Regional Science and Urban Economics 39 (2009) 233–242

Contents lists available at ScienceDirect

Regional Science and Urban Economics

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

Interregional mixed duopoly

Tomohiro Inoue *, Yoshio Kamijo, Yoshihiro Tomaru

Faculty of Political Science and Economics, Waseda University, 1-6-1, Nishi-waseda, Shinjuku-ku, Tokyo 169-8050, Japan

ARTICLE INFO

Article history:
Received 17 December 2007
Received in revised form 8 October 2008
Accepted 10 October 2008
Available online 25 October 2008

JEL classification:
H42
L13
R32

Keywords:
Interregional mixed duopoly
Local public firm
Spatial model

ABSTRACT

We investigate an interregional mixed duopoly wherein a local public firm competes against a private firm. We employ a spatial model with price competition. The public firm is owned by the local government of the left half of the linear city called Region 1, and maximizes its welfare. We demonstrate that our two-stage game comprising location choice and price competition has two types of equilibria. In one equilibrium (E_1), the local public firm locates in Region 1, and the private firm locates outside the region. In the other equilibrium (E_2), both firms are located in Region 1. We find that although the two firms are closely located in E_2, E_2 payoff-dominates E_1. Moreover, E_2 is robust in the sense that the sequential choice of location adopts this equilibrium, regardless of whether the public firm is a leader or a follower.

1. Introduction

During the recent wave of privatization, not only state-owned firms but also local public firms have been privatized. Nevertheless, local public firms still exist in many developing countries as well as in developed countries. This is because they usually provide essential services such as natural gas, electricity, water, medical facilities, and education. In most cases, such goods and services are also provided by private firms. The purpose of this paper is to investigate mixed markets wherein private and local public firms compete.

Competition among public and private firms has been studied in literature on mixed oligopolies (e.g., De Fraja and Delbono, 1989). It usually assumes one country or one market in which one public firm and several private firms compete, and it examines the effect of the privatization of the public firm on social welfare. Thus, the literature has not established an appropriate model reflecting the behaviors of local public firms in a country comprising a number of regions or provinces. Certainly, a few previous studies such as Fjell and Pal (1996), Pal and White (1998), and Matsushima and Matsumura (2006) have investigated the effect of imports from foreign firms on the domestic mixed market. If we regard the domestic and foreign countries as provinces or counties, it appears that some works analyzed mixed markets, which include a local public firm. However, in the real world, local public firms in one region often supply goods and services to consumers in other regions. In fact, state (or city) universities, local airports, and city hospitals supply services to residents of other regions. For example, in Japan, Yokohama City University, which is owned and managed by Yokohama City, admits not only students who live in Yokohama but also those hailing from the other regions. Another example is Kobe Airport owned by Kobe City, which is a representative airport in the Kansai area of Japan. In this paper, we establish a model wherein a local public firm in a region competes against a private firm and supplies goods and/or services to consumers who live outside the region.

For this purpose, we employ a Hotelling-type spatial model (Hotelling, 1929) in which the population is dispersed and each consumer has a specific personal address on the line with a length of unity (hence, the so-called linear city). In this model, a firm locates at a point on the line, and the purchase of goods from one of them involves transportation costs that vary according to the consumer's location. Since consumers have to incur the transportation costs of goods, they select a firm to purchase goods from, taking into account the transportation costs in addition to prices. Studies on mixed oligopolies using a spatial model have been conducted earlier (see, e.g., Cremer et al., 1991; Matsumura and Matsushima, 2003, 2004; Matsushima and Matsumura, 2003, 2006). Cremer et al. (1991) conducted a pioneering work on spatial mixed oligopoly, in which they assumed that the state-owned and private firms exist in a linear city and decide their own locations and prices. We extend their model by dividing the city into two symmetric districts, Regions 1 and 2, each of which is run by a local government, and thus, a firm owned by the government is regarded as a local public firm. We assume that the local government of Region 1 owns the public firm, and the owners of the private firm reside in Region 2. In addition, we assume that the local public firm

* Corresponding author. Tel.: +81 3 3203 7391.
E-mail address: tomo-ino@suou.waseda.jp (T. Inoue).

0166-0462/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.regsciurbeco.2008.10.001

aims at maximizing local welfare in Region 1 and that the local welfare does not include the profit of the private firm.

In the above setting, we find that our model of location choice and price competition has multiple equilibria. In one equilibrium (henceforth, we refer to this equilibrium as E_1), the local public firm locates in the region run by the government, and the private firm locates outside the region. This equilibrium well fits hospitals, which exist ubiquitously regardless of whether they are owned by the public or private sector. In this equilibrium, the local public firm supplies goods and services to all the residents in Region 1. Moreover, this firm also provides goods to some of the residents in Region 2. In the other equilibrium (E_2), both firms locate in Region 1. In Japan, various universities including private and local public universities agglomerate in large cities such as Tokyo, Osaka, and Kobe. Such universities present an example of equilibrium E_2. Furthermore, in contrast to E_1, goods are supplied to a large number of the consumers in Region 1 by the private firm, and the local public firm monopolizes the demand of the residents in Region 2.

The results of our paper are very peculiar compared to those of the existing works. d'Aspremont et al. (1979) show that in private duopoly, one firm is located at one endpoint of the linear city, and the other firm is located at the other endpoint. Cremer et al. (1991) investigated the mixed duopoly model wherein a private firm competes against a state-owned firm that maximizes the social welfare of the entire linear city. They show that one firm is located at point 1/4 and the other is located at point 3/4 of the city, which indicates that competition between the state-owned and private firms yields the first-best locational configuration. The difference between the result of our paper and those of the existing works arises from the fact that the local public firm in our model takes into account only the benefits of residents in one region (Region 1). This implies that the local public firm has two incentives; one is to decrease the transportation costs of the residents in Region 1 and the other is to increase its profits from Region 2. Due to these two incentives, which do not appear in the existing works, our result differs from those of the existing works.

Other interesting features of the multiple equilibria are that equilibrium E_2 payoff-dominates equilibrium E_1, and that the social welfare of the entire city is larger in E_1 than in E_2. The reasons for these occurrences are as follows. In equilibrium E_2, the local public firm sets a higher price to earn higher profits from Region 2 since it monopolizes the demand of Region 2. As a result, not only the local public firm but also the private firm enjoys higher profits due to strategic complementarity in the price-setting stage. Since the profit of the public firm in E_2 is so large that it should increase the local welfare to a level higher than that in E_1, E_2 is payoff-dominant to E_1. Moreover, the residents in Region 2 incur higher transportation costs in E_2 due to the one-sided location of both firms, which results in lower social welfare in E_2 than in E_1.

As shown in Matsumura et al. (2005), in the context of the spatial competition, in the sequential-move model, the efficient equilibrium is chosen from among the multiple equilibria in the simultaneous-move model. We investigate the sequential location choice game in our setting. Similar to Matsumura et al. (2005), we find that E_2 is chosen in the sequential-move game, although it is not efficient from the social welfare viewpoint. Further, this is robust in the sense that E_2 is chosen regardless of whether the public firm is a leader or a follower.

Our results related to the order of moves have the following significances in the literature on mixed oligopoly as well as that on pure oligopoly. First, whether a public firm should become a leader or a follower has been discussed by several researchers in the context of mixed oligopoly such as Matsumura and Matsushima (2003) and Ogawa and Sanjo (2007). They show that the equilibrium location pattern is different between the public leadership and the private leadership in the location choice. In contrast to these studies, we show that the same equilibrium location pattern arises, regardless of whether the public firm is a leader or a follower. Second, the multiplicity of equilibria in the simultaneous location choice case is resolved in the case of sequential location choice in our model. That is, the sequential location choice serves as an equilibrium selection between E_1 and E_2. Similar results are observed in Matsumura et al. (2005) who consider a shipping model with quantity-setting in circular markets. Finally, we also consider the issue of the endogenous order of moves in mixed oligopoly by using the observable delay game of Hamilton and Slutsky (1990), for example, Pal (1998b) for Cournot competition and Bárcena-Ruiz (2007) for Bertrand competition. We show that in equilibrium, two types of Stackelberg competition (public leadership and public followership) arise.

There exist some studies that also consider public firms that supply goods to consumers outside their region without using a spatial model. Bárcena-Ruiz and Garzón (2005b) analyze the model where two regions (or countries) trade with one another and their governments strategically decide whether to privatize their public firms. They show that the decision of privatization and the trade patterns are determined by the difference in the marginal costs between the local public and private firms. Using a similar model, Bárcena-Ruiz and Garzón (2005a) analyze whether national governments should decide whether to privatize public firms or whether this decision should be delegated to a supra national authority. Since these two studies use non spatial models, they do not discuss firms' location patterns, which can be abundantly analyzed in our spatial model. Meanwhile, some works investigate a spatial model with plural regions. Tharakan and Thisse (2002) analyze the model in which two regions are divided by a boundary point on the linear city, and each region has a private firm. However, they assume that each private firm locates at the center of its region, although in our model, firms' locations are determined endogenously, and they can locate in either country.[1]

The remainder of this paper proceeds as follows. In Section 2, we explain the basic framework of the spatial model. In Section 3, we first explore the subgame perfect equilibrium for the two-stage game: In the first stage, a local public firm and a private firm choose their location, and in the second stage, they compete in price. We then discuss the properties of the two types of equilibria. In Section 4, we extend the basic model to a sequential-move game. In Section 5, we offer some concluding remarks and discuss possibilities for future research.

2. Model

A linear city represented by the interval [0, 1] exists, and consumers are uniformly distributed with a unit density in the city. We assume two regions that divide this city into two symmetric areas. These areas [0, 1/2) and [1/2, 1] are referred to as Regions 1 and 2, respectively.

There are two firms—A and B—that produce a homogeneous good at the same constant marginal production cost. Here, we introduce the assumption of zero marginal production cost to simplify the analysis because our results do not depend on it. Each consumer purchases one unit of the good from the firm offering the lowest full price, defined as the mill price charged by the firm plus the transportation cost between the firm and the consumer.[2] Thus, the demand is perfectly inelastic. Let $a \in [0,1]$ and $b \in [0,1]$ denote the locations of Firms A and B, respectively. The mill price of Firm i is $P_i \in [0, \infty)$ ($i=A, B$), and the

[1] Ohsawa (1999) also considers the regional division of the linear city in the context of tax competition.

[2] We implicitly assume that each consumer derives a surplus from consumption equal to s, which is so large that every consumer consumes one unit of the product. However, the value of s is irrelevant to the result. Thus, we omit the surplus as with Cremer et al. (1991).