Transportation Research Part B 114 (2018) 131–146

Contents lists available at ScienceDirect

Transportation Research Part B

journal homepage: www.elsevier.com/locate/trb

The joy of flying: Efficient airport PPP contracts☆

Eduardo Engel[a], Ronald Fischer[b,1,*], Alexander Galetovic[c]

[a] Universidad de Chile, Departamento de Economia, Diagonal Paraguay 257, of. 1401, Santiago, CP 8330015, Chile
[b] Universidad de Chile, Departamento de Ingeniería Industrial, República 851, of. 718, Santiago, CP 8370456, Chile
[c] Universidad de los Andes, Facultad de Ciencias Económicas y Empresariales, San Carlos de Apoquindo 2200, Santiago, CP 7700062, Chile

ARTICLE INFO

Article history:
Received 19 December 2017
Revised 2 May 2018
Accepted 3 May 2018
Available online 14 June 2018

JEL classification:
H440
R420
L51

Keywords:
Airports
PPPs
Non-aeronautical revenues
Optimal contract

ABSTRACT

We derive the optimal concession contract for an airport where the concessionaire's effort impacts either non-aeronautical revenue (shops, restaurants, parking lots and hotels) or aeronautical revenues (passenger and airline fees). Our first model assumes that demand for the infrastructure is exogenous whereas demand for non-aeronautical services depends both on passenger flow and on the concessionaire's effort and diligence. We show that the optimal principal-agent contract separates exogenous and endogenous risks. First, the term of the concession varies inversely with passenger flow, so that the concessionaire bears no exogenous demand risk. Second, the concessionaire bears part or all of non-aeronautical risk, which fosters effort. We also study a model where the concessionaire's effort affects demand for aeronautical services and focus on the case where the contract includes a demand trigger for investment as an incentive. Both optimal contracts can be implemented with a Present-Value-of-Revenue (PVR) auction in which firms bid on the present value of aeronautical revenue and the concession ends when the bid is collected. PVR auctions have been used to auction airport PPP contracts in Chile, and demand triggers for investment have been used both in Brazil and Chile.

1. Introduction

> "What sets airports apart from most investments in infrastructure is their dual income stream: they bring in money both on the aeronautical side (landing fees, contracts with carriers) and from passengers (parking, shopping, hotels). If you own a toll road and traffic dwindles, there's not much you can do. But with an airport there are lots of levers to pull, such as cutting capital costs, firing staff and upping the price of parking."
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> The Economist, June 6th, 2015.

☆ We thank Francisco Díaz-Valdés, Gerard Jobet, Nicolás Suárez and participants at CEMA (Buenos Aires), Economics of Public Sector Reform Conference (London), HEC Lausanne, International Transport Economics Association (Oslo), Getulio Vargas Foundation (Sao Paulo), LACEA-LAMES (Buenos Aires), Paris School of Economics, SCID-Stanford, SIOE Conference (Paris), U. Alberto Hurtado, U. de Chile, U. de Montevideo, U. de Santiago, the editor and three anonymous referees for comments and suggestions. Declarations of interest: none.

* Corresponding author.
E-mail address: rfischer@dii.uchile.cl (R. Fischer).

[1] R. Fischer gratefully acknowledges the financial support of the Complex Engineering Systems Institute (CONICYT - PIA - FB0816) and the Instituto Milenio MIPP (IS130002).

https://doi.org/10.1016/j.trb.2018.05.001
0191-2615/

In recent years PPPs have become the main mechanism for airport procurement.[2,3] Indeed, according to the PPIAF database, in 2014 there were 141 airport PPPs around the world (Farrell and Vanelslander, 2015). One of the main features of an airport PPP is that it has two sources of revenue, aeronautical (e.g. landing or airport fees) and non-aeronautical such as sales in duty-free shops, restaurants, airport hotels, parking and rental cars. Recent data show that non-aeronautical revenues represent 40% of global airport revenues (Calleja, 2017) and that the contribution of non-aeronautical services to total profits is even larger (Graham, 2009).

The main advantage of PPPs over public provision of airport services is that they provide better incentives to attract demand, allocate risks and foster innovation. In this paper we study airport PPP contracts that provide optimal incentives to the concessionaire. In the first model, demand for non-aeronautical services is responsive to non-observable effort exerted by the concessionaire. In the second model, the concessionaire's effort affects the demand for aeronautical services. The first model corresponds to a monopoly airport, while the second model analyzes airports that compete in facilities investment. Both types of airports are important. Many airports face little competition and our first model is relevant in this case. By contrast, hub airports as well as some regional airports, compete with each other. In these cases our second model is relevant.[4]

In our first model, a risk neutral planner hires a risk-averse concessionaire to build and operate an airport.[5] The concessionaire can exert costly effort which increases ancillary revenue per passenger with positive probability. Each passenger pays a user fee and aeronautical revenue is random, exogenous and price inelastic. These assumptions allow us to focus on the optimal incentive and risk sharing contract while abstracting from explicit pricing considerations.[6]

We find that the optimal airport contract when effort affects non-aeronautical revenue has three characteristics. First, the concessionaire does not bear any of the demand risk caused by exogenous variations in passenger volume.[7] Second, the concessionaire bears ancillary profit risk, which provides incentives to invest in ancillary services and exert costly effort. Third, the contract can be implemented with a present-value-of-revenue (PVR) auction in which participants bid on the present value of aeronautical revenue and there is a proportional sharing rule for non-aeronautical revenues. Note that the bidding variable does not include the proceeds of ancillary revenues. As in other PVR contracts, the duration is variable and the concession ends when the concessionaire collects aeronautical fees equal to the winning bid.

To understand the economics of the optimal contract, assume first that exogenous aeronautical revenue is the only source of income. As we have shown elsewhere (see Engel et al., 2001; Engel et al., 2013), in this case it is optimal to allocate the concession to the lowest PVR bid. The concession ends when the bid revenue has been collected. Because the concessionaire is risk averse and demand risk is exogenous, it is optimal to fully transfer risk to the planner.

Now add ancillary services to the concession and note that the number of potential customers is roughly proportional to the number of passengers at the airport, as documented in Calleja (2017).[8] The reason is that passengers visit an airport with the primary objective of traveling and that parking or buying in the shops at the airport is at most a subsidiary objective. The optimal contract exploits the high correlation between the two types of airport PPP revenues by tying the term of the concession for non-aeronautical services to the term of the concession for aeronautical services and thus making it also variable. As the term of the concession of non-aeronautical services is variable (it is part of the same contract), the revenue from these services depends only on effort and investment, and thus under the contract the concessionaire bears no *exogenous* demand risk.

At the same time, once a passenger is at the airport, she will spend more, on average, if the concessionaire dedicates resources to increase demand for non-aeronautical services. Finding the right combination of service types and service providers is a problem similar to that of managing a shopping mall and can have a significant impact on overall profits. Thus the demand for non-aeronautical services has an endogenous random component, which depends on the concessionaire's investment and effort. As is standard in principal-agent model, the optimal contract is such that the concessionaire receives more revenue and profits if the project succeeds. But because exogenous risk can be fully separated from the endogenous risk component by varying the term of the concession, the variation in the reward of the concessionaire depends only on the fate of the ancillary project and not on the realization of the exogenous demand component.[9] Thus the regulator can exploit the relation between demand for aeronautical and non-aeronautical services to concession both services using

[2] On airport reform and privatization see, for example, Gillen (2011) and Winston and de Rus (2008).

[3] Engel et al. (2014) define a PPP as "an agreement by which the government contracts a private company to build or improve infrastructure works and to subsequently maintain and operate them for an extended period in exchange for a stream of revenues during the life of the contract." Under this definition the concessionaire is remunerated with a combination of user fees and government transfers.

[4] Czerny et al. (2016b) show that airport demand is responsive to rental car prices while Ivaldi et al. (2015) find that demand is responsive to parking charges. Both these cases can be incorporated into our second model as a form of effort by the concessionaire.

[5] Assuming a risk averse concessionaire and a risk neutral government is standard when applying principal-agent models to PPPs. See, for example, Martimort and Pouyet (2008); Iossa and Martimort (2012) and Iossa and Martimort (2015).

[6] The latter assumption can be relaxed as shown in the working paper version of Engel et al. (2013) (see http://www.nber.org/papers/w13284).

[7] Demand risk may be macroeconomic or due to variations in regional growth, but if the airport has few close-by substitutes, passenger demand is exogenous from the point of view of the concessionaire.

[8] This a common assumption in the theoretical literature, see Zhang and Zhang (1997).

[9] The intuition is obvious in the case of no discounting. In that case, the contract always ends when a predetermined number of passengers have arrived. These passengers are exposed to the investment effort of the concessionaire in ancillary services, and thus their demand for ancillary services is endogenous to the concessionaire's effort.