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## Setting public service obligations in low-demand air transportation networks: Application to the Azores


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### ABSTRACT

The deregulation of air transportation was expected to have negative implications on regions with insufficient passenger demand to generate profits – regions where air transportation often plays a crucial role with respect to the mobility of people and goods, as well as to the development of tourism. Because of this, governments have decided to accompany the deregulation process with the adoption of subsidy schemes aimed at mitigating the anticipated consequences to low-demand regions. The subsidy scheme adopted in the European Union is known as the Public Service Obligations (PSO) system. In this paper, we propose a decision approach to assist governments (aviation authorities) in the setting of PSO standards consistent with the budget available to finance their implementation. The approach is based on an integrated flight scheduling and fleet assignment model to determine the air transportation network that minimizes the total social costs of satisfying a given origin/destination target demand. The usefulness of the approach is illustrated with an application to the network of the Azores, one of the main European networks fully operated according to the PSO system.

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## 1. Introduction

In response to the deregulation of air transportation, commercial airlines were expected to concentrate their networks on profitable routes and to reduce services and/or increase fares in thinner markets. Also, they were expected to change the configuration of their networks to adopt a hub-and-spoke structure, thus decreasing both demand variability per leg and fares (in higher demand markets) but increasing travel times (Reynolds-Feighan, 1995a). Both types of reaction go against the interests of regions with insufficient passenger demand to generate profitable legs – regions where air transportation often plays a crucial role with respect to the mobility of people and goods, as well as to the development of tourism. Because of this, governments have decided to accompany the air transportation deregulation process with the adoption of subsidy schemes aimed at mitigating the consequences that could be anticipated with respect to low-demand regions (Santana, 2009). Currently, there are two major subsidy schemes: the Essential Air Services (EAS) program, launched in the USA in 1978, and the Public Service Obligations (PSO) system, launched in the European Union (EU) in 1992. Detailed information about both schemes and their differences can be found in Reynolds-Feighan (1995b) and Braathen (2011).

The PSO system was put forward as a core part of the legislation pertaining to the deregulation of air transportation in Europe (CEC, 1992a,b,c, 2008). According to the regulation currently in force (CEC, 2008), an EU Member State can open subsidized scheduled air services (PSO routes) to/from any airport located in low-demand regions of its territory. The right to

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operate a PSO route or group of routes is granted to an EU airline for a period of 4 years at most (5 years in the case of outermost regions) through a public tender. The call for tenders is made specifying the PSO standards, and the airline is selected taking into account the adequacy of the service and the subsidy (“cost of compensation”) required from the Member State, if any.

The items included in the PSO standards vary significantly from country to country. The minimum flight frequency between airports and the minimum number of seats available per flight leg are among the most frequent items imposed by governments. With respect to flight schedules, earliest departure times and latest arrival times are sometimes included in the PSO standards to guarantee daily round trips. In order to ensure good connectivity, governments can set the maximum number of stops between airports or the maximum waiting time between flights. Governments can also specify aircraft features such as the minimum number of seats or even the aircraft type (jets vs. turbo-props). Finally, maximum airfare values and discount rates for residents, students, and/or retired people can be explicitly imposed in the PSO standards.

The number of routes operated in Europe – within a country or between countries – under PSO contracts has been growing consistently throughout time: they were 67 in 1997, 168 in 2001, 230 in 2003 (Minshall, 2004), and, according to CEC (2010), at least 260 routes in 2010 (the expression “at least” is used because the number of routes changes during the year). Currently, eight EU countries plus Norway and Iceland offer PSO services, awarding financial compensation to airlines operating regular services to/from or inside low-demand regions. Norway and France are the countries with the largest number of PSO routes – respectively, 61 and 41 routes in 2010 (CEC, 2010). The country where the domestic network is most dependent on this kind of subsidies is Portugal – in 2001, 40% of the domestic passengers in Portugal traveled on PSO routes compared to around 10% in France, Norway, and Scotland (Williams and Pagliari, 2004). The level of subsidies varies widely across countries, being around 120 EUR per passenger in Germany and only slightly above 20 EUR per passenger in France and Portugal (Braathen, 2011).

In this paper, we propose an operational decision approach aimed to assist governments (aviation authorities) in the definition of standards for PSO tenders consistent with the budget available to subsidize their implementation. The objective of governments is assumed to be the minimization of the total social costs of satisfying a given origin/destination (O/D) air travel demand in an equitable manner. The key ingredient of the proposed approach is the integrated flight scheduling and fleet assignment (IFSFA) model used to determine the cost-minimizing air transportation network and to estimate its costs for passengers, airlines, and government. This model differs from traditional IFSFA models (Lohatepanont and Barnhart, 2004; Sherali et al., 2010), which are designed for airlines, and aim at maximizing profit without taking into account equity issues. The literature about the subsidization of air transportation is increasing quickly but, to the best of our knowledge, has not dealt with these types of operational issues before. Instead, it has focused on the analysis and comparison of subsidy schemes (see, e.g., Reynolds-Feighan, 1995b; Graham, 1998; Santana, 2009; Braathen, 2011; Metrass-Mendes and De Neufville, 2011; Fageda and Flores-Fillol, 2012; Matisziw et al., 2012), and, more recently, also on the study of their impacts on specific regions (Lian, 2010; Calzada and Fageda, 2012; Di Francesco and Pagliari, 2012). Given the increasing pressure on governments to ensure an efficient and transparent use of public money and the great importance of air transportation in many low-demand regions, we believe that the proposed approach contributes by filling a significant gap in the literature.

The potential usefulness of the proposed approach is illustrated for a case study concerning the air transportation network of the Azores, a Portuguese archipelago located in the Atlantic Ocean 1500 km west of Lisbon. This is one of the largest networks fully operated according to the PSO system, involving about 12,000 flights and 300,000 passengers annually in recent years. The application of the approach clearly suggests that the total social cost of the network could be significantly lower and the level of service offered to passengers could be higher on average, even if the amount of public subsidies decreases.

The remainder of this paper is organized as follows. In the next section we present the proposed operational decision approach and then the formulation of the IFSFA model upon which the approach is based. Afterward, we describe the Azores case study. The results are first presented globally and then at the local (island) level. The case study section also comprises an analysis of the sensitivity of results to changes in some important parameters. To conclude the paper, we summarize its contents and indicate guidelines for future research.

## 2. Decision approach

The problem faced by a government when setting the service standards to be used within a PSO tender process is quite complex, and the operational decision approach proposed below is designed to cope with such complexity. The objective of the government is assumed to be the minimization of the total social costs of the air transportation network. A possible alternative could be the maximization of social welfare, but this is a less straightforward objective that does not facilitate communication with stakeholders (and leads to significant modeling complications). The government’s objective must be pursued while balancing demand satisfaction and passenger level of service requirements with equitable treatment of passengers and the subsidies budget that the government can allocate to airlines operating the network. The demand depends on the costs incurred by passengers, which consist of airfares and time costs (including the waiting time of connecting passengers), which in turn depend on the flight schedules, and hence, on the level of service offered to passengers. Several choices to make in this context are policy driven. First is the case of the amount of subsidies to assign to air transportation – a larger budget allocated to these subsidies signifies that less money is available to finance road infrastructure or public

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