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Efficiency and Sustainability of Regional Aviation on Insular Territories of the European Union: A Case Study of Public Service Obligations on Scheduled Air Routes among the Balearic Islands

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Abstract: Mediterranean islands of the European Union (EU) have traditionally suffered from a lack of regularity in supplying public transportation due to the high seasonality of the demand for scheduled transport services. The insular fact forces people and goods to be carried either by sea or air, and therefore needs to actively stimulate interest in operating specific routes by proper carriers. As regional economies on insular territories also have a tight dependence on tourism, it is vital to achieve an appropriate balance between the need for effective public transportation and sustainable means of transport. This paper aims to provide an approach to the Public Service Obligation (PSO) system imposed on air routes serving the regional transport needs of the Balearic Islands. This study has analyzed data relating to freight and passenger traffic in the period between 2004 and 2019 from scheduled air services linking Palma de Mallorca with Ibiza and Menorca, as well as those between Menorca and Ibiza, and to their respective short-sea links. Results obtained in the research suggest that PSO impositions, together with significant improvement in the resident subsidy schema (from 50% to 75%), have recently led to a sharp increase in the demand for passenger air services on these routes; thus, avoiding the tender for the award of a public contract. However, it has led to a dramatic fall of freight transport on air routes concerned, as such, public intervention on the air market has only sought to ensure the mobility of passengers.

Keywords: European Union; public transportation; public service obligation; regional transport; passenger traffic; scheduled air services; freight transport; public intervention; mobility

1. Introduction and Overall Framework

An adequate design of public transport routes is, in many cases, the product of needs assessment and economic opportunity. The determining authorities are bound to ensure that the allocation of public resources on transport infrastructures is efficient while promoting sustainable mobility. As a result, the social profitability of public expenditure and its possible suitability from the point of view of the general interest should be determined before setting the public transport services. Public transportation also plays a fundamental role in interconnecting cities, some of which are not necessarily situated close to great transport hubs. Determining passenger traffic for each mode of transport concerned is an important factor not only in developing an urban public transport system [1], but also in making proper planning of intercity routes from an intermodal perspective. Assuming that metropolitan areas would continue to grow in the next 25 years, future local passenger transportation systems have been framed within four possible scenarios, depending upon transport automation and urban density [2]. In the case of urban areas situated on island territories, however, the identification of a baseline scenario is much more complex than simply analyzing surveys collected from interviews, since mobility solutions are subject to the challenges and difficulties of the insularity. Many transportation strategies shall be

subject to the existence of enough level of availability of supply to meet the demand for regular transport services, especially in those passenger routes where there is low profitability. This is precisely the case of the interisland transport services studied in this paper, as outlined below, whose airports involved have a high dependence on tourist activity. Mobility is inherent to tourism and often plays a significant role in regional economies. This is particularly important not only in most regions belonging to developed economies, as the case study analyzed herein, but also in those that belong to developing countries [3].

If an air route is seen as an essential service for the regional economy and is not served by any carrier in the free market, public authorities may intervene to correct such market failure. When it occurs, market forces alone cannot meet mobility needs, and thus transport services concerned are regulated and often subsidized from public schemes, such as Public Service Obligation (PSO), Remote Air Service Subsidy Scheme (RASS), and Essential Air Services (EAS), in the European Union (EU), Australia, and United States of America (USA), respectively. These forms of public intervention on a deregulated market are used to ensure that regular transport services are in place. Regarding island territories subject to intensive forms of tourism activity, it is worth highlighting how significant volumes of passenger transport carried, either by sea or air, can strengthen local economies. However, a broader question arises from handicaps related to island conditions of whether the need to effectively meet this growing demand can prevent negative externalities, particularly in regard to the provision of air transport services. As a result, the social profitability of public transportation and its possible suitability from the point of view of the general interest should be analyzed in terms of efficiency and sustainability. On one hand, the public efficiency of essential air routes is intimately linked to the Level of Service (LOS) and objective of the PSO imposed, since it may lead to a situation close to social optimum [4]. On the other hand, the socioeconomic sustainability of regional aviation on non-mainland territories usually involves the study of short routes that have some environmental vulnerability, since airports concerned are often situated on islands and even located near urbanized areas. It can even become a limiting factor in the operation of the runways due to noise restrictions. Besides night flight limitations, regional airports can suffer from limited traffic, considering minimum fixed infrastructure requirements owing to existing constraints on runway length and aeronautical limitation surfaces, and thus insufficient revenues to cover their cost from airport charges [5]. While the literature on this subject is scarce, the interest of the scientific community in learning more about the negative externalities of aviation has escalated in recent years, particularly in the case of short-haul flights. For instance, by studying the relationship between air connectivity and carbon/noise local levels at Bologna airport [6]. Earlier studies have analyzed some issues regarding airport environmental impact, especially those concerning carbon emissions, such as air quality matters and health impacts attributable [7] and taxi-out procedures for reducing the impact on neighboring inhabitants [8]. Similarly, strategies for more efficient transport operation have been studied on liner shipping [9] and truck transportation [10].

Sustainable transportation is a key element to running more efficient mobility according to the EU common transport policy, thus stimulating a competitive transport industry within the European internal market. Market deregulation in the aviation sector was carried out based on an orderly legislative process through three liberalization packages, which were successively implemented in December 1987, June 1990, and July 1992. With the entry of the third package on 1 January, 1993, thanks to the provision of a legal framework from the European Economic Community (EEC) regulation numbers 2407/92, 2408/92, and 2409/92, with an ambitious market-opening process that ended, giving way to the formation of a genuine single market for air transport services. Amongst other changes, the common legislative framework has introduced the concept of “community air carrier: by which any airline with a valid Air Operator Certificate (AOC) granted by a member state, can enjoy the same market access opportunities as other national carriers in the operating regular air services, even domestic routes. However, this has not always led to an increasing number of direct flights on air routes with low demand, otherwise known

as “thin routes”. In the case of island territories, the need for regular air transportation with other surrounding communities is essential in connecting scattered populations living amongst them, as mobility plays a vital role in territorial cohesion. Situated far from European capitals and thus far from main transport hubs, most peripheral areas do not have adequate transport services in terms of availability and fares. EU insular regions, thought to be populated by around 15 million people, have traditionally suffered from a lack of affordable transportation connecting regular passenger services to hub airports, especially during periods of slack demand. Since low seasons usually coincide with those where tourist activity decreases, airlines tend to adjust the offer of passenger transport services to the real demand by adapting flight schedules that, moreover, are released up to six months before starting operations. Considering that airport capacity is a limited resource within the Single European Sky (SES), airlines have habitually been cautious in applying for the slot allocation where a route could not be profitable, and operating problems may arise due to inadequate fleet. Typically, many peripheral airports have high seasonality due to heavily dependent on tourism. Furthermore, airlines operating domestic routes are also scarce, combined with few air links with a good performance and high yield. Despite the existence of thin routes, some of them even unprofitable, both local authorities and those of state members concerned have often advocated for maintenance of direct flights for socioeconomic reasons and also as a contribution to territorial cohesion, as they may be indispensable for the development of regional economies within the EU single market. According to the EU law based on Article 10.2 of [11], eligible airlines are provided with operating authorization at selected airports from slot coordination. Since they have to demonstrate that a minimum of 80 percent of their slots has been fully used to avoid the loss of their rights over them in the next slot conference of the International Air Transport Association (IATA), requests for slot allocation on particular routes are often very tight to fleet capacity and above all with a reasonable expectation of profitability. In the case of Spanish islands, low demand periods do not necessarily correspond to the IATA winter season, as the seasonal demand may be more prevalent in the summer period (from June to September), which often depends on how important tourism outbound markets are for their territories to generate economic activity and how carriers can cover the demand from attractive flight schedules. As it has a greater reliance on people mobility due to insularity reasons, it has not always been possible to ensure an adequate transport network with free-market rules in terms of continuity, regularity, capacity, and pricing.

Unlike the special member state territories (for instance, the Spanish Canary islands, as well as the Portuguese Azores and Madeira islands), the Mediterranean islands do not often enjoy a specific tax regime that is different from that applied in the EU mainland territory. While the challenge to the economic and social cohesion of the less favored regions, mainly peripheral areas, and remote areas, was shortly reflected in Article 174 of the Lisbon Treaty, there has been no attempt at unifying a special fiscal framework for island territories so far. This is the case of the Balearic Islands, where, although it was recognized the condition of insularity at the national level, no special tax regime has been introduced [12]. Only specific measures, such as resident subsidies or public benefits, have been applied for island residents so far. Instead, for those legally living in the Canary Islands, there is an economic and fiscal regime from the Economic and Fiscal Regime (REF) and the Special Economic Zone (ZEC). Similar to this Spanish overseas territory, and protected by EU legislation for special territories, Melilla and Ceuta enjoy a special tax regime due to their specific geographical situation. Regardless of whether passengers are residents or visitors, the proper legal instrument to ensure regular and affordable air transport services at remote or peripheral airports, such as those serving the Balearic archipelago, therefore, is the PSO schema from the Articles 16–18 of the Air Services Regulation 1008/2008 (hereafter [13]). Once a route is selected as an essential service under Article 95 [14], a PSO imposition can be addressed.

1.1. Some Considerations about the PSO Schema Used in the EU Internal Aviation Market

The imposition of PSO on certain air routes is a form of public intervention in the EU single aviation market, which enjoys a high level of competition from free regime rules. The introduction of the third package of market liberalization measures, (1993) and subsequent completion of the internal market (1997), enabled the provision of PSOs. The market liberalization has led to a great expansion of the regular transport services on many air routes. In contrast, certain air links serving small-community airports, and often thin routes, have been promoted from the PSO schema to avoid the lack of affordable transportation. However, this is neither administrated nor funded at the EU level, but by individual states, as already pointed out in one of the first papers studying the issue [15]. A model of multilevel governance for the PSO schema, similar to that existing in certain domestic public transportation systems, should also be useful to coordinate the EU transport policies on this matter [16]. Theoretically, a centralized system for administration and funding at the EU level could result in a more efficient and equitable distribution of such public subsidies from PSO impositions, thus achieving common social and regional development goals [17]. As the lack of affordable transportation is usually vital for socioeconomic development in peripheral communities, regional administrations have often urged their national governments to submit a request for imposition to the Commission, with the expectation that related transport services may be ensured from a public contract due to social interest and public service of the air route concerned.

In the last few years, there have been many state members that have used the PSO to remedy the lack of scheduled transport services mostly on marginal routes (176 as of 2019). As shown in Table 1, PSO imposition notices have always been published in the Official Journal of the European Union (EUOJ). This also applies to tender notices if the procurement procedure is organized by the state member, apart from those impositions whose expected number of passengers is less than 10,000 per year according to articles 16(5) and 17(2) of [13]. Nevertheless, any imposition of a PSO on an air route must be duly substantiated by the civil aviation authority concerned, as it forces to make an exception to the rules of the free market. This implies that competent national authorities have to provide the European Commission (hereafter the Commission) with evidence that a PSO imposition is both necessary and adequate and that it also meets the eligibility criteria for the provision of transport services according to the EU regulation (Article 16(3) of [13]).

Table 1. Key features of Public Service Obligation (PSO) schema for scheduled air services under the regular procedure.

	Type 1 (Open PSO)	Type 2 (Closed PSO)	Type 3 (Closed PSO)
PSO Justification	■	■	■
PSO Imposition	■	■	■
PSO Limitation ^a	•	•	•
Call for tender	n/a	n/a	■
Information notice in the EUOJ	■	■	■
Restricted access to one carrier	n/a	■	■
Maximum fares	•	■	■
Frequencies	•	■	■
Seating capacity	•	■	■
Economic compensation	n/a	n/a	■
Contract duration ^b	n/a	n/a	■
Equipment ^c	•	•	•

Source: own work based on an analysis of current European Union (EU) legislation, [13] and [18]. Caption: black square “■” denotes a mandatory requirement from a PSO imposition n/a indicates “not applicable” under the imposition of a PSO on regular air routes concerned. Black circle “•” denotes a specification not strictly necessary. Explanatory notes: ^a if air services have not been operated in 12 months on the air route concerned, the imposition shall be expired and then moved on to operate in the free regime (Type 0); ^b up to 4 years (5 years for overseas routes); ^c type of aircraft.

1.2. Basic Aspects of the PSO Impositions Existing in the Spanish Air Domestic Market

The implementation of the PSO schema in the Spanish domestic market has been traditionally focused on scheduled air transport services serving island territories (the Balearics and the Canaries), some areas with difficulties in rail transportation (Almeria and Badajoz), and even an isolated community (Melilla). Despite the wide decentralization of public administration existing in Spain, its national state administration has exclusive jurisdiction in matters of air transportation according to Article 149(1)(20) of the Spanish constitution. Hence, PSO impositions have been managed by the national civil aviation authority (DGAC) on behalf of the Ministry of Transport, Mobility, and Urban Agenda (hereafter MITMA) [14]. In Spain, moreover, the PSO schema co-exists with a subsidy regime in public transport for residents only, which is applicable under Article 107(1) of the Treaty of the Functioning of the European Union (TFUE). While these two instruments have a very different regulatory basis from each other within the existing legal framework on a European and state member level, both are managed by the MITMA in Spain. The resident subsidy has led to an increase in the demand for regular transport services in island territories, such as in the Canary, albeit with some questions about adverse effects on airfares for non-residents [19]; thus, causing an undesirable equilibrium that can even translate into a dominant market position [20]. Tenders for PSO contracts have been carried out by MITMA and afterward conducted under e-procurement procedures [21]. As shown in Table 2, so far, a total of 23 routes have been imposed with a PSO in Spain, nine of which have been operated by one carrier from a PSO contract. Except for ES12 and ES13, interisland services neither in the Canary nor the Balearic have been tendered.

1.3. Addressing the Issue of Interconnecting the Balearic Islands from the PSO Schema

In the study of air routes linking with island destinations, airline yields are often higher during peak seasons, as the demand for air travel is usually very seasonal. As discussed later in chapter 6, this issue does not always occur with interisland flights for which regular air transport services are considered essential for socio-economic development in the Balearic Islands. In this regard, after having reviewed the related passenger traffic from the primary database [24] for each of the three routes considered, there is no evidence of a strong seasonal component. Nevertheless, the interisland air services considered in the present study involve three airports whose importance in the national airport network (managed by a state-owned company hereafter referred to as Aena) is very high in the Spanish domestic market. As can be seen in Table 3, these airports have led to a steady growth in passenger traffic in recent years, which is fundamentally due to tourism activities. Considering induced effects, indeed, the weight of tourism in the Balearic economy has been estimated at 75% [25]. Moreover, tourism in the Balearic Islands is not only very sensitive to prices, but also sensitive to the costs of travel [26]. All of this reinforces the idea that the existence of accessible and affordable transportation is vital for the tourism sector of the Balearic, and therefore for the regional economy. Furthermore, since air transportation is a fundamental part of the regional mobility ecosystem in the Balearic, the three airports from Table 3 have been traditionally considered an essential infrastructure of the archipelago. However, beyond the economic effect of tourism itself, the interisland traffic has a social component that cannot be overlooked in the analysis of whether the regional passenger air transport is efficient, but also environmentally sustainable. To achieve this, public efforts have focused on the enhancement of regular air transport services over past years by imposing a PSO on the air routes considered, in addition to introducing a special subsidy for residents (recently increased from 50% to 75%) [27]. Hence, these routes have been operating since 2003 under a PSO imposition, which, thus, has been successful in ensuring passenger air transport services in terms of availability and continuity.

Table 2. Existing PSO air routes in the Spanish domestic air transport market (as of 14 March 2020).

Route Code	Airport (from/to)	IATA ^c Code	Airport (to/from)	IATA ^c Code	PSO Contract	Contract Duration	Resident Subsidy
ES01	Almeria	LEI	Sevilla	SVQ	43/A18	12	No
ES02	Menorca	MAH	Ibiza	IBZ	-	-	Yes
ES03	Menorca	MAH	Madrid	MAD	123A2019 ^a	48 ^b	Yes
ES04	Palma de Mallorca	PMI	Ibiza	IBZ	-	-	Yes
ES05	Palma de Mallorca	PMI	Menorca	MAH	-	-	Yes
ES06	Gran Canaria	LPA	El Hierro	VDE	-	-	Yes
ES07	Gran Canaria	LPA	Tenerife Sur	TFS	-	-	Yes
ES08	Gran Canaria	LPA	Fuerteventura	FUE	-	-	Yes
ES09	Gran Canaria	LPA	Lanzarote	ACE	-	-	Yes
ES10	Gran Canaria	LPA	Tenerife Norte	TFN	-	-	Yes
ES11	Gran Canaria	LPA	La Palma	SPC	-	-	Yes
ES12	La Gomera	GMZ	La Palma	LPA	15/A18	36	Yes
ES13	La Gomera	GMZ	Tenerife Norte	TFN	15/A18	36	Yes
ES14	La Palma	SPC	Lanzarote	ACE	-	-	Yes
ES15	Tenerife Norte	TFN	El Hierro	VDE	-	-	Yes
ES16	Tenerife Norte	TFN	Fuerteventura	FUE	-	-	Yes
ES17	Tenerife Norte	TFN	Lanzarote	ACE	-	-	Yes
ES18	Tenerife Norte	TFN	La Palma	SPC	-	-	Yes
ES19	Badajoz	BJZ	Madrid	MAD	123A18	18	No
ES20	Badajoz	BJZ	Barcelona	BCN	123A18	18	No
ES21	Melilla	MLN	Almeria	LEI	162A2020	12	Yes
ES22	Melilla	MLN	Granada	GRX	162A2020	12	Yes
ES23	Melilla	MLN	Sevilla	SVQ	162A2020	12	Yes

Source: compilation based on information collected from both [22] and [23] according to the list of airports provided in Appendix C. For further information see Appendix C. Explanatory note: ^a that obligation is not applicable during the period between May and October; ^b economic compensation applicable in seasonal period only; ^c International Air Transport Association (IATA).

Although no paper has been published so far for analyzing the PSO schema applied on interisland routes in the Balearic, similar cases relating to EU island territories have analyzed the PSO system from some earlier studies. In the case of interisland air transport in the other Spanish archipelago, the market liberalization has also resulted in certain market dysfunctions concerning its local network that cannot be left entirely to airlines' business criteria, as it affects territorial cohesion [28]. This often causes higher fares, especially on mainland routes with a demand seasonality, such as in those serving Sardinia [29]. The first PSO impositions were introduced in 1998 from the first package of 13 interisland routes in the Canary Islands. Similar considerations in this regard apply to the Azores case, whose regional network has been fully operated under a PSO system with varying degrees of success, but should be approached at aiming at maximizing social welfare instead of minimizing total social costs as the main objective [30], or even towards an approach combining cost and level-of-service objectives without crisis scenario [31].

The regional air transport network serving the Balearic Islands is comprised of three air routes forming a triangle over the archipelago, as can be seen in Figure 1. Although these inter-island connections operated from a single PSO imposition, they are regarded as point-to-point air transport services. However, for operational purposes and in accordance with the provision of PSOs, scheduled passenger services on the air route ES02 have not always operated by a direct flight, but with an intermediate stop at Palma de Mallorca airport (PMI). In the cases examined for this research, passenger traffic records have

revealed that these regular services had operated on a non-stop flight throughout each year in the period from 2008 to 2011. For all other years considered, the route ES02 has been operating as the sum of two legs (i.e., ES04 and ES05) for operational efficiency reasons. The exception is mainly during summer seasons and special periods. With regard to the sustainability of concerned air operations, air carriers operating such short-haul flights are practically compelled to have a competitive fleet that includes regional airliners designed to carry up to 100 passengers. Concerning the travel distances considered in this case study (less than 500 km), besides the route performance, a turboprop plane is highly the most general adequate option, such as the ATR family (ATR-42/72 series) or the DHC-8 family (Q100/200/300/400 series). In the case of high demand time during certain summer seasons, a regional twin-engine turbofan aircraft from the CRJ700/900/1000 series. Since the DHC-8 has traditionally not been present in Spanish skies, the figures from Table 4 were calculated in terms of fuel consumption for the ATR72, which has been operating by the regional airlines based in Spain (UX, YW, and NT).

Table 3. Key facts of air passenger traffic at airports considered (2004–2019).

IATA Code	Airport Group ^a	Airport Typology ^b	Airport Category ^c	Average Annual Passenger Traffic ^d	CAGR (%) ^e
PMI	Major	Touristic	Level 3	23,781,000	0.6
IBZ	I	Touristic	Level 2 ⁱ / 3 ⁱⁱ	5,789,000	1.1
MAH	I	Touristic	Level 2 ⁱ / 3 ⁱⁱ	2,811,000	0.4

Source: own calculation based on information from Aena database [23]; additional information provided by the Spanish Directorate-General for Civil Aviation (DGAC) upon request. Explanatory notes: ^{a,b} according to the classification provided by Aena; ^c according to the categorization under Article 3 of [11] and Article 4 of [32], Spanish air facilities are classified as non-coordinated airports (Level 1), airports with schedules facilitated (Level 2), or coordinated airports (Level 3); ^d total amount including both arrivals and departures at each airport; ^e compound annual growth rate (CAGR). Additional note: ⁱ during the winter season; ⁱⁱ during the summer season.



Figure 1. PSO air routes among the Balearic Islands (as of 31 December 2019). Source: prepared with FreeMapTools.com.

Table 4. Operational facts of PSO air routes among the Balearic Islands (as of 14 March, 2020).

PSO Route Code	Travel Distance (km) ^a	Travel Time (h)	Heading Vector Navigation	Block Fuel (kg) ^{b,c}	CO ₂ Emissions (kg) ^{b,c}	Standard Aircraft Equipment	Emissions CO ₂ /PAX (kg) ^{b,c}	Standard Cabin Configuration
ES02	269	0:52	247° (WSW)	436	1373	ATR72-600	19	72Y
ES04	140	0:36	238° (WSW)	228	718	ATR72-600	10	72Y
ES05	132	0:35	74° (ENE)	213	671	ATR72-600	9	72Y

Source: own figures partially based on a performance study provided by ATR upon specific request. Explanatory note: ^a orthodromic distance; ^b standard assumptions: Jet A1 density as of 0.804 kg/l, CO₂ emissions as of 3.15 kg of CO₂ per kg of Jet A1; ^c en-route assumptions: maximum payload, no wind, one aircraft per leg under technical specifications by International Standard Atmosphere (ISA), Joint Aviation Requirements (JAR), European Union (EU) Aviation Safety Agency (EASA); passengers (PAX).

2. Overall Findings and Key Results from the Case Study

Beyond shaping an important part of the EU's external borders, the Mediterranean islands have been put at a competitive disadvantage as most of them have faced specific public measures that facilitate a more inclusive Europe in terms of territorial cohesion. Thus, the lack of adequate air transport services is precisely a challenge due to the condition of insularity, particularly those concerning interisland routes. In the case of the Balearic Islands, as already pointed out, the provision of scheduled flights for passengers has been operated continuously from a PSO imposition since 2003. Moreover, the provision of the related public services on these air routes (ES02, ES04, and ES05) had been ensured without the need for a PSO contract until the entry into force of the state of emergency from entire territory in Spain due to the coronavirus disease 2019 (hereafter COVID-19) [33]. As shall be seen later, this situation has obliged central administration to ensure minimum air transport services for those persons entitled to move within the national territory (i.e., essential workers) through the PSO contracts and to fly up on interisland routes.

In the period considered for the case study, two major features have been observed in how the imposition of a PSO on these interisland routes is applied, which are closely linked to the two legislative reforms carried out. The first being procompetitive and the second being restrictive, in 2006 and 2011 respectively [34]. Firstly, the imposition was introduced in 2003 to provide a stable operational framework for those airlines interested in scheduling flights under certain conditions from a PSO of type 1 [35]. These routes have therefore been designed on the premise that certain segments of the population with fewer resources may have more difficulty in accessing transportation. For the protection of such vulnerable groups as old and young people, as can be seen in Table 5, the related PSO imposition was initially set out to provide them with social tariffs, in addition to the establishment of general maximum fares. It was also designed for carrying essential goods including those considered fundamental for the regional economy, such as footwear and jewelry industries. Since the three routes were mainly imposed with a PSO on passenger grounds, the related air transport services were provisioned from a yearly minimum capacity, specifically on those connecting Palma de Mallorca with Menorca and Ibiza. Secondly, there has been a marked shift in operating conditions from the revision of the imposition in 2008. While these air routes have been operated under a sole PSO since late 2003, the requirements for the provision of regular transport services have undergone a remarkable change concerning airfares and social tariffs [36]. Comparing the findings from Table 6 with Table 5, it can be observed that a change of prices regime from a maximum fares-based system to a reference-based system. This change was aimed at introducing a flexible fare system to encourage airlines in operating the routes which should have resulted in more competition.

Table 5. Summary of conditions from the imposition of a PSO on interisland air routes in the Balearic (2003).

Resolution of 28.11.2003	ES02	ES04	ES05
Social tariffs (discount rate)	Up to 22 years: 10% off older than 65 years: 10% off athletes/patients: 10% off	Up to 22 years: 10% off older than 65 years: 10% off athletes/patients: 10% off	Up to 22 years: 10% off older than 65 years: 10% off athletes/patients: 10% off
Yearly minimum capacity (per leg) ^b	NWS: Unspecified NSS: Unspecified	NWS: 63,000 seats NSS: 107,000 seats	NWS: 71,000 seats NSS: 110,000 seats
Daily minimum frequency (per leg) ^b	NWS: 1 ^a NSS: 1 ^a	NWS: 4 NSS: 5	NWS: 4 NSS: 5
Priority freight	Essential goods, drugs, and daily press	Essential goods, drugs, and daily press	Essential goods, drugs, and daily press
Maximum fare	€101	€72	€72

Source: own work based on data collected from imposition documents [35]. Explanatory notes: ^a when there are no direct flights on ES02, regular services shall be operated as a stopover route (ES04 + ES05); ^b explicitly referred to each northern summer and winter season (NSS and NWS, respectively), and currently starting on 28 March 2021 and 31 October 2021, respectively).

Table 6. Summary of conditions from the imposition of a PSO on interisland air routes in the Balearic (2008).

Order FOM/1085/2008	ES02 ^a	ES04	ES05
Social tariffs (discount rate)	Up to 24 years: 20% Older than 65 years: 20% Athletes/patients: 10%	Up to 24 years: 20% Older than 65 years: 20% Athletes/patients: 10%	Up to 24 years: 20% Older than 65 years: 20% Athletes/patients: 10%
Yearly minimum capacity (per leg) ^b	NWS: Unchanged NSS: Unchanged	NWS: Unchanged NSS: Unchanged	NWS: Unchanged NSS: Unchanged
Daily minimum frequency (per leg) ^b	NWS: Unchanged NSS: Unchanged	NWS: Unchanged NSS: Unchanged	NWS: Unchanged NSS: Unchanged
Priority freight	Unchanged	Unchanged	Unchanged
Reference fare	€114	€82	€82

Source: own work based on data collected from imposition documents [36]. Explanatory note: ^a when there are no direct flights on ES02, regular services shall be operated as a stopover route (ES04 + ES05); ^b explicitly referred to each northern summer and winter season (NSS and NWS, respectively), and currently starting on 28 March 2021 and 31 October 2021, respectively).

Since the changes introduced by the revised PSO imposition, as summarized in Table 6, only have affected social tariffs and reference fares, maximum prices were removed. As a result, this revision has led to the establishment of flexible fares, which generally must not exceed 25% of the reference ones. As can be seen in Figure 2, the evolution of the maximum fares within the period between April 2008 and January 2019 indicates that the introduction of a flexible price system has allowed the related air transport services to contain any abrupt air fare movement. All of this without renouncing the application of a generous resident subsidy system designed to facilitate certain mobility problems in the Balearic Islands arising as a result of its insularity. Under these circumstances, related short-haul operations would be viable for regional airlines and these regular air services may be profitable. Indeed, as noted in Table 6, it becomes clear that there is a slight increased maximum fare since 2013. Moreover, all of this exactly coincides with a significant change of demand trend for regular transport services on ES04 and ES05, as shown in Figure 3.

As shown in Figure 3, two of the three air routes (ES04 and ES05) considered in the study are not thin routes according to criteria from paragraph 20(b) of [18], as much more than 100,000 passengers have been carried on them. Moreover, both routes have become increasingly similar behavior with significant growth since 2014. Similarly, this fact can be seen in Figure 4 regarding the Passenger Load Factor (PLF) of both routes since 2017.

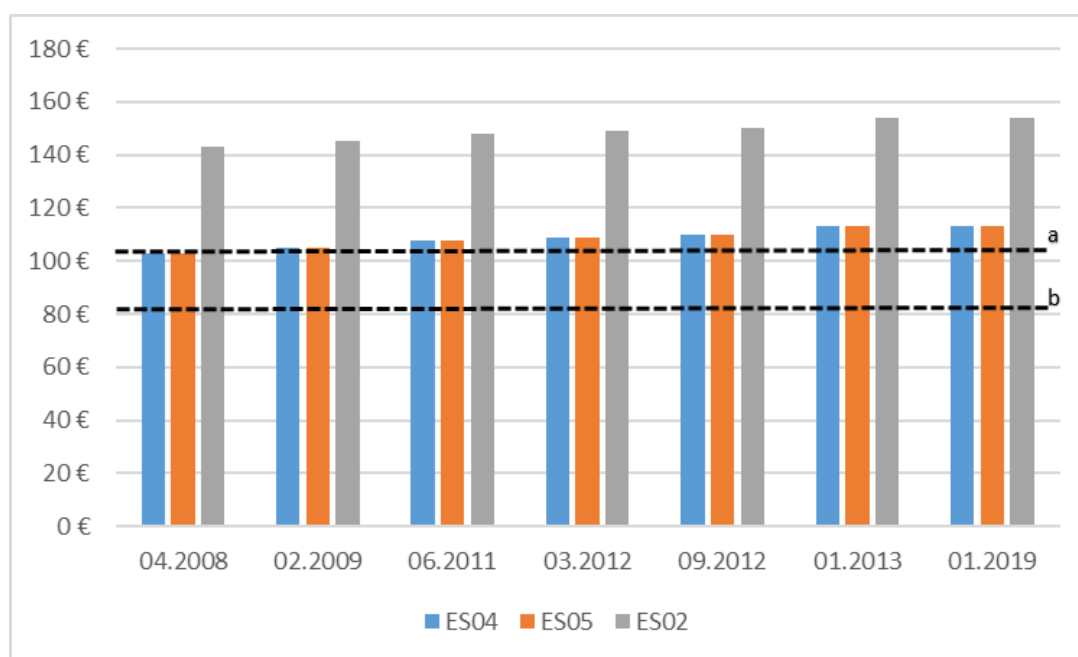


Figure 2. Maximum airfares for interisland routes serving the Balearic from the entry into force of updated PSO imposition (2008). Source: own work based on data collected from PSO documents in the public domain through [23], and other figures with specific access rights submitted to Ministry of Transport, Mobility, and Urban Agenda (MITMA) under special request. Captions: (a) reference fare for air routes ES02; (b) reference fare both for air routes ES04 and ES05.

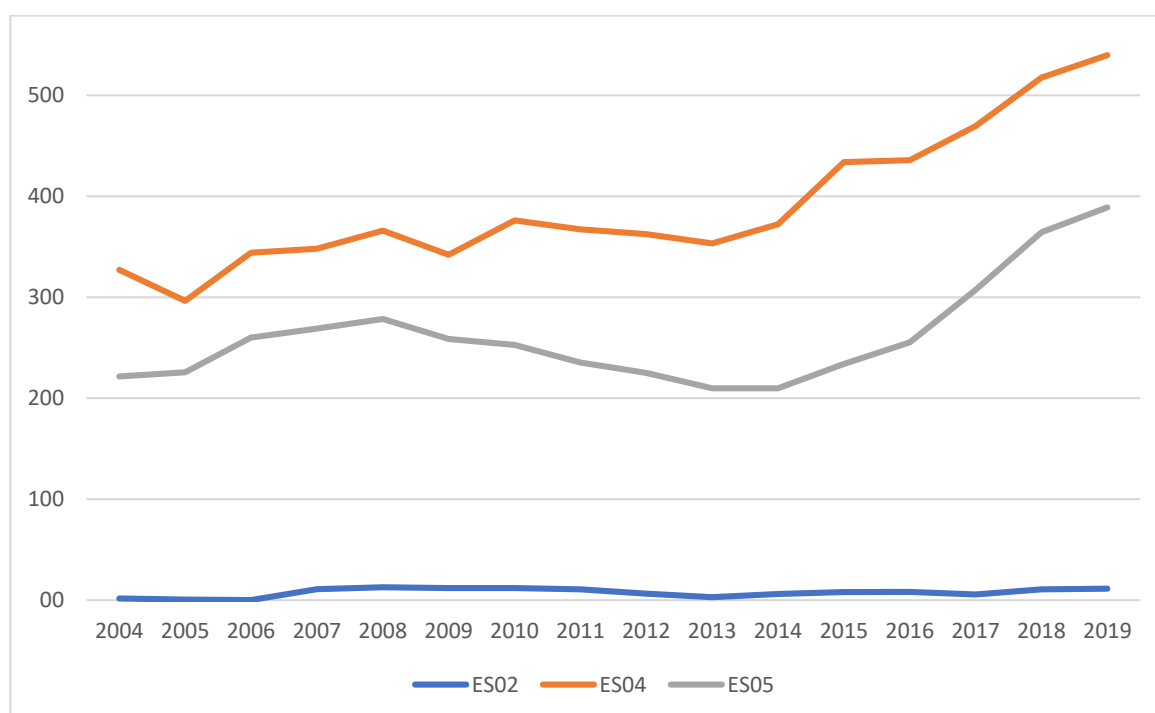


Figure 3. Annual air route performance on regular air services among the Balearic Islands as thousands of passengers carried (2004–2019). Own Source: own work based on data collected from air traffic statistics [24].

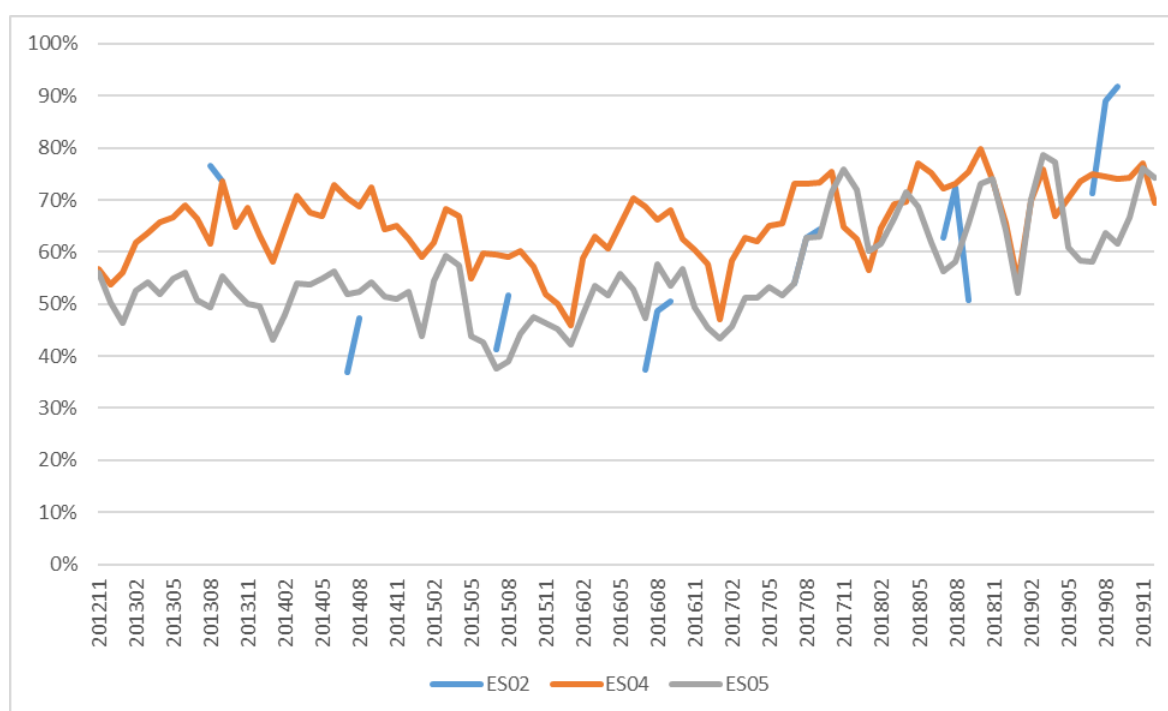


Figure 4. Annual performance as Passenger Load Factor (PLF) (%) of PSO air routes among the Balearic Islands in the period between November 2011 (201111) and December 2019 (201912). Source: own work based on data collected from PSO documents in the public domain upon [23,24], and other figures with specific access rights submitted to MITMA under special request. Explanatory note: data concerning ES02 only for non-stop direct flights.

As already pointed out, commercial passenger air transportation is far more sensitive to worldwide economic crises and global events, since the geographical scope of the airline sector is broader than other means of public transport, such as the train or the bus. Nowadays, the transversality of aviation activity is closely linked with the globalization phenomenon since both business and leisure travels play an important role in air transportation. In the event of an outbreak of a pandemic disease such as the present one; thus, certain passenger transport services can be disrupted by mobility constraints in avoiding the spread of the pathogen. This is especially noticeable in a public health crisis of a global nature such as the COVID-19, as it has forced several countries to seal their borders. Presumably, the pandemic will have a long-term implication on worldwide aviation, as the whole industry has been plunged into a deep crisis from which it is currently being difficult to emerge due to, among other reasons, the scarce capacity of vaccination campaigns across the world. In this context, the Balearic air route network has needed public intervention as a result of the state of alarm declared in 2020. For this purpose, as shown in Table 7, a public contract had to be tendered for ensuring essential transport services on the routes ES04 and ES05 (see Figure 5) with a minimum of weekly operations and to avoid full isolation by air of the two satellite islands (MAH and IBZ) with the regional capital (PMI). Only the two air carriers (UX, YW) operating interisland routes in the Balearic decided to submit a bid under the tender procedure concerned (118V2020). The contract was awarded to a tender (UX), which had submitted the lowest price, and then it was furthermore renewed for one week until four times for a total of €74,536 per week.

Table 7. Summary of public contracts applied during the coronavirus disease 2019 (COVID-19) (2020).

Symbol Caption	Contract Reference ^a	Public Funds	Contract Type	Total Award Amount ^b	Starting Date	Ending Date
α	118V2020	National	PSO	€106,480	20.03.2020	29.03.2020
β	118V2020	National	PSO	€138,424	30.03.2020	12.04.2020
γ	118V2020	National	PSO	€149,072	12.04.2020	26.04.2020
δ	118V2020	National	PSO	€149,072	26.04.2020	10.05.2020
ϵ	118V2020	National	PSO	€149,072	10.05.2020	24.05.2020

Source: own work based on data collected from tender dossiers [23]. Explanatory note: ^a applicable on PSO air routes ES04 and ES05 only; ^b including taxes.

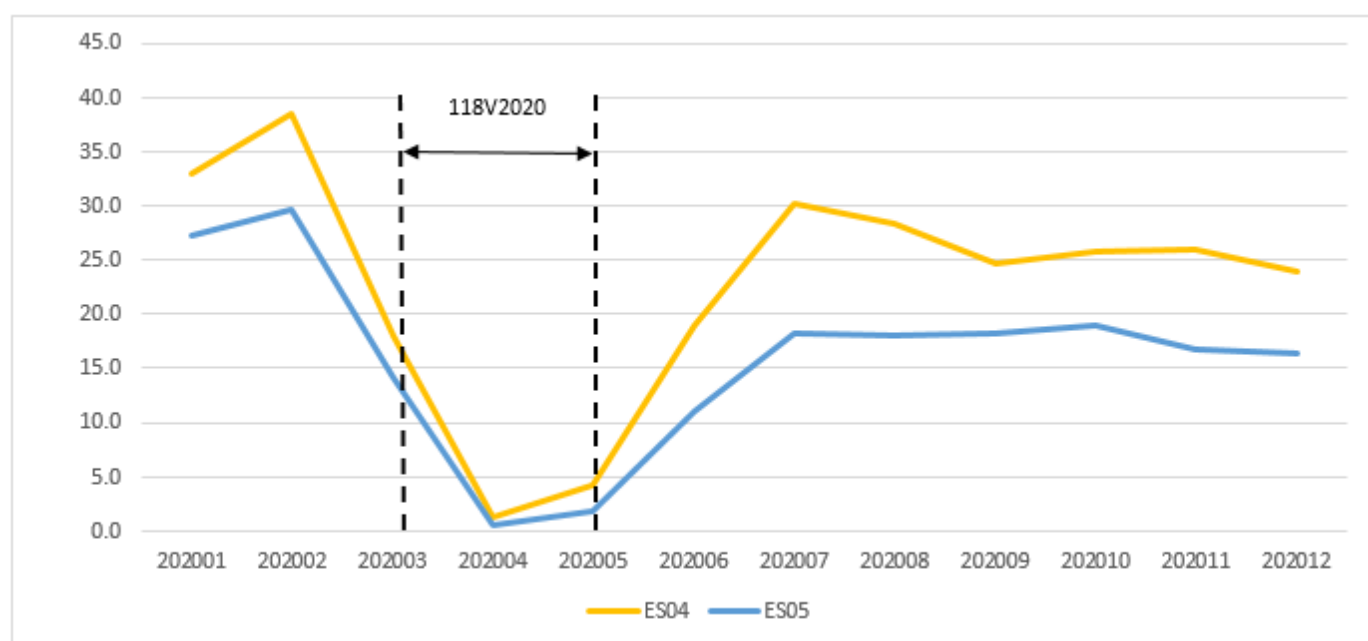


Figure 5. Passengers carried (in thousands) monthly on PSO air routes ES04 and ES05 in 2020 during the period from January (202001) to December (202112). Source: own work based on data collected from air traffic statistics [24].

While a PSO air route can be designed exclusively for freights based on EU regulation [13], there has been so far no PSO imposition on cargo air route within EU Single Market, with the exception of the tentative provision for air cargo and mail only between the Portugal mainland and the Azores islands through two impositions of a PSO on routes concerned, one imposed in 2015, and another in 2017. However, the related tender procedures have remained unsuccessful, since the Portuguese Civil Aviation Authority (hereafter PCAA) did not find any airline in a position to fulfill the requirements of the concerned PSO; thus, the imposition expired at the end of 2017. Although the PSO schema so far applied in Spain has not been aimed at providing freight transportation services, certain routes were designed with some special considerations for the transport of specific goods. In the case study of interisland air routes in the Balearic Islands, even though no cargo transport requirements have been fixed, the related PSO merely determines the priority for the transportation of some goods among the islands, such as essential goods, drugs, and daily press. However, since the provision of public transport services on such routes does not oblige airlines to provide a minimum payload capacity for freights on each flight, as can be seen from Tables 5 and 6, scheduled passenger services are operated by using the optimal type of aircraft in terms of operational efficiency according to demand. This is one of the reasons why such regular services have been traditionally served with narrow-body aircrafts suitable for short-haul flights, either by operating turboprop or turbojet airplanes, such as from ATR72 and CRJ series, respectively. Nowadays, the extensive use of regional

airliners on air routes as those considered in this study is also the most suitable solution for providing regular passenger transport services in terms of efficiency and sustainability. This allows airlines to make better profits by turning their airplanes round more quickly, scheduling more flights per day with the minimum number of cabin crew required (one or two workers), as well as burning less aviation fuel per full operation than commercial jetliners. However, the use of regional airliners is not suitable for cargo movements due to low payloads. For instance, 7550 and 10,247 kg at typical in-service Operating Empty Weight (OEW) for ATR72-600 and CRJ900, respectively. As shown in Figure 6, although air route ES05 had significantly increased the goods carried until 2008, the number of goods carried on these PSO routes is practically insignificant since 2014.

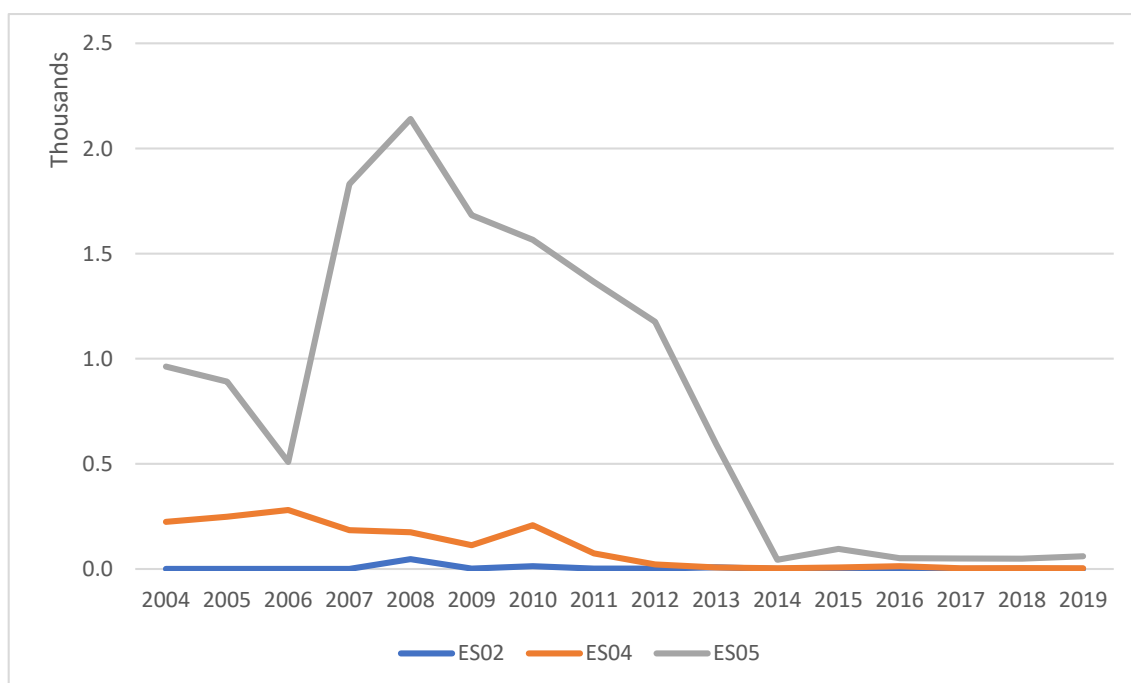


Figure 6. Quantity of goods carried (in thousand tons) on regular air transport services among the Balearic Islands. Source: own work based on data collected from the official database [24].

3. Discussion

The above findings show that the discussion on how the efficiency of the PSO system imposed on the air routes considered should be interpreted from the perspective of earlier studies is not easy to approach in only one article. Firstly, no previous paper has specifically addressed the issue of the Balearic air transport network in terms of public efficiency and socioeconomic sustainability from the PSO schema. Secondly, though here briefly analyzed with regard to either reference fares or maximum prices, the lack of complete cost and pricing data from open-access databases has made impossible the use of statistical regression techniques to predict a wide range of phenomena relating to price elasticity of demand and price-sensitivity in the intermodal market considered base on the two modes of transport possible considered in the research (air and sea traffic). Nevertheless, the findings and their implications are discussed below in the broadest context possible concerning the 176 PSO air routes so far imposed in the EU single market of air transportation.

In the case study at issue, the provision of regular air transport services among the Balearic Islands has only sought to enhance an adequate provision of passenger transportation in terms of continuity, regularity, and prices. From the air routes considered in Table 8, just one of them (ES04) had enjoyed a good level of competition. Having been operated by up to three airlines, especially in the summer season, this route has suffered a loss of capacity for regular services due to the cessation of activity of the third player, Air

Belin (formerly AB). However, this has not resulted in a drop in demand, neither in the number of passengers carried nor PLF, as can be seen, both in Figures 3 and 4, respectively. Regarding the route ES02, as already pointed out, scheduled passenger transport services have been operated infrequently, mostly in summer seasons and for four whole years (from 2008 to 2011). As shown in Table 8, one of Europe's largest regional airline, Air Nostrum (YW), has become a clear leader in the Balearic market of interisland routes, which, together with the third-largest Spanish airline, Air Europa (UX), have been operating regularly the routes ES04 and ES05. Passenger transport services on route ES02, when operated directly, have always been carried out by YW. After carefully analyzing the traffic data on the three routes, it can be stated that YW has become the dominant market player in the Balearic air routes. Moreover, this regional airline will likely become the only carrier operating within the Balearic Islands, once the purchase agreement to buy UX by Iberia (IB) becomes effective. The entry of new players also seems difficult, once the global passenger traffic can return to pre-COVID-19 levels, as the second-largest Spanish regional airline, Binter (NT), is based in the Canary Islands. Therefore, it can be assumed that the provision of regular passenger services on these routes shall be provided from an updated PSO imposition and presumably also with public contract at least until 2024 in avoiding the Balearic Island can be under-connected among them. Considering that the increase of 25% in resident subsidy occurred in 2018 (a total of 75% as of 2019) may have been certain undesired effects on airfares for those passengers visiting the Balearic Islands, findings suggest that the future challenge will be faced in stimulating the concurrence in the local transport market, even enhancing the intramodality between air and sea transport (for instance, through a combined ticket).

Table 8. Market share of main airlines on each inter-island route in the Balearic between January 2004 and October 2019.

PSO Route	Air Nostrum	Air Europa	Air Berlin ^a
ES02	98.4% ■	-	-
ES04	64.4% ■	13.4% ●	21.0% ■
ES05	85.6% ■	8.7% ●	4.7% ■

Source: own calculation based on data collected from air traffic statistics [24], and other figures with specific access rights submitted to Aena under special request. Caption: black square "■" denotes a turbofan aircraft mostly operating the air route considered while black circle "●" denotes a turboprop aircraft mostly operating the air route considered. Explanatory note: ^a this airline definitively ceased operations on 28 October 2017.

3.1. Evaluation of Findings Concerning the PSO Imposed on Air Route ES02

The route linking Menorca with Ibiza has been traditionally considered a secondary route within the transport network of regional air service in the Balearic Islands. Because of its high seasonal demand (see Figure 8), the route has been habitually operated in the winter season (between 2005 and 2007, and later since 2012) as a connecting flight via PMI with YW. Hence, the high seasonality of the demand for direct flights has forced airlines to operate this route sporadically and at low frequencies. As pointed out previously (see Tables 5 and 6), the existing imposition on the interisland routes serving the Balearic allows supply to adapt itself to seasonal fluctuations in demand under PSO limitations so that some flights can be operated with an intermediate stop. This explains why passenger transport services concerned have sometimes been provided with one single air carriage contract, which comprises two legs, habitually in low seasons. Regarding the route ES02, the data analyzed in this study are only those that comprise direct flights. For this reason, among others, graphs obtained on the performance of this air route shows sometimes disconnected segments. Nevertheless, the limited data available, mostly those related to occupancy factor (see Figure 4), indicates that non-stop flights for regular passenger transport services on the route in question, when scheduled, have seen a predictable and unchanging demand over the past years. As already seen from Figure 3, in contrast with the other two routes considered in the study, the ES02 has traditionally been considered

a minor route within domestic transportation in terms of market impact, albeit essential in terms of territorial cohesion. While flight prices for this route have been higher than those relating to ES04 and ES05, either maximum or reference fares, regular transport services concerned have been covered by both the initial imposition (2003) and the latter modification (2008), as previously described in Tables 5 and 6, respectively. However, discontinuity of regular transport services between both islands appears to be one of the causes of the insignificant amount of goods transported on this route. Regarding the sustainability of the air transport operations on this route, despite a very scarce freight capacity, the adequate airliner would be a turboprop aircraft because of its low carbon emissions. Less well known by travelers, but singularly important in the European regional airlines, the AT7 has been used extensively across the single aviation market. Additionally, as summarized in Table 9, some regional jets, such as CR9, and CRK, may also be suitable for the summer seasons. In contrast, scheduling a narrow-body aircraft, either 320 or 738, on a thin route, such as ES02, does not appear to be a viable option, since their operating costs are usually covered if there is a high level of occupancy (a PLF over 80%).

Table 9. Performance of air transport operation on route ES02 according to most popular airliners for short-haul flights.

Standard Type of Aircraft ^a	Travel Time (h)	Fuel Consumption (kg)	CO ₂ Emissions (kg) ^{b,c}	Main Airlines Holding a Spanish AOC ^a	Emissions CO ₂ /PAX (kg) ^{b,c,d}	Standard Cabin Configuration ^d	Standard Cabin Crew ^e
CR2	0:39	907.5	2858.7	YW	57.2	50Y	1
AT7	0:52	504.3	1588.6	X5, YW, NT, PM	22.1	72Y	2
DH4	0:56	794.8	2053.6	none *	32.1	78Y	2
CR9	0:38	1300.3	4095.8	YW	46.0	89Y	2
CRK	0:38	1367.7	4308.1	YW	43.1	100Y	2
E95	0:39	1582.6	4985.3	X5	40.9	122Y	3
319	0:38	1854.5	5841.8	IB, V7, VY	38.9	150Y	4
320	0:38	1942.8	6120.0	IB, I2, VY	34.0	180Y	4
738	0:37	1992.8	6277.3	UX	34.9	180Y	4

Source: own calculation based on related methodology from International Civil Aviation Organization (ICAO) [37] and considering fleets of commercial airlines with an Aircraft Operator Certificate (AOC) issued by DGAC only (as of 16 September 2019). Explanatory notes:

^a according to the list of designator codes provided in both Appendices A and B ^b standard assumptions: 3.15 kg of CO₂ emitted per 1 kg of Jet A1 burned; ^c en-route assumptions: maximum payload, no wind, each flight leg operating under technical specifications by ISA, JAR, and EASA; ^d tourist class seats only; ^e most common number of cabin crew members on board. (*) Sparsely operated in Europe (as of December 2019).

3.1.1. Specific Assessment on Considerations Related to Passenger Traffic

Although these destinations have a high dependence on the tourism sector, and thus a strong seasonal impact on the activity at their airports, the territorial component of the air transport on both islands has not ignored this route. As can be seen in Figure 7, there has been a growing demand for passenger services, at the time it was operated with a direct flight. Moreover, Figure 8 shows that the demand for scheduled air transport services has a high dependence on summer seasons, and presumably on tourism activity. While the identified seasonality is noticeable, the performance obtained in operating this route in the past few years seems not to be considered adequate for yield management. Consequently, apart from the summer seasons, flights concerned have been habitually scheduled with intermediate stops.

Annual traffic data have also been analyzed to determine whether the demand for passenger transport services depends on each semester. Figure 9 shows a slight increase in demand during the second half over past years. Apparently, this may be due to the fact that there are more people traveling for visiting relatives and folks during Christmas time. However, Figure 10 seems to indicate otherwise, as the evolution of passenger demand during low seasons is much more accentuated in the first period than in the second one.

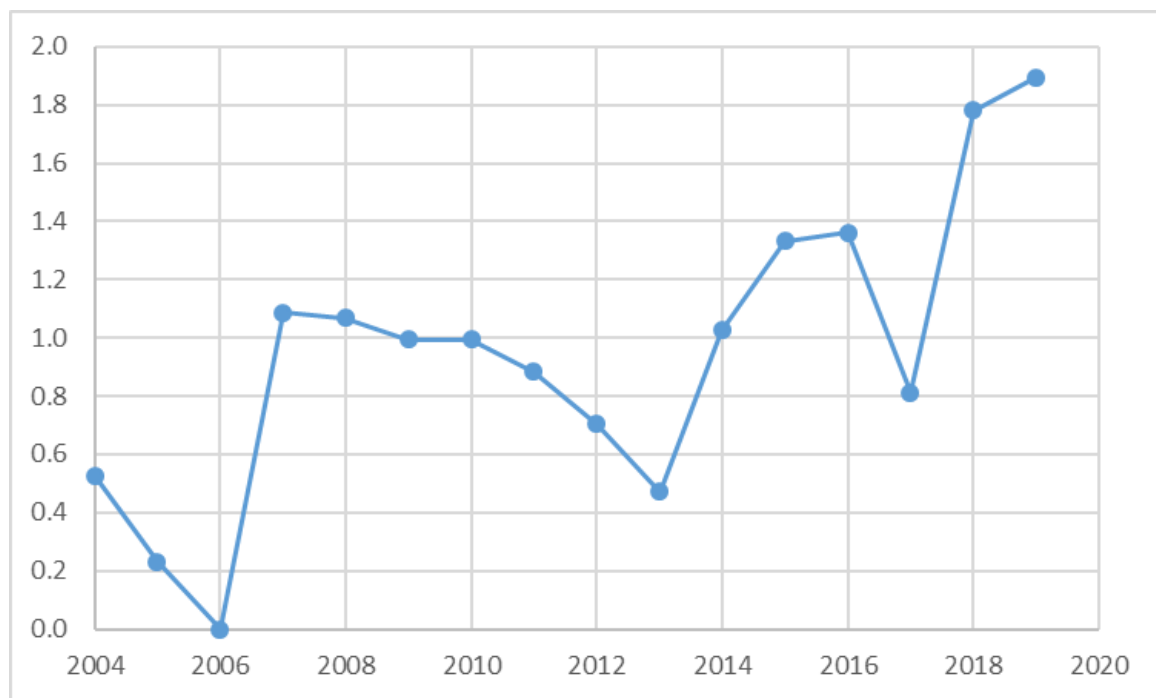


Figure 7. Thousands of passengers carried as a yearly average on ES02 in the period between 2004 and 2019. Source: own work based on data collected from air traffic statistics [24].

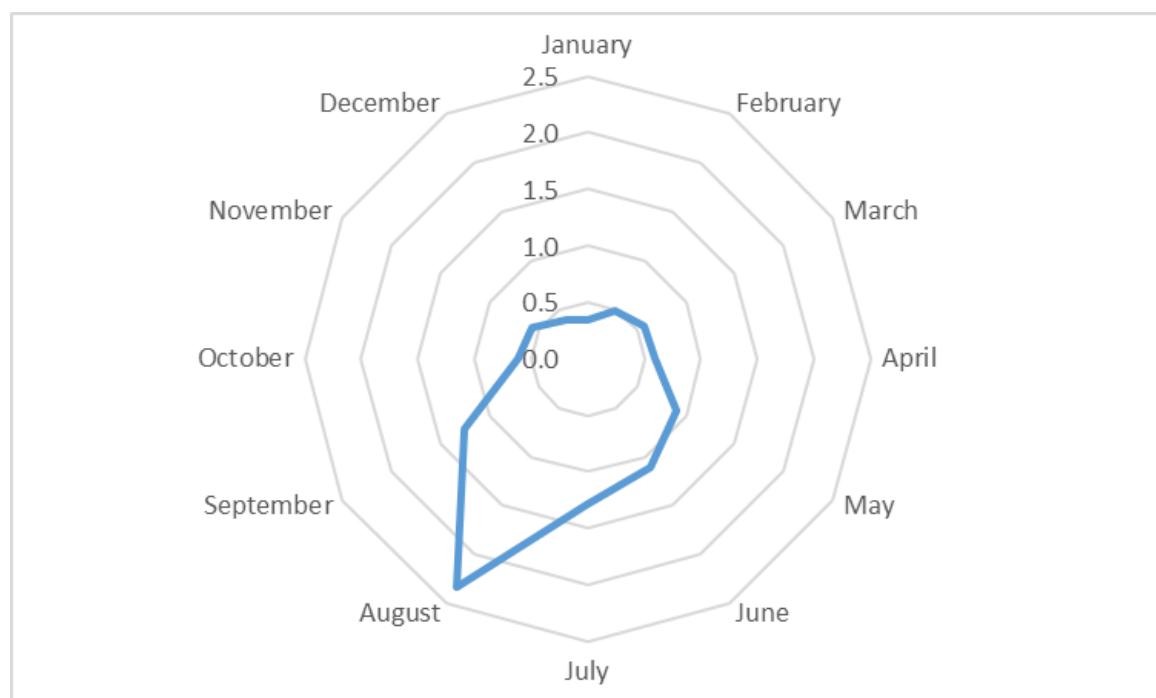


Figure 8. Thousands of passengers carried as monthly average on ES02 in the period between 2004 and 2019. Source: own work based on data collected from air traffic statistics [24].

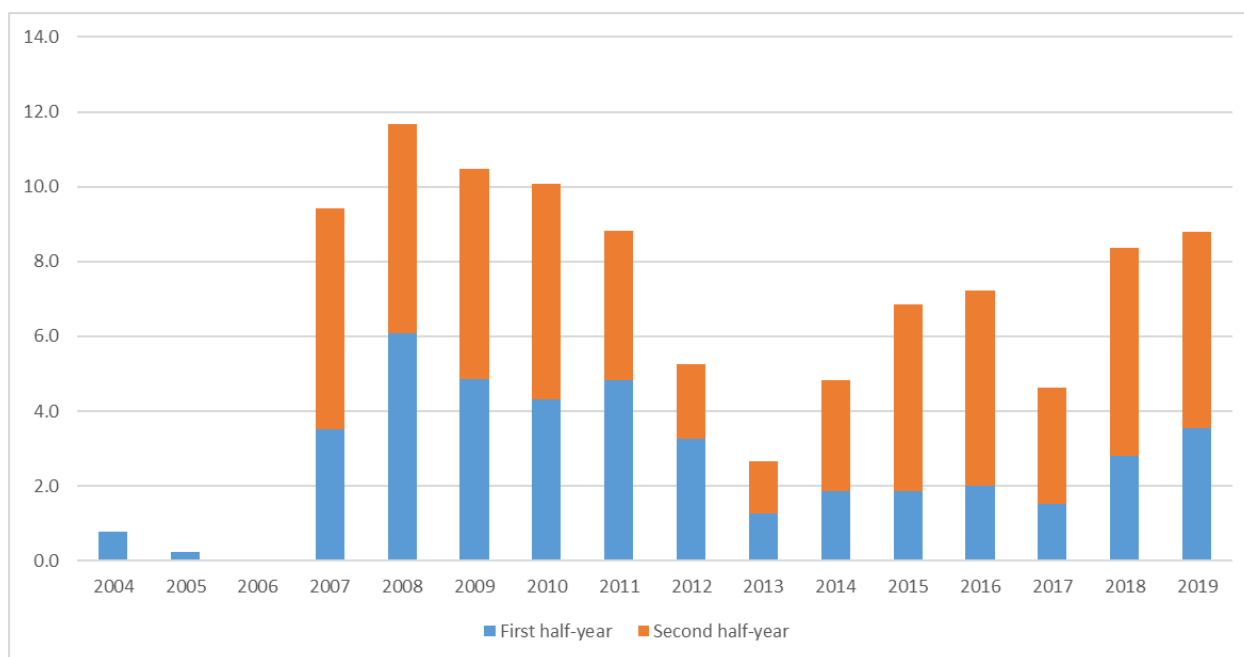


Figure 9. Thousands of passengers carried per half-year on air route ES02. Source: own work based on data collected from the official database [24].

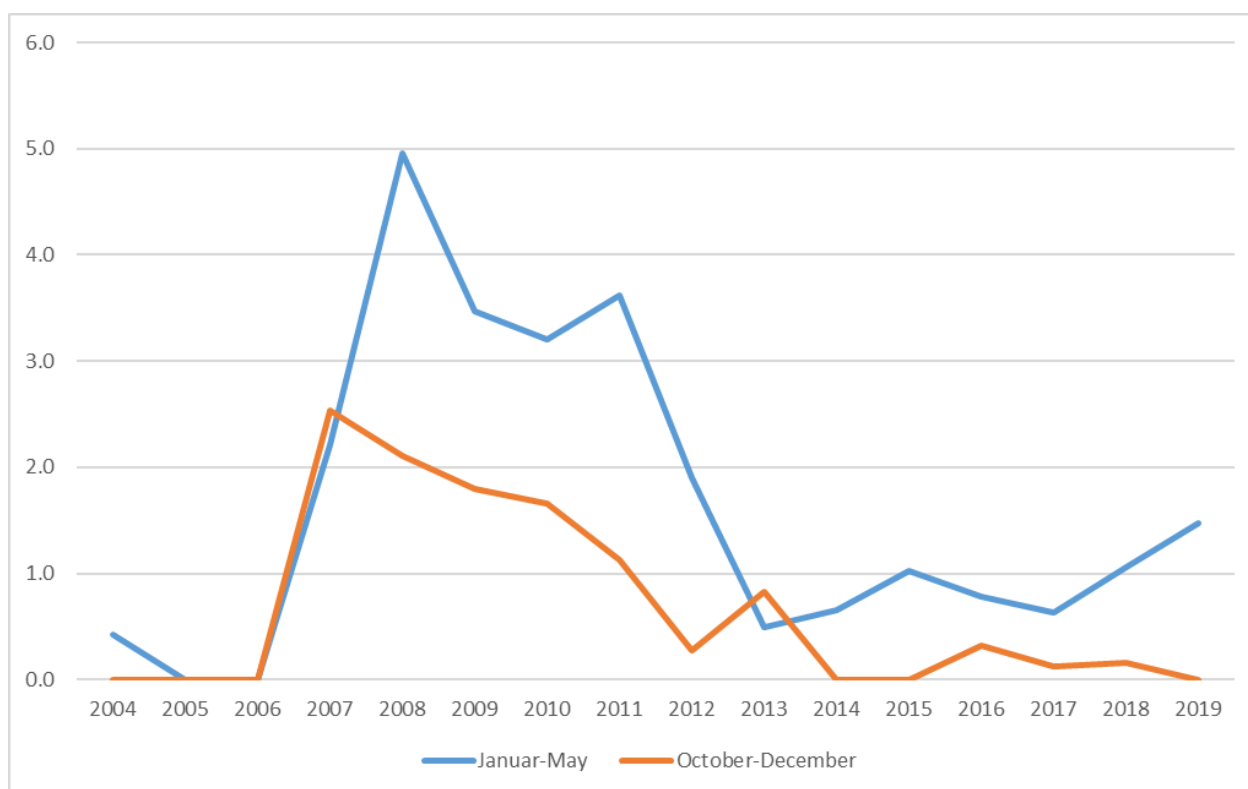


Figure 10. Thousands of passengers carried in down seasons on air route ES02. Source: own work based on data collected from the official database [24].

3.1.2. Specific Assessment on Considerations Related to Freight Traffic

As regular air transport services on this route have been occasionally operated over past years by operating regional airliners, there are three years (2008, 2010, and 2013) whose data obtained has shown some amount of goods transported (see Figure 11). Although the results obtained are quite insignificant for the study period considered, Figure 12 shows a curious overlap during low seasons from 2012 to 2014 with no apparent cause.

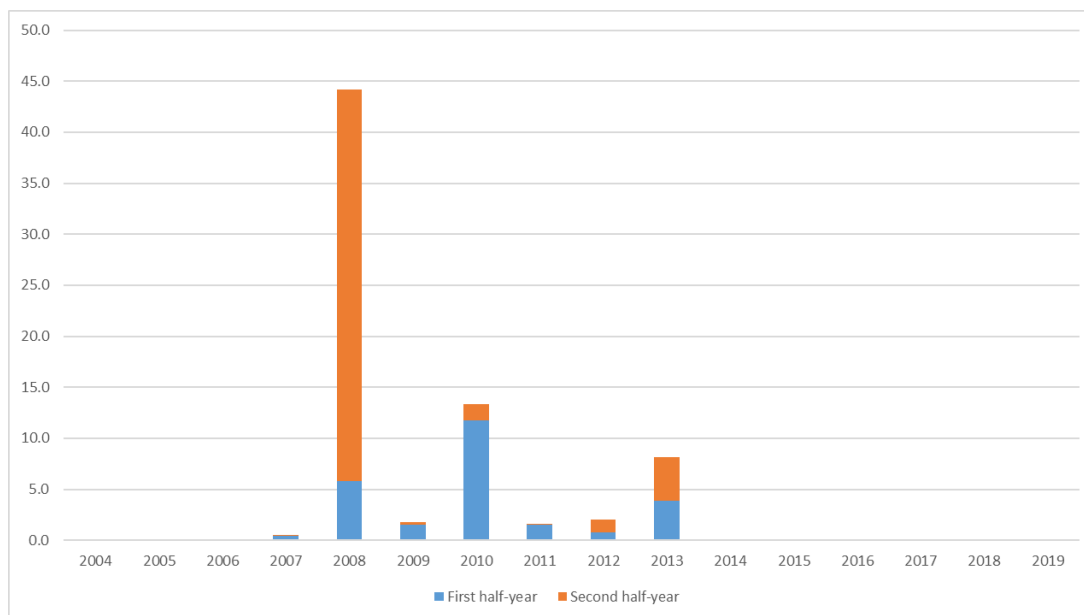


Figure 11. Quantity of goods carried on air route ES02 (in tons) per half-year. Source: own work based on data collected from the official database [24].

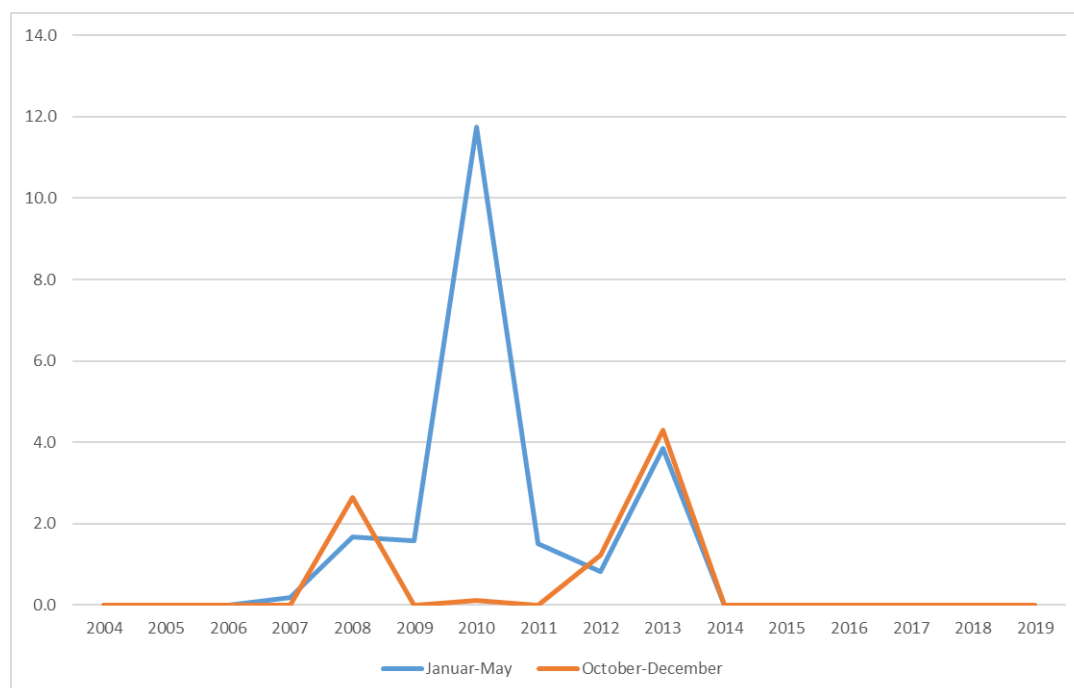


Figure 12. Tons of goods carried per year during down seasons on air route ES02. Source: own work based on data collected from the official database [24].

3.2. Evaluation of Findings Concerning the PSO Imposed on Air Route ES04

The route between Palma de Mallorca and Ibiza is the most important air corridor serving the regional transportation network in terms of the number of passengers carried on scheduled services within the Balearic Islands, as already seen in Figure 3. The route has also benefitted from a considerable level of competence according to Table 8, with up to three airlines (YW, UX, AB) operating until May 2016. Moreover, unlike in the previous route, the demand for regular passenger transport services on the ES04 had traditionally experienced a growing demand until the COVID-19 pandemic began, and hence restrictions on the mobility of citizens were imposed in several countries around the world. As stated above from [33], the pandemic forced the Spanish government to trigger an alarm state on 14 March 2020, which applied until 21 June 2020. Within this period of 98 days, scheduled transport services on this route were ensured between 20 March 2020 and 24 May 2020, by awarding a PSO contract through an urgent tender procedure (118V2020), as already seen in Table 7. During these 65 days operated under this public contract, despite mobility restrictions, it was possible to provide minimum transport services targeted exclusively at essential mobility, such as that concerning key personnel, either public officials or employees, as well as any patient traveling by air for medical reasons. Except for this exceptional contract period, this air route has been operated under the PSO of type 1, and thus open to any European airline interested in providing regular passenger transportation. Moreover, given the characteristics of the transportation needed within the archipelago and the fact that related interisland transport services have been considered essentials for regional development, the implementation of the PSO schema applied to the route ES04 has led to a substantial increase in the passenger traffic operations, but not for freights. This is primarily a result of scheduling regional airliner rather than narrow-body aircraft when transporting passengers on a flight less than 500 km; thus, allowing airlines for an increase in flight frequency, which results in a more effective aircraft turnover per operating day. Although no carbon emissions requirements from this PSO imposition have been placed so far for sustainable transportation, the route has been habitually operated over the past years by regional airplanes up to 100 seats, mainly after leaving AB. Consequently, as can be seen from Table 10, the use of a turboprop aircraft, either AT7 or DH4, is usually the optimal choice for such an air route in accordance not only with sustainability criteria but also with efficiency. This is due in part to the lowest emissions and a small number of cabin crew, respectively. Instead, for peak seasons, it might be more convenient to use turbofan aircraft, depending on which capacity is necessary.

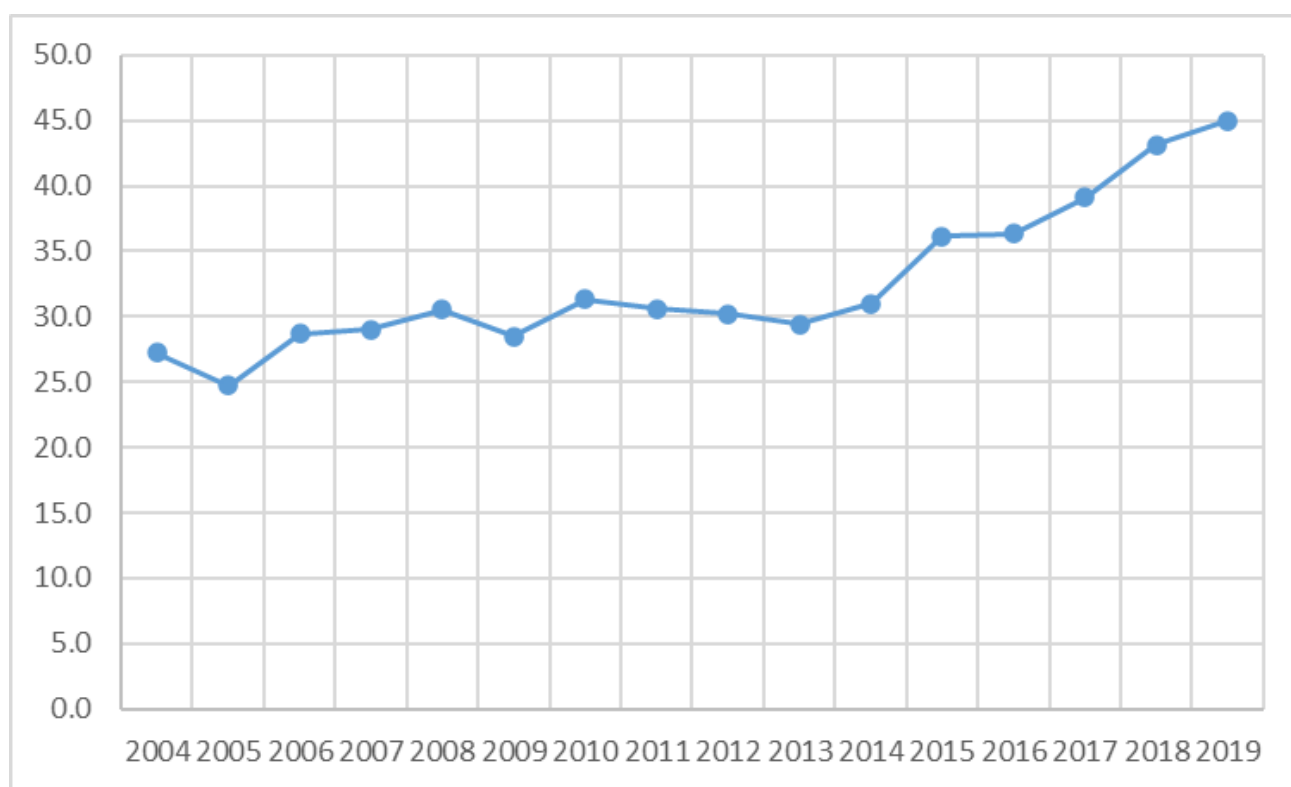
3.2.1. Specific Assessment on Considerations Related to Passenger Traffic

As can be seen in Figure 13, the passenger demand on this route has experienced continuous growth over past years, especially noticeable since 2013. This coincided with the extension of the resident subsidy (50 percent discount on airfares as of April 2013) to relatives of legal permanent residents as well as non-EU residents. This finding suggests that the extension of the subsidy coverage may not only be an important spur for stimulating the demand on the route, but also for reinforcing the transport services concerned as an essential part of regional mobility. Furthermore, Figure 14 shows a slight seasonal trend of the passenger demand for the period May–September. This suggests that tourism activity can also have an impact on the route in addition to regional mobility.

Table 10. Performance of air transport operation on route ES04 according to the most popular airliners for short-haul flights.

Standard Type of Aircraft ^a	Travel Time (h)	Fuel Consumption (kg)	CO ₂ Emissions (kg) ^{b,c}	Main Airlines holding a Spanish AOC ^a	Emissions CO ₂ /PAX (kg) ^{b,c,d}	Standard Cabin Configuration ^d	Standard Cabin Crew ^e
CR2	0:30	472.3	1487.8	YW	29.8	50Y	1
AT7	0:36	262.5	826.8	X5, YW, NT, PM	11.5	72Y	2
DH4	0:39	413.7	1303.0	none *	16.7	78Y	2
CR9	0:30	676.7	2131.7	YW	24.0	89Y	2
CRK	0:30	711.8	2242.1	YW	22.4	100Y	2
E95	0:30	965.2	3040.3	X5	20.3	122Y	3
319	0:29	823.7	2594.6	IB, V7, VY	21.3	150Y	4
320	0:29	1011.1	3185.1	IB, I2, VY	17.7	180Y	4
738	0:29	1037.1	3267.0	UX	18.2	180Y	4

Source: own calculation based on related methodology from International Civil Aviation Organization (ICAO) [37] and considering fleets of commercial airlines with an Aircraft Operator Certificate (AOC) issued by DGAC only (as of 16 September, 2019). Explanatory notes: ^a according to the list of designator codes provided in both Appendices A and B; ^b standard assumptions: 3.15 kg of CO₂ emitted per 1 kg of Jet A1 burned; ^c en-route assumptions: maximum payload, no wind, each flight leg operating under technical specifications by ISA, JAR, and EASA; ^d tourist class seats only; ^e most common number of cabin crew members on board. (*) Sparsely operated in Europe (as of December 2019).

**Figure 13.** Thousands of passengers carried as yearly average on ES04 in the period between 2004 and 2019. Source: own work based on data collected from air traffic statistics [24].

The passenger demand has experienced better performance in each second semester over past years, as shown in Figure 15. In contrast, when eliminating the effect of peak seasons mostly due to the tourism effect, the situation changes radically (see Figure 16).

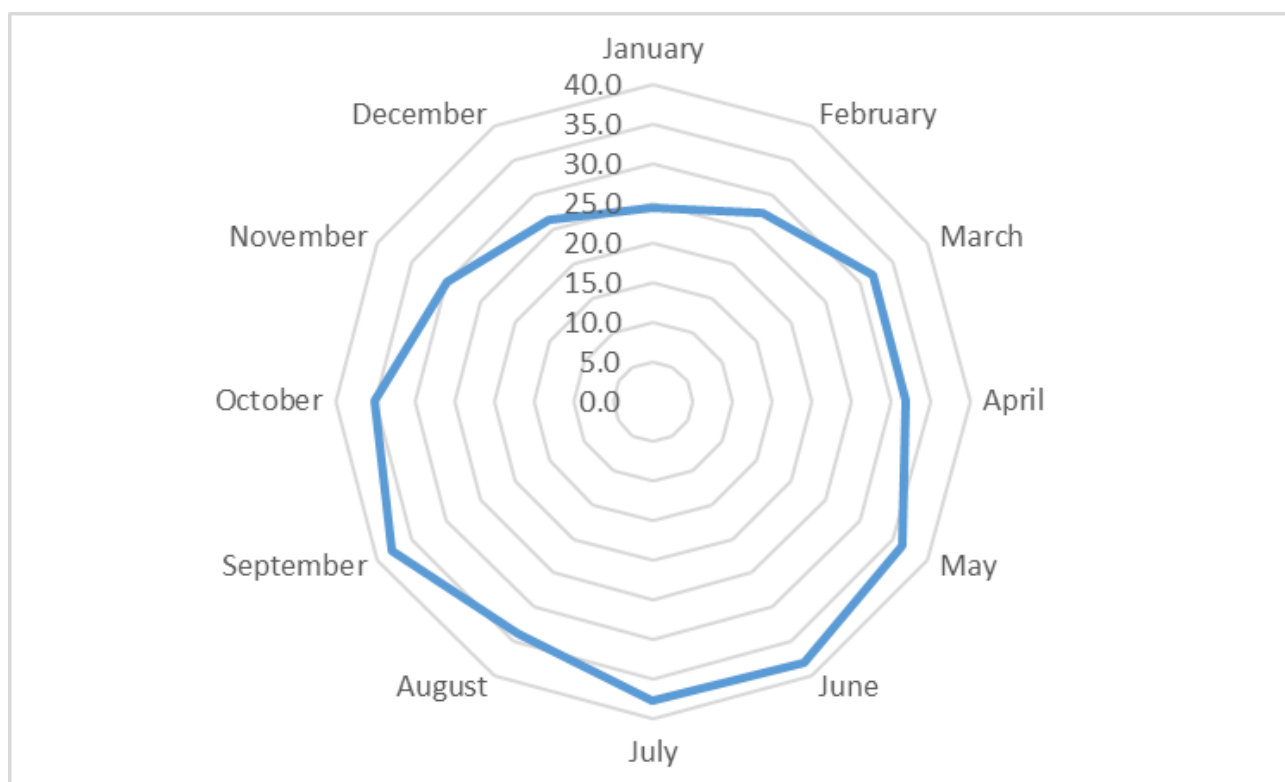


Figure 14. Thousands of passengers carried as monthly average on ES04 in the period between 2004 and 2019. Source: own work based on data collected from air traffic statistics [24].

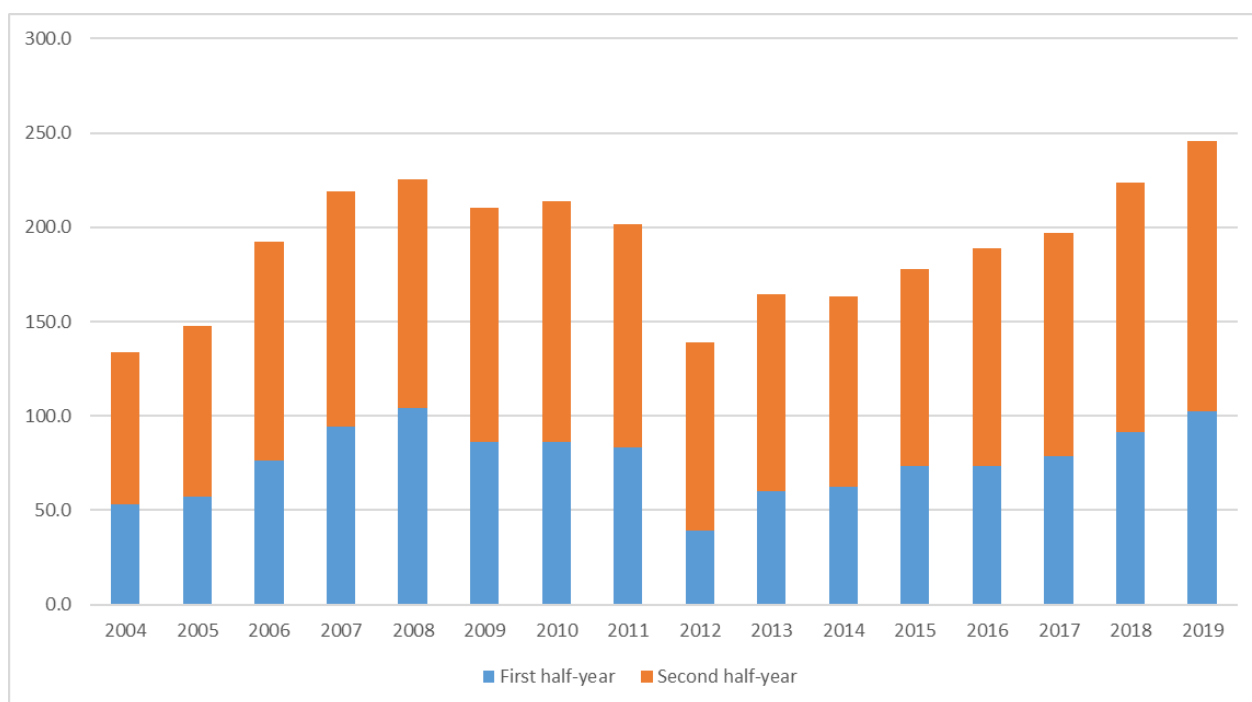


Figure 15. Thousands of passengers carried per half-year on air route ES04. Source: own work based on data collected from the official database [24].

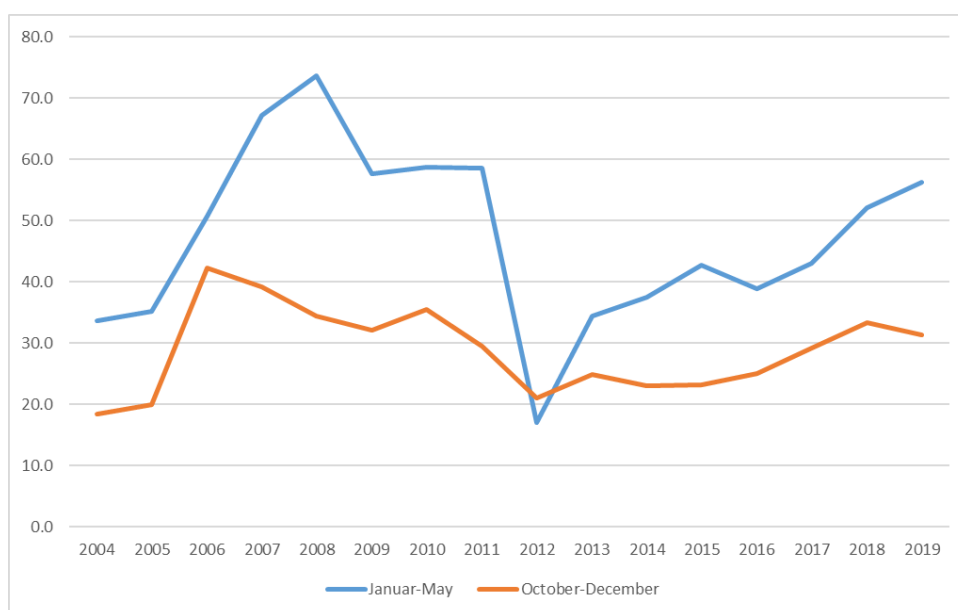


Figure 16. Thousands of passengers carried during low seasons on air route ES02. Source: own work based on data collected from the official database [24].

3.2.2. Specific Assessment on Considerations Related to Freight Traffic

Concerning goods transported on this PSO route, as shown in Figure 17, there has been a dramatic fall from the peak in 2006 to practically zero since 2013. As can be seen in Figure 18, the significant loss of the number of freights appears to not depend on seasonality. With the results obtained from the research, no convincing reasons have been found to clearly explain this fact on this route. Apparently, the type of aircraft operating the route may be one of the causes, as Air Belin had not scheduled these flights by using regional airliners, but with bigger aircraft, such as B737 and A320 families.

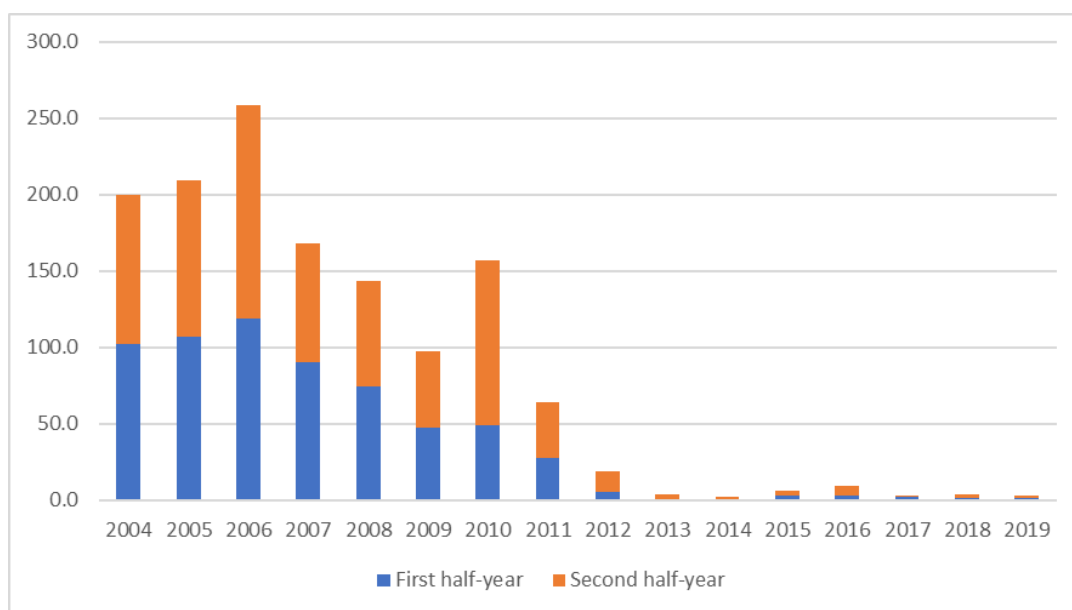


Figure 17. Quantity of goods carried on air route ES04 (in tons) per half-year. Source: own work based on data collected from the official database [24].

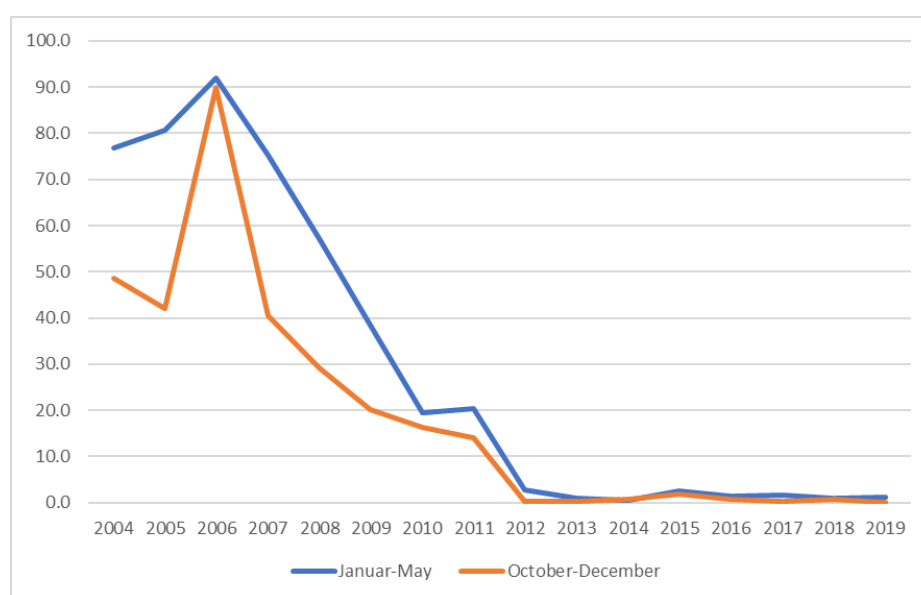


Figure 18. Tons of goods carried per year during low seasons on air route ES04. Source: own work based on data collected from the official database [24].

3.3. Evaluation of Findings Concerning the PSO Imposed on Air Route ES05

As with the case of route ES04, the direct air connection between Palma de Mallorca and Menorca comprises a fundamental part of the regional air transport network in the Balearic Islands. While both routes have similar characteristics such as travel distance, flight time, and connecting each route with the capital of the archipelago, results obtained from this study show that the route ES05 has faced a lower demand than the ES04 over the past years, as already shown in Figures 3 and 4. Moreover, as previously seen from Tables 5 and 6 the PSO routes considered in this study have been designed upon a close regional approach aiming at the needs of the resident population. In the case of both routes, the PSO imposition (2003) and its subsequent revision (2008) have sought to ensure the provision of regular passenger transport services comprehensively, prioritizing a minimum daily frequency of flights against a minimum number of seats available per flight. As a large yearly minimum capacity on each leg of these routes is required from the PSO imposition, airlines have the complete freedom to schedule any airplanes, either turbofan or turboprop, depending on market conditions. In the case of the ES05, as summarized in Table 11, its relatively low seasonality and its continuing growth in passenger air traffic make it most suitable for the schedule of large regional airliners in terms of seating capacity, either CRJ or CRK, even E95. However, concerning carbon emissions, a turboprop airliner, either DH4 or AT7, appears to be the most appropriate means on this route. As with the case of ES04, the route has been mostly operated using both CRJ and ATR series, which are perfectly suited for short-haul routes with frequent flights among islands. Furthermore, in situations of market contractions, a regional aircraft with a small seating capacity should be eligible to operate thin routes, thus meeting PSO requirements. Regarding operational efficiency, this is perhaps why having the opportunity to operate with a mixed fleet of regional airliners, either twin-turboprop or turbojet planes, below and above 90 seats such as has been used by the two carriers (YW, UX) so far operating the route. Moreover, that is precisely the reason why the public contract (118V2020) for essential air transport services on both ES04 and ES05 in extreme market conditions during the last alarm state period due to COVID-19, as early pointed out from Table 7, had been bid by both airlines. Although a uniform fleet often simplifies and cuts the cost of maintenance and operational processes, a mixed fleet may provide for greater flexibility when the demand is lumpy and cyclical, even with an upward trend. This is also important in terms of economic efficiency

and sustainable mobility, if it is possible to fine-tune air transport supply to demand an adequate yield management at any time.

Table 11. Performance of air transport operation on route ES05 according to most popular airliners for short-haul flights.

Standard Type of Aircraft ^a	Travel Time (h)	Fuel Consumption (kg)	CO ₂ Emissions (kg) ^{b,c}	Main Airlines Holding a Spanish AOC ^a	Emissions CO ₂ /PAX (kg) ^{b,c,d}	Standard Cabin Configuration ^d	Standard Cabin Crew ^e
CR2	0:29	445.3	1402.8	YW	28.1	50Y	1
AT7	0:35	247.5	779.5	X5, YW, NT, PM	10.8	72Y	2
DH4	0:38	390.0	1228.5	none *	15.8	78Y	2
CR9	0:29	638.0	2,009.8	YW	22.6	89Y	2
CRK	0:29	671.1	2114.0	YW	21.1	100Y	2
E95	0:29	776.6	2446.3	X5	20.1	122Y	3
319	0:29	910.0	2866.6	IB, V7, VY	19.1	150Y	4
320	0:29	953.4	3003.1	IB, I2, VY	16.7	180Y	4
738	0:28	977.9	3080.3	UX	17.1	180Y	4

Source: own calculation based on related methodology from International Civil Aviation Organization (ICAO) [37] and considering fleets of commercial airlines with an Aircraft Operator Certificate (AOC) issued by DGAC only (as of 16 September 2019). Explanatory notes: ^a according to the list of designator codes provided in Appendices A and B; ^b standard assumptions: 3.15 kg of CO₂ emitted per 1 kg of Jet A1 burned; ^c en-route assumptions: maximum payload, no wind, each flight leg operating under technical specifications by ISA, JAR, and EASA; ^d tourist class seats only; ^e most common number of cabin crew members on board. (*) Sparsely operated in Europe (as of December 2019).

3.3.1. Specific Assessment on Considerations Related to Passenger Traffic

Based on results shown in Table 8, the route had been habitually operated by two airlines (YW and UX) in previous years, and sporadically by a third carrier (AB) until 2016. As a result, YW has become the dominant player in providing regular transport services concerned. Results obtained in this study concerning ES05 (see Figure 19) show that the average demand for passenger transport posted a mixed performance over past years, in which there have been three differentiated periods. Initially, a slight upturn between the PSO imposition (2003) and the subsequent revision (2008). Then, it came a period of sharp decline, which culminated in late 2013. Finally, the route has led a significant growth until the outbreak of the COVID-19. It should be noted that, as with the ES05, the last reference price (€90) has not yet been updated since 2013. As can be seen in Figure 20, moreover, there is no significant seasonality, indicating a very essential route for regional mobility.

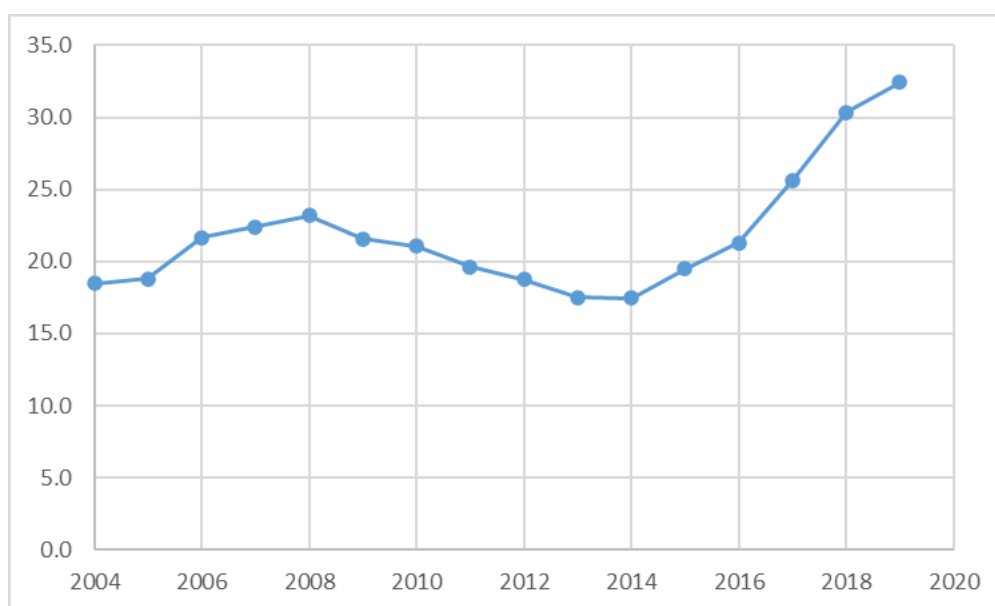


Figure 19. Thousands of passengers carried as a yearly average on ES05 in the period between 2004 and 2019. Source: own work based on data collected from air traffic statistics [24].

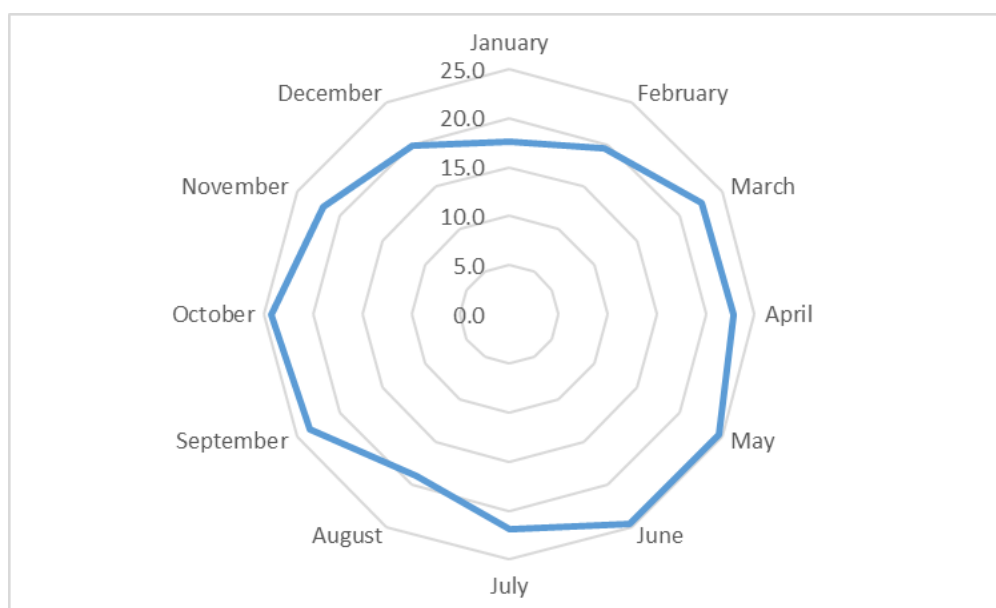


Figure 20. Thousands of passengers carried as monthly average on ES05 in the period between 2004 and 2019. Source: own work based on data collected from air traffic statistics [24].

3.3.2. Specific Assessment on Considerations Related to Freight Traffic

In the previous years, as can be seen in Figure 21, goods transportation on the route ES05 has fallen dramatically, with very similar behavior to the previous case (see Section 3.2.2), to practically zero since 2013. In addition, Figure 22 shows an identical trend in demand for freight transported in the route, when eliminating the summer effect.

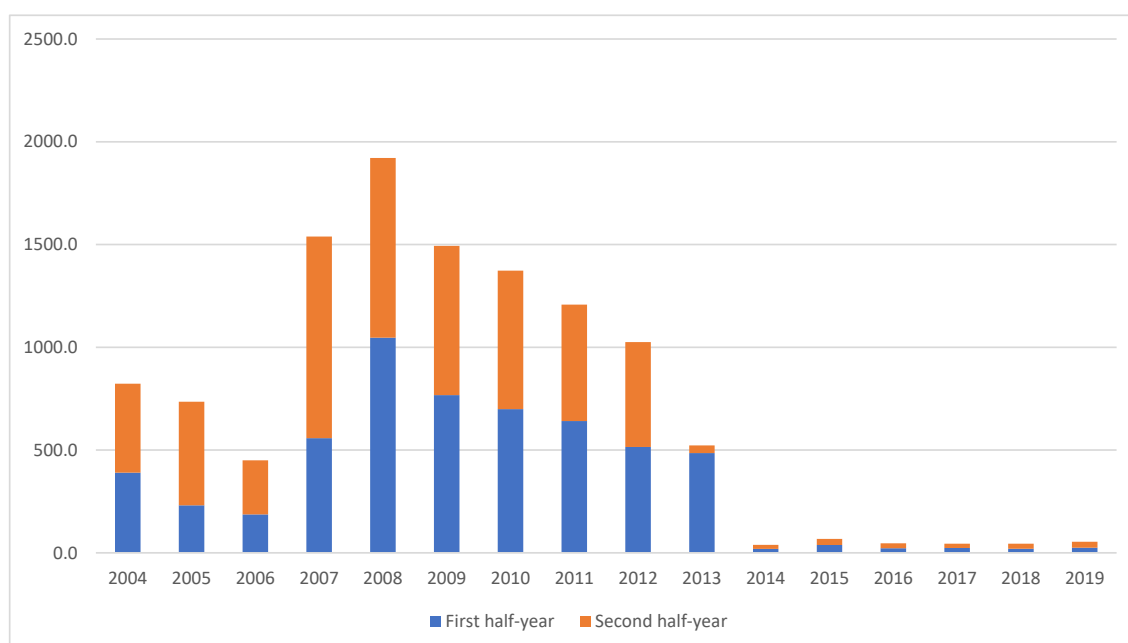


Figure 21. Tons of goods carried per half-year on air route ES05. Source: own work based on data collected from the official database [24].

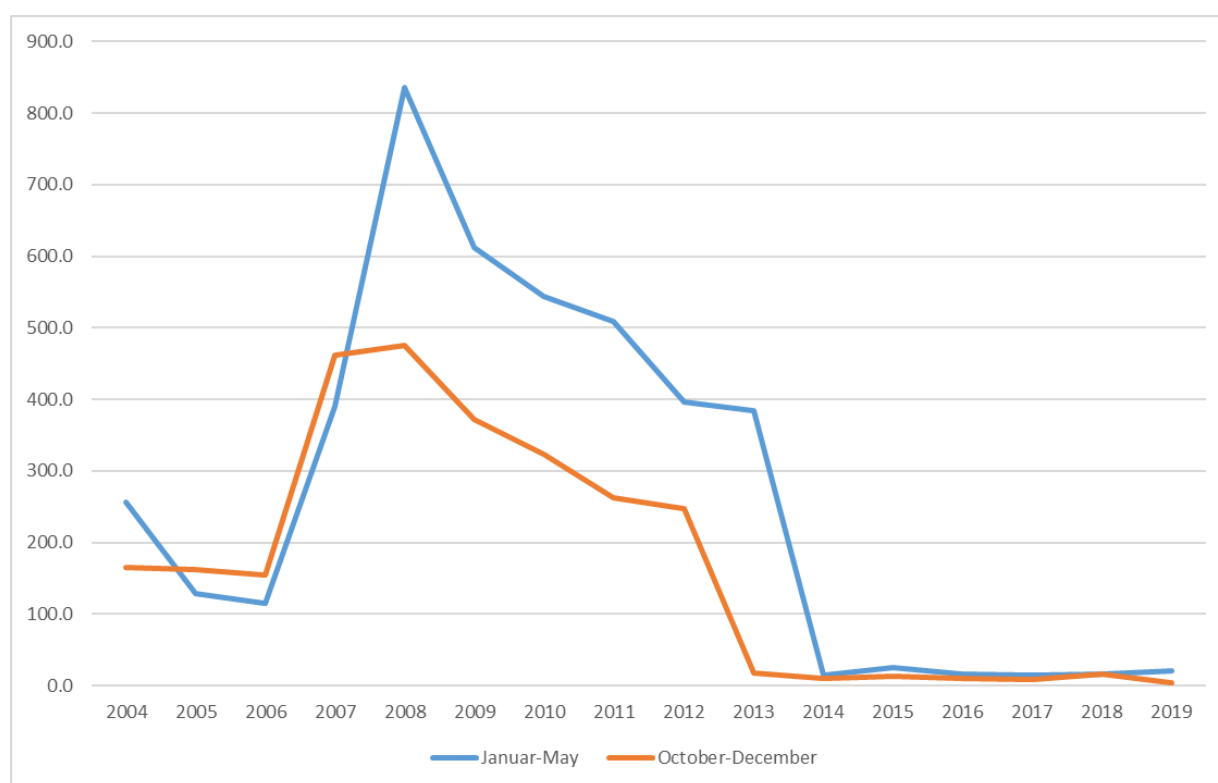


Figure 22. Tons of goods carried per year during low seasons on air route ES05. Source: own work based on data collected from the official database [24].

4. Conclusions

The main objective of this paper has been to provide an empirical approach to the PSO schema applied in island territories within the EU single market in aviation through an analysis of the interisland routes in the Balearic. This study should shed some light on the details of how the imposition of a PSO on air routes serving scattered populations living in not mainland territories can be useful to enhance the regional public transport market. Since the related EU regulation [13] only covers the internal market, the research has been focused on the particular study of three interisland air routes operated under a PSO imposition, but not carried out with a public contract for the provision of scheduled air services. Thus, in this study case and departing from the complexity of the research topic as expressed previously, it has been attempted to stress in the paper that it is not possible to approach this rarely studied area from earlier studies concerning public efficiency and socioeconomic sustainability, since the preview literature is almost inexistent on this matter. Moreover, the complexity of the PSO schema applied within the EU single market in aviation forces to study each imposition of a PSO on air routes by comprehensively analyzing the domestic transportation market concerned. That is precisely the main problem with this issue and its originality at the same time.

Since the PSO schema can be implemented on either air routes or airport managing bodies, being considered as services of general economic interest [38], this form of public intervention should be applied carefully in avoiding market distortions. Throughout the paper, the analysis of the legal framework of the PSO system at the EU level, as well as the way of implementing it at the national level, has not only identified some of its strengths but some of its weaknesses. For instance, common assessment criteria based on socioeconomic needs (thin, peripheral, or development transport services) in designing PSO routes across the EU single market, and the lack of effective supervision of the performance of PSO impositions and related public contracts, respectively. In this concern, the Directorate-General for Mobility and Transport (DG MOVE) on behalf of the

Commission should strengthen monitoring tasks, even beyond the surveillance system towards a unified governance code for the PSO impositions and related tender processes. In the case of PSO contracts tendered so far in Spain, including that of the PSO considered in this study (118V2020), related procurement procedures have been carried out from a single electronic platform at the national level, and since 2018 all of them tendered under a full e-procurement process [39]. Nowadays, however, not all EU state members have awarded their PSO contracts by tendering from a state contracting platform, but through various regional platforms (i.e., France, Italy, and the Czech Republic), and some, even not publishing all tender documents (i.e., Lithuanian and Croatian).

While a PSO air route can be designed exclusively for freights based on EU guidelines [18], there has so far been no PSO imposition on cargo air route within EU Single Market, excepting one in Portugal imposed an air cargo/mail PSO from the mainland to the Azores in 2015. However, the related tender procedure has remained unsuccessful, as it did not find any airline to cover the route, so the imposition expired. In the case study of PSO routes on the Balearic island. Since no PSO has been imposed so far in Spain on freight grounds, the use of PSO air routes for cargo transportation in the Balearic has fallen drastically over the past years, especially given that the three routes have been operated by using airliners (either CRJ or ATR72 series) not very suitable for massive transport of goods (parcels, newspapers, and drugs only). As also discussed previously, prices could have raised artificially over the last few years due to the existence of a generous resident subsidy, and thus creating a market distortion. However, because of the complex nature of the issue, besides the lack of reliable price data over past years, there is not enough evidence that confirms this fact. A regulated single rate on each inter-island route would be a solution in stabilizing airfares concerned, such has been implemented by PCAA in the Azores islands. This public measure may, however, have the disadvantage of causing substantial price imbalance in the liberalized aviation market. Another solution would be a discount schema depending on the income level of the eligible passenger.

Finally, this study has analyzed the market disruption generated by mobility restrictions on the interisland air routes of the Balearic archipelago. This is particularly relevant for dramatic market events, such as the September 11 attacks and the ongoing pandemic of COVID-19, affecting the mobility of citizens on the overall aviation network, in particular when there is a global slump in the number of passengers carried. So far, the ongoing coronavirus pandemic has forced the Spanish government to take out twice a state of emergencies throughout the national territory, one for the period between 14 March 2020 and 21 June 2020, and another between 9 November 2020 and 9 May 2021. During the first declare, a specific ministerial order [40] was introduced to enforce restrictions on the provision of interisland air transport services, and those between the Spanish mainland and the Balearic Islands. Although free-market rules had not been disrupted, no carrier was keen to continue operating air routes concerned. As previously pointed out, that was precisely why minimum operating conditions were ensured by tendering a public contract from an emergency procurement procedure. With a total duration of 65 days, the service contract for the routes ES04 and ES05 was awarded under a minimum price criterion only. This meant that the contract was awarded to the lowest tender, which had also been bid by the second player (UX) operating both routes since there was a substantial difference between the two price bids (more than double between both of them). Once restrictions were lifted from a comprehensive ministerial order [41], carriers concerned were able to resume operations under the PSO requirements. Nevertheless, the findings from this study reveal disturbing trends in goods and passenger movements, which suggest that the demand is not only severely affected by travel restrictions due to the impact of the pandemic outbreak on worldwide tourism but also the regional economic activity. Therefore, it is likely that this transportation will need to be encouraged by updating the PSO imposition, or even through public contracts over the next few years to ensure interisland mobility, particularly for winter seasons.

5. Future Directions and Research Limitations

In this paper, no theories are tested due to the scarce literature existing on the research area in terms of efficiency and sustainability from the PSO schema applied in EU island territories. However, some implications for theory development can be derived from the findings in this paper. This paper focuses on a relevant and rarely studied area in the field of transport economy, such as the effects of the PSO impositions on regional transportation in terms of efficiency and sustainability for the case of the Balearic Islands. It may also be appropriate to analyze possible transportation solutions for better sustainable mobility in island territories through an intermodal system network, combining both sea and air modes under a combined ticket issued by a regional transport consortium with the participation of the national government. Moreover, based on some earlier studies, though not directly linked to the sustainability of the PSO schema, an approach to the relationship between the social inclusion and economic development in those EU regions whose air transportation is considered essential and supported by PSO contracts would also be very well suited to the issue [42]. Furthermore, further studies based on the efficient procurement of public air services could be useful for designing a theoretical model that can be consistent with the necessities of a comprehensive system for the provision of regular air transport services such as the PSO schema [43]. Nevertheless, the lack of sufficient reliable data from a liberalized market whose players are no longer compelled to share their core business information (such as fuel consumption, emissions, PLF, aviation fuel price agreements, etc.) with third parties, since most airlines are mostly private owned-companies, is one the most important research limitation on this topic. Accordingly, this study has identified three potential research lines concerning the PSO schema:

- Approaching to better sustainable mobility through an intermodal transport system.
- Assessing the relationship between social inclusion and economic development.
- Designing a theoretical model for tendering public contracts that can be consistent with a comprehensive system for the provision of regular air transport services.

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Appendix A

Airliners mentioned in the paper:

IATA Designator	ICAO Designator	Aircraft Type	Manufacturer (as of 1 January 2021)
AT7	AT72	Aerospatiale/ Alenia ATR 72	Avions de Transport Régional (ATR) GIE
CR2	CRJ2	Canadair Regional Jet (CRJ) 200	MHI RJ Aviation ULC
CR9	CRJ9	Canadair Regional Jet (CRJ) 900	MHI RJ Aviation ULC
CRK	CRJX	Canadair Regional Jet (CRJ) 1000	MHI RJ Aviation ULC
DH4	DH8D	DHC-8-400 Dash 8Q	De Havilland Aircraft of Canada Ltd.
E95	E195	Embraer 195	Embraer S.A.
319	A319	Airbus A319 ceo	Airbus SAS
320	A320	Airbus A320-100/200 ceo	Airbus SAS
738	B738	Boeing 737-800	The Boeing Company

Appendix B

Airlines mentioned in the paper:

IATA Designator	ICAO Designator	Trade Name	AOC Issued by an EU National Civil Aviation Authority (as 18 January 2021)
UX	AEA	Air Europa	ES.AOC.004
X5	OVA	Air Europa Express	ES.AOC.020
formerly AB	formerly BER	Air Berlin	withdrawn
YW	ANE	Air Nostrum	ES.AOC.002
NT	IBB	Binter Canarias	ES.AOC.011
PM	CNF	Canaryfly	ES.AOC.100
IB	IBE	Iberia	ES.AOC.001
I2	IBS	Iberia Express	ES.AOC.117
V7	VOE	Volotea	ES.AOC.115
VY	VLG	Vueling	ES.AOC.060

Appendix C

Airports mentioned in the paper:

IATA Designator	ICAO Designator	Original Airport Name	Situation
MAD	LEMD	Adolfo Suárez Madrid–Barajas	mainland Spain
LEI	LEAM	Almería	mainland Spain
BJZ	LEBZ	Badajoz	mainland Spain
ACE	GCRR	César Manrique-Lanzarote	Canary Islands (Spain)
BCN	LEBL	Josep Tarradellas Barcelona-El Prat	mainland Spain
VDE	GCHI	El Hierro	Canary Islands (Spain)
GRX	LEGR	F.G.L. Granada-Jaén	mainland Spain
FUE	GCFV	Fuerteventura	Canary Islands (Spain)
LPA	GCLP	Gran Canaria	Canary Islands (Spain)
IBZ	LEIB	Ibiza	Balearic Islands (Spain)
GMZ	GCGM	La Gomera	Canary Islands (Spain)
SPC	GCLA	La Palma	Canary Islands (Spain)
MLN	GEML	Melilla	Spanish North African Enclaves
MAH	LEMH	Menorca	Balearic Islands (Spain)
PMI	LEPA	Palma de Mallorca	Balearic Islands (Spain)
SVQ	LEZL	Sevilla	mainland Spain
TFN	GCXO	Tenerife Norte-Ciudad de La Laguna	Canary Islands (Spain)
TFS	GCTS	Tenerife Sur	Canary Islands (Spain)

References

1. Belokurov, V.; Spodarev, R.; Belokurov, S. Determining passenger traffic as important factor in urban public transport system. *Transp. Res. Procedia* **2020**, *50*, 52–58. [[CrossRef](#)]
2. Enoch, M.P.; Cross, R.; Potter, N.; Davidson, C.; Taylor, S.; Brown, R.; Huang, H.; Parsons, J.; Tucker, S.; Wynne, E.; et al. Future local passenger transport system scenarios and implications for policy and practice. *Transp. Policy* **2020**, *90*, 52–67. [[CrossRef](#)]
3. Albayrak, M.B.K.; Özcan, İ.Ç.; Can, R.; Dobruszkes, F. The determinants of air passenger traffic at Turkish airports. *J. Air Transp. Manag.* **2020**, *86*, 101818. [[CrossRef](#)]

4. Bråthen, S.; Eriksen, K.S. Regional aviation and the PSO system—Level of Service and social efficiency. *J. Air Transp. Manag.* **2018**, *69*, 248–256. [\[CrossRef\]](#)
5. Adler, N.; Ülkü, T.; Yazhemsky, E. Small regional airport sustainability: Lessons from benchmarking. *J. Air Transp. Manag.* **2013**, *33*, 22–31. [\[CrossRef\]](#)
6. Postorino, M.N.; Mantecchini, L. Connectivity carbon and noise levels in the airport neighborhood. *Transp. Policy* **2019**, *79*, 204–212. [\[CrossRef\]](#)
7. Stettler, M.E.J.; Eastham, S.; Barrett, S.R.H. Air quality and public health impacts of UK airports. Part I: Emissions. *Atmos. Environ.* **2011**, *45*, 5415–5424. [\[CrossRef\]](#)
8. Postorino, M.N.; Mantecchini, L.; Paganelli, F. Improving taxi-out operations at city airports to reduce CO2 emissions. *Transp. Policy* **2019**, *80*, 167–176. [\[CrossRef\]](#)
9. Abioye, O.F.; Dulebenets, M.A.; Pasha, J.; Kavooosi, M. A vessel schedule recovery problem at the liner shipping route with emission control areas. *Energies* **2019**, *12*, 2380. [\[CrossRef\]](#)
10. Dulebenets, M.A. A delayed start parallel evolutionary algorithm for just-in-time truck scheduling at a cross-docking facility. *Int. J. Prod. Econ.* **2019**, *212*, 236–258. [\[CrossRef\]](#)
11. European Union. Council regulation (EEC) No 95/93 of 18 January 1993 on common rules for the allocation of slots at community airports. *Off. J. Eur. Union* **1993**, L 14/1, 31993R0095.
12. The Kingdom of Spain. Law 30/1998, of 29 July, on the special regime in the Balearic Islands. *Off. State Gaz.* **1998**, *181*, 25842–258547, BOE-A-1998-18269.
13. European Union. Regulation (EC) No 1008/2008 of the European Parliament and of the Council of 24 September 2008 on common rules for the operation of air services in the Community (Recast). *Off. J. Eur. Union* **2008**, L 293/3, 32008R1008.
14. The Kingdom of Spain. Law 2/2011, of 4 March, for sustainable economy. *Off. State Gaz.* **2011**, *55*, 25033–25235, BOE-A-2011-4117.
15. Reynolds-Reighan, A. European air transport public service obligations: A periodic review. *Fisc. Stud.* **1995**, *58*. [\[CrossRef\]](#)
16. Veeneman, W.; Mulley, C. Multi-level governance in public transport: Governmental layering and its influence on public transport service solutions. *Res. Transp. Econ.* **2018**, *69*, 430–437. [\[CrossRef\]](#)
17. Williams, G.; Pagliari, R. A comparative analysis of the application and use of public service obligations in air transport within the EU. *Transp. Policy* **2004**, *11*, 55–66. [\[CrossRef\]](#)
18. European Union. Interpretative guidelines on Regulation (EC) No 1008/2008 of the European Parliament and of the Council. Public Service Obligations (PSO). *Off. J. Eur. Union* **2017**, C 194/01, 52017XC0617.
19. Calzada, J.; Fageda, X. Discounts and public service obligations in the airline market: Lessons from Spain. *Rev. Ind. Organ.* **2012**, *40*, 291–312. [\[CrossRef\]](#)
20. Valido, J.; Pilar Socorro, M.; Hernández, A.; Betancor, O. Air transport subsidies for resident passengers when carriers have market power. *Transp. Res. Part E Logist. Transp. Rev.* **2014**, *70*, 388–399. [\[CrossRef\]](#)
21. Martínez Raya, A.; González-Sánchez, V.M. Tender management relating to imposition of public service obligations on scheduled air routes: An approach involving digital transformation of procurement procedures in Spain. *Sustainability* **2020**, *12*, 5322. [\[CrossRef\]](#)
22. European Commission. Directorate-General for Mobility and Transport (DG MOVE). PSO Inventory Table (as of 18/9/2019). Available online: ec.europa.eu/transport/modes/air/internal-market/psoen (accessed on 30 November 2020).
23. The Kingdom of Spain. Ministry of Finance. State Contracting Platform. Available online: contrataciondelestado.es (accessed on 30 September 2020).
24. Aena SME. Air Transport Statistics. Available online: <http://www.aena.es/es/corporativa/estadisticas-trafico-aereo.html> (accessed on 15 December 2021).
25. Matias, A.; Nijkamp, P.; Sarmiento, M. *Advances in Tourism Economics*; Springer: New York, NY, USA, 2009; pp. 121–143. [\[CrossRef\]](#)
26. Garín-Muñoz, T.; Montero-Martín, L.F. Tourism in the Balearic Islands: A dynamic model for international demand using panel data. *Tour. Manag.* **2007**, *28*, 1224–1235. [\[CrossRef\]](#)
27. The Kingdom of Spain. Resolution of 2 July, by the secretary of state for transportation which publishes the agreement of the council of ministers of 13 July 2018, authorizing the increase of the transport bonus according to the additional provision of the 40th Act, Law 6/2018, of 3 July, on General State Budgets for the year 2018. *Off. State Gaz.* **2018**, *170*, 71142–71143, BOE-A-2018-9926.
28. Hernández Luis, J.Á. The role of inter-island air transport in the Canary Islands. *J. Transp. Geogr.* **2004**, *12*, 235–244. [\[CrossRef\]](#)
29. Francesco, A.D.; Pagliari, R. The potential impact of removing public service obligation regulations on air fares between the Italian Mainland and the island of Sardinia. *J. Transp. Geogr.* **2012**, *24*, 332–339. [\[CrossRef\]](#)
30. Pita, J.P.; Antunes, A.P.; Barnhart, C.; De Menezes, A.G. Setting public service obligations in low-demand air transportation networks: Application to the Azores. *Transp. Res. Part A Policy Pract.* **2013**, *54*, 35–48. [\[CrossRef\]](#)
31. Antunes, A.P.; Santos, M.G.; Pita, J.P.; Menezes, A.G. Study on the evolution of the air transport network of the Azores. *Transp. Res. Part A* **2018**, *118*, 837–851. [\[CrossRef\]](#)
32. The Kingdom of Spain. Royal Decree 20/2014, of 17 January, supplementing the legal regime on the allocation of slots at Spanish airports. *Off. State Gaz.* **2014**, *16*, 2748–2761, BOE-A-2014-508.
33. The Kingdom of Spain. Royal Decree 463/2020, of 14 March, declaring the state of alarm for the management of the public health crisis caused by COVID-19. *Off. State Gaz.* **2020**, *67*, 25390–25400, BOE-A-2020-3692.

34. Abreu, J.; Fageda, X.; Jiménez, J.L. An empirical evaluation of changes in Public Service Obligations in Spain. *J. Air Transp. Manag.* **2018**, *67*, 1–10. [[CrossRef](#)]
35. The Kingdom of Spain. Resolution of 28 November 2003 of the Undersecretary, providing for the publication of the agreement of the Council of Ministers of 21 November 2003 declaring public service obligations on interisland air routes in the Balearic. *Off. State Gaz.* **2003**, *290*, 43330–43333, BOE-A-2003-22166.
36. The Kingdom of Spain. Order FOM/1085/2008 of 7 April 2008, replacing the system of maximum tariffs with reference tariffs for public service obligations on interisland air routes in the Balearic. *Off. State Gaz.* **2008**, *95*, 20596–20597, BOE-A-2008-6924.
37. ICAO Carbon Emissions Calculator Methodology (Version 11), June 2018. Available online: www.icao.int/environmental-protection/CarbonOffset (accessed on 28 February 2021).
38. Zajac, G. The scope of state aid and public service obligation for airports and air carriers in the light of European Law. *Int. J. Commer. Financ.* **2015**, *1*, 1–10.
39. Martínez Raya, A.; González-Sánchez, V.M. Efficiency and sustainability of public service obligations on scheduled air services between Almeria and Seville. *Econ. Res. Ekon. Istraz.* **2020**, *33*, 2751–2768. [[CrossRef](#)]
40. Order TMA/247/2020 of 17 March, establishing the transport measures to be applied to connections between the peninsula and the Autonomous Community of the Balearic Islands. *Off. State Gaz.* **2020**, *72*, 25850–25852, BOE-A-2020-3823.
41. Order TMA/400/2020, of 9 May, which establishes the conditions to be applied in phase I of the clearance in terms of mobility and sets out other requirements to ensure safe mobility. *Off. State Gaz.* **2020**, *131*, 32027–32036, BOE-A-2020-4912.
42. Smyth, A.; Christodoulou, G.; Dennis, N.; AL-Azzawi, M.; Campbell, J. Is air transport a necessity for social inclusion and economic development? *J. Air Transp. Manag.* **2012**, *22*, 53–59. [[CrossRef](#)]
43. Merkert, R.; O'Fee, B. Efficient procurement of public air services—Lessons learned from European transport authorities' perspectives. *Transp. Policy* **2013**, *29*, 118–125. [[CrossRef](#)]