0000	1 757	7,4156	0,0000
Feb	3 409	7,0413	0,0000	1 568	4,5728	0,0000	1 841	7,7731	0,0000
Mar	3 944	7,5999	0,0000	2 101	5,7166	0,0000	1 843	7,2591	0,0000
Apr	4 935	4,1895	0,0000	3 210	3,8476	0,0002	1 725	2,9938	0,0032
May	7 257	14,9885	0,0000	4 558	13,2927	0,0000	2 699	11,3946	0,0000
Jun	6 575	13,5793	0,0000	3 979	11,6062	0,0000	2 595	10,9556	0,0000
Jul	7 215	14,9020	0,0000	4 587	13,3779	0,0000	2 628	11,0948	0,0000
Aug	8 342	17,2301	0,0000	5 466	15,9409	0,0000	2 877	12,1434	0,0000
Sep	7 646	15,7919	0,0000	5 080	14,8166	0,0000	2 566	10,8312	0,0000
Oct	7 145	14,7566	0,0000	4 692	13,6839	0,0000	2 453	10,3545	0,0000
Nov	4 523	9,3421	0,0000	2 541	7,4105	0,0000	1 982	8,3682	0,0000
Dec	4 956	10,2359	0,0000	2 256	6,5810	0,0000	2 699	11,3958	0,0000
Easter (constant)	3 840	0,4078	0,6840	7 319	1,0975	0,2741	-3 479	-0,7552	0,4513
Easter (increment)	621	0,4926	0,6230	301	0,3367	0,7368	320	0,5195	0,6042
R^2		0,9537			0,9530			0,9039	
Obs. no.		180			180			180	

6.7. OLS Model II – differences in increment for every pair of months, foreign and domestic guests

How to read the table: for foreign guests (filled in grey), a value corresponds to the increment constant value of the month in row subtracted of the increment constant value of the month in column. For instance, the 511 in the first row and third column is obtained by subtracting 1,590 (value in January) to 2,101 (value in March). For domestic guests it's the other way around: a value corresponds to the increment constant value of the month in column subtracted of the increment constant value of the month in row. For instance, the value of 87 in the third row and first column is obtained by subtracting 1,757 (value in January) to 1,843 (value in March). The table is, therefore, symmetric and the respective differences for total guests can be obtained by adding symmetric cells.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jan	-	-22	511	1,619	2,967	2,389	2,997	3,875	3,490	3,102	951	666
Feb	85	-	533	1,642	2,990	2,412	3,019	3,898	3,512	3,124	973	689
Mar	87	2	-	1,109	2,457	1,878	2,486	3,365	2,979	2,591	440	155
Apr	-31	-116	-118	-	1,348	770	1,377	2,256	1,871	1,482	-669	-953
May	943	858	856	974	-	-578	29	908	522	134	-2,017	-2,301
Jun	839	754	752	870	-104	-	607	1,486	1,101	712	-1,439	-1,723
Jul	872	787	785	903	-71	33	-	879	493	105	-2,046	-2,330
Aug	1,120	1,035	1,033	1,151	177	281	248	-	-386	-774	-2,925	-3,209
Sep	809	724	722	840	-133	-29	-62	-311	-	-388	-2,539	-2,824
Oct	696	611	609	727	-246	-142	-175	-424	-113	-	-2,151	-2,435
Nov	226	141	139	257	-717	-613	-646	-894	-583	-471	-	-284
Dec	943	858	856	974	0	104	71	-177	134	247	717	-

- Foreign guests
- Domestic guests

7. Bibliography

Agnew, M. D. (2001). Potential Impacts of Climate Change on International Tourism. *Tourism and Hospitality Research, 3*(1), 37-60.

Almeida, C. R. (2011). The new challenges of tourism airports: The case of Faro airport. *Tourism & Management Studies, 7*, 109-120.

ANA. (2015a). ANA routelab website Retrieved November 8, 2015, from http://routelab.ana.pt/en-US/Airports/Porto/Pages/default.aspx

ANA. (2015b). Francisco Sá Carneiro Airport overview: ANA Aeroportos de Portugal.

Andriotis, K. (2005). Seasonality in Crete: problem or a way of life? *Tourism Economics, 11*(2), 207-224(218).

Ashworth, G., & Page, S. J. (2011). Urban tourism research: Recent progress and current paradoxes. *Tourism Management, 32*, 1-15.

BarOn, R. R. V. (1975). *Seasonality in tourism: A guide to the analysis of seasonality and trends for policy making*: Economist Intelligence Unit.

Barret, S. (2004). The sustainability of the Ryanair model. *International Journal of Transport Management, 2*(2), 89-98.

Bieger, T., & Wittmer, A. (2006). Air transport and tourism: Perspectives and challenges for destinations, airlines and governments. *Air Transport Management, 12*(1), 40-46.

Brilha, N. M. (2008). Airport Requirements for Leisure Travellers. In A. P. A. Graham, & P. Forsyth (Eds.) (Ed.), *Aviation and Tourism: Implications for Leisure Travel* (pp. 167-176). Aldershot: Ashgate.

Burger, J. (2000). Landscapes, tourism, and conservation. *The Science of the Total Environment, 249*(1-3), 39-49.

Butler, R. W. (2001). *Seasonality in tourism: Issues and implications*.

Butler, R. W., & Mao, B. (1997). *Seasonality in tourism: Issues and implications*.

Cannas, R. (2012). An overview of tourism seasonality: Key concepts and policies. *Almatourism: Journal of Tourism, Culture and Territorial Development, 3*(5), 40-58.

Carballo-Cruz, F., & Costa, V. (2014). Success factors of regional airports: The case of Oporto airport. *Tourism & Management Studies, 10*(1), 37-45.

Cisneros-Martínez, J. D., & Fernandéz-Morales, A. (2015). Cultural tourism as tourist segment for reducing seasonality in a coastal area: the case study of Andalusia. *Current Issues in Tourism, 18*(8), 765-784.

Corluka, G. Seasonality in tourism - Causes, implications and strategies.

Coshall, J., Charlesworth, R., & Page, S. J. (2015). Seasonality of Overseas Tourism Demand in Scotland: A Regional Analysis. *Regional Studies, 49*(10), 1603-1620.

Cuccia, T., & Rizzo, I. (2011). Tourism seasonality in cultural destinations: Empirical evidence from Sicily. *Tourism Management, 32*(3), 589-595.

Cunado, J., Gil-Alana, L. A., & Gracia, F. P. (2005). The nature of seasonality in Spanish tourism: time series. *Tourism Economics, 11*(4), 483-499.

de Cantis, S., & Ferrante, M. (2008). *Seasonality in tourism: a critical review of its main measures* (Edizioni Scientifiche Italiane ed.). Napoli.

de Cantis, S., Ferrante, M., & Vaccina, F. (2011). Seasonal pattern and amplitude - a logical framework to analyse seasonality in tourism: an application to bed occupancy in Sicilian hotels. *Tourism Economics, 17*(3), 655-675.

de Oliveira, M. M., Santos, L. D., & Fortuna, N. (2011). *Econometria*: Escolar Editora.

Drakatos, C. G. (1987). Seasonal concentration of tourism in Greece. *Annals of Tourism Research, 14*(4), 582-586.
Duro, J. A. (2016). Seasonality of hotel demand in the main Spanish provinces: Measurements and decomposition exercises. *Tourism Management, 52*, 52-63.
Edwards, D., Griffin, T., & Hayllar, B. (2008). Urban tourism research: Developing an agenda. *Annals of Tourism Research, 35*(4), 1032-1052.
ELFAA. (2004). Liberalization of European air transport: The benefits of low fares airlines to consumers, airports, regions and the environment: ELFAA.
Esteves, A. (2014). *O impacto do aeroporto Francisco Sá Carneiro no desenvolvimento da região Norte.* Master degree, Universidade Lusófona de Humanidades e Tecnologias, Lisbon.
Fernandéz-Morales, A. (2003). Decomposing seasonal concentration. *Annals of Tourism Research, 30*(4), 942-956.
Fernandéz-Morales, A. (2014). Simulating seasonal concentration in tourism series. *Journal of Hospitality, Leisure, Sport & Tourism Education, 15*, 116-123.
Fernandéz-Morales, A., Cisneros-Martínez, J. D., & McCabe, S. (2016). Seasonal concentration of tourism demand: Decomposition analysis and marketing implications. *Tourism Management, 56*, 172/190.
Fernandéz-Morales, A., & Mayorga-Toledano, M. C. (2008). Seasonal concentration of the hotel demand in Costa del Sol: A decomposition by nationalities. *Tourism Management*, *29*(5), 940-949.
Frechtling, D. C. (1996). *Practical tourism forecasting*. Oxford: Butterworth-Heinemann.
Giles, A. R., & Perry, A. H. (1998). The use of a temporal analogue to investigate the possible impact of projected global warming on the UK tourist industry. *Tourism Management, 19*(1), 75-80.
Goh, C., & Law, R. (2002). Modeling and forecasting tourism demand for arrivals with stochastic nonstationary seasonality and intervention. *Tourism Management, 23*(5), 499-510.
Gonzáles, P., & Moral, P. (1995). An analysis of the international tourism demand in Spain. *International Journal of Forecasting*, *11*(2), 233-251.
Gonzáles, P., & Moral, P. (1996). Analysis of tourism trends in Spain. *Annals of Tourism Research, 23*(4), 739-754.
Graham, A. (2013). Understanding the low cost carrier and airport relationship: A critical analysis of the salient issues. *Tourism Management, 36*, 66-76.
Guzman-Parra, V. F., Quintana-García, C., Benavides-Velasco, C. A., & Vila-Oblitas, J. R. (2015). Trends and seasonal variation of tourist demand in Spain: The role of rural tourism. *Tourism Management Perspectives, 16*, 123-128.
Halpern, N. (2011). Measuring seasonal demand for Spanish airports: Implications for counter-seasonal strategies. *Research in Transportation Business & Management, 1*(1), 47-54.
Hartmann, R. (1986). Tourism, seasonality and social change. *Leisure Studies, 5*(1), 25-33.
Hughes, H. L. (1996). Redefining cultural tourism. *Annals of Tourism Research, 23*(3), 707-709.
Hui, T.-K., & Yuen, C. C. (2002). A study in the seasonal variation of Japanese tourist arrivals in Singapore. *Tourism Management, 23*(2), 127-131.
Hylleberg, S. (1992). *Modelling Seasonality*: Oxford University Press.

Hylleberg, S., Engle, R. F., Granger, C. W. J., & Yoo, B. S. (1990). Seasonal integration and cointegration. *Journal of Econometrics, 44*(1-2), 215-238.
Iatrou, K., & Tsitsiragou, E. (2008). Leasure Travel, Network Carriers and Alliances. In A. P. A. Graham, & P. Forsyth (Eds.) (Ed.), *Aviation and Tourism: Implications for Leisure Travel*. Aldershot: Ashgate.
Jang, S. S. (2004). Mitigating tourism seasonality: A quantitative approach. *Annals of Tourism Research, 31*(4), 819-836.
Jeffrey, D., & Barden, R. R. D. (1999). An analysis of the nature, causes and marketing implications of seasonality in the occupancy performance of English hotels. *Tourism Economics, 5*(1), 69-91.
Jeffrey, D., Barden, R. R. D., Buckley, P. J., & Hubbard, N. J. (2002). What makes for a successful hotel? Insights on hotel management following 15 years of hotel occupancy analysis in England. *The Service Industries Journal, 22*(2).
Koenig, N., & Bischoff, E. E. (2003). Seasonality of tourism in Wales: a comparative analysis. *Tourism Economics, 9*(3), 229-254.
Koenig, N., & Bischoff, E. E. (2004). Analyzing seasonality in Welsh room occupancy data. *Annals of Tourism Research, 31*(2), 374-392.
Koenig, N., & Bischoff, E. E. (2005). Seasonality Research: The state of the art. *International Journal of Tourism Research*.
Kulendran, N., & Witt, S. F. (2001). Cointegration versus least squares regression. *Annals of Tourism Research, 28*(2), 291-311.
Kuznets, S. (1933). *Seasonal variations in industry and trade*: NBER.
Lacher, R. G., & Nepal, S. K. (2013). The changing distribution of global tourism: Evidence from gini coefficients and markov matrixes. *Tourism Analysis, 18*(2), 133-144.
Lim, C., & McAleer, M. (2000). A seasonal analysis of Asian tourist arrivals to Australia. *Applied Economics, 32*(4), 499-509.
Lim, C., & McAleer, M. (2001). Montly seasonal variations: Asian tourism to Australia. *Annals of Tourism Research, 28*(1), 68-82.
Lundtorp, S. (2001). *Measuring tourism seasonality*.
Lundtorp, S., Rassing, C. R., & Wanhill, S. (1999). The off-season is 'no season': the case of the Danish island of Bornholm. *Tourism Economics, 5*(1), 49-68.
Makridakis, S., Wheelwright, S. C., & Hyndman, R. J. (1998). *Forecasting: methods and applications* (3rd ed.): John Wiley & Sons.
Martín, J. M. M., Aguilera, J. d. D. J., & Moreno, V. M. (2014). Impacts of seasonality on environmental sustainability in the tourism sector based on destination type: an application to Spain’s Andalusia region. *Tourism Economics, 20*(1), 123-142.
Nadal, J. R., Font, A. R., & Rosselló, A. S. (2004). The economic determinants of seasonal patterns. *Annals of Tourism Research, 31*(3), 697-711.
Papatheodorou, A., & Arvanitis, P. (2009). Spatial evolution of airport traffic and air transport liberalisation: the case of Greece. *Journal of Transport Geography, 17*(5), 402-4012.
Pearce, D. G. (2001). An integrative framework for urban tourism research. *Annals of Tourism Research, 28*(4), 926-946.
Pegg, S., Patterson, I., & Gariddo, P. V. (2012). The impact of seasonality on tourism and hospitality operations in the alpine region of New South Wales, Australia. *International Journal of Hospitality Management, 31*(3), 659-666.

Rodrigues, P. M. M., & Gouveia, P. M. D. C. B. (2004). An application of PAR models for tourism forecasting. *Tourism Economics, 10*(3), 281-303.

Smith, K. (1990). Tourism and climate change. *Land Use Policy, 7*(2), 176-180.

Song, H., & Li, G. (2008). Tourism demand modelling and forecasting—A review of recent research. *Tourism Management, 29*(2), 203-220.

Sutcliffe, C. M. S., & Sinclair, M. T. (1980). The measurement of seasonality within the tourism industry: an application to tourism arrivals in Spain. *Applied Economics, 12*(4), 429-441.

Warnock-Smith, D., & Potter, A. (2005). An exploratory study into airport choice factors for European low-cost airlines. *Journal of Air Transport Management, 11*(6), 388-392.

Witt, S. F., & Witt, C. A. (1992). *Modeling and forecasting demand in tourism*: Academic Press Ltd.

Witt, S. F., & Witt, C. A. (1995). Forecasting tourism demand: A review of empirical research. *International Journal of Forecasting, 11*(3), 447-475.

Yacoumis, J. (1980). Tackling seasonality : The case of Sri Lanka. *International Journal of Tourism Management*, *1*(2), 87-98.

Yan, M., & Wall, G. (2003). Disaggregating visitor flows: The example of China. *Tourism Analysis, 7*(3/4), 191-205.