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Competition in complementary transport services

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ABSTRACT

For passengers to reach the final destination of the trip it is often necessary to make use of the transport services provided by several firms. When these transport services follow in a natural transport chain they are characterized as complementarities and the firms providing the services can, as for substitutes, to some extent influence the demand facing the other firms by their own behaviour. A model is presented in this paper where two firms compete in complementary transport services differentiated by travel distance. Equilibria are derived for collusion and competition in price and quantity, and these are analyzed with respect to the degree of complementarity and distance. The analysis shows that the influence of type of competition on equilibrium price and quantity increases with the complementarity of the products. Moreover, it is discussed how marginal operating costs for the firms, marginal time cost for the passenger and the type of competition influences whether fares will increase with distance and which of the two firms will set the higher price. The commonly accepted ranking for complements that the collusive price is lower than the Bertrand price is not necessarily true. It is demonstrated that the collusive price of the shorter (longer) distance could be set above (lower) that of price competition. It is also addressed how mark-up of price over marginal cost is influenced by changes in own and competitors distance for the different types of competition.

1. Introduction

Even though the liberalization of transport markets in industrialized countries has increased competition, many passenger transport routes are still served by one or two suppliers (e.g. Blauwens et al., 2008). Hence, the classic duopoly models discussed in the literature dating back to Cournot (1927) are still relevant to explain equilibria in passenger transport markets. The role of substitutability and complementarity with respect to equilibria has been addressed in economic literature (e.g. Economides and Salop, 1992; Häckner, 2000; Singh and Vives, 1984), but has rarely been related to the transport industry. A central characteristic of this industry is the role of transport distance which has been included in the literature on optimal design of scheduled passenger transport (e.g. Kraus, 1991; Mohring, 1972). Transport distance has also been addressed by Li et al. (2012) when discussing the optimal fares for a rail line. Founded on the model by Singh and Vives (1984), Clark et al. (2011) considered simultaneous and sequential duopoly competition and addressed specifically how transport distance influences the equilibrium prices when all firms maximize profit and compete on services between the same locations. However, these latter works focus purely on competition between alternative transport solutions, which thereby is regarded as

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substitutable services, over the same distance. Complementary services[1] are, however, often found in the passenger transport industry, and there is, therefore, a need to address them in the theoretical models.

The fact that cooperation and competition can be parts of one and the same was addressed by Nalebuff and Brandenburger (1996) using the concept co-opetition to describe such a relationship. Some studies on complementary services have used the computer industry as case. Packalen (2010) modelled a monopolist (Microsoft) acting in complementary markets and compared the equilibria to that of quantity competition (Cournot). Also, Casadesus-Masanell et al. (2008) studied competing complements using the relationship between the software provider Microsoft and CPU producers AMD and Intel as a case. As one of several industries, Economides and Salop (1992) addressed the transport industry when studying equilibrium prices under different forms of competition among complementary products. In fact, the situation where two firms both compete and cooperate is frequently found in the transport industry. An example is bus and train companies that compete on legs where both supply transport services, and complement each other by feeding passengers for further transport to the other provider.

In a congested transport corridor De Borger et al. (2007) studied pricing decisions when two links are controlled by different governments. Also using freight transport as a case, Rodrigue et al. (2009) argue that complementarity between transport modes can take place in different geographical markets, different transport markets and different levels of service. These criteria can clearly be transferred to passenger transport. The complementarity between air transport and high speed rail, and the possible advantages of integrating these two transport modes, has been addressed by Socorro and Viecens (2013). In fact, air transport is an obvious example of an industry where complementarity takes place both between different transport modes and within the same type of transport. First, passengers need to be transported between the city centre and the airport and vice versa. In this case, changes in price on the commuting services by train or bus can influence the demand for air transport. Second, due to the well established hub-and-spoke networks air transport does, however, also include complementarity between services with the same transport mode. When the route includes more than one flight, the trip from the airport of departure to the hub and further from the hub to the airport at the final destination can be provided by the same firm as well as by competing firms. Since there are relatively few suppliers of aircrafts, it can well be that legs served by different carriers are made by the same type of aircraft and thereby with somewhat similar costs. This is further actualized by the forming of alliances where a through ticket can include legs provided by more than one firm.

The most important aim of this paper is to analyse how fares relate to distance when two profit maximizing companies produce complementary transport services that are differentiated by distance. Taking the degree of competition addressed by Clark et al. (2009) and the role of trip length by Clark et al. (2011) the focus of this paper will be directed towards firms providing complementary services of different trip lengths. Hence, models applied in the earlier studies are changed and extended by assuming complementary services and introducing asymmetric distance for the services provided by the transport firms. Singh and Vives (1984) modelled duopoly under complements but did not solve for collusion or address quality differences which are relevant for the transport industry. Earlier studies have focused on differences in quality by factors such as frequency, capacity (e.g. De Borger and Van Dender, 2006) or congestion (e.g. Wan and Zhang, 2013; Wu et al., 2011). Moreover, it must be considered that, in the case of transport, competition often depends on strategic behaviour of governments rather than firms (see e.g. review by De Borger and Proost (2012)).

Equilibria are calculated under collusion and simultaneous and sequential competition on price or quantity. The model results demonstrate how fares for complementary transport services depend on distance under different regulatory policies and degrees of complementarity between the services provided by the two firms. We present conditions under which fares are increasing and decreasing in distance, and for when the company with the largest travelled distance sets the highest price. Moreover, the influence of mark-up of price over marginal cost for changes in own and competitors distance is discussed for the different types of competition.

Section 2 presents the model and accounts for central assumptions. The equilibria under different forms of competition are derived in Section 3. Section 4 provides the analysis with focus on ranking of equilibrium fares and how they develop with respect to the degree of complementarity under different types of competition. Finally, conclusions and implications are presented in Section 5.

2. The model

Let us assume a transport route where passengers are required to make a mode change at place B in order to travel between A and C. The distances for the two legs are denoted D_1 and D_2 as illustrated in Fig. 1. Two operators, denoted firm 1 and firm 2, provide transport services on the separate legs D_1 and D_2, respectively. The two services are complements and total demand depends on their prices. The complementarity between the two legs of the service is, thereby, not perfect. The fact that demand could be transferred to other modes is not modelled here.

The inverse demand functions in (1) follow the specifications by Clark et al. (2009 and 2011) based on how Singh and Vives (1984) incorporated in their model how passengers maximize their utility according to the quantities for the services provided by the two firms. In line with Singh and Vives (1984) we assume that a representative consumer maximizes

[1] Complements are goods and services that are used together and defined by negative cross-price elasticity, where more negative value indicates a higher degree of complementarity (e.g. Hubbard and O'Brien, 2013).