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# A public firm in a vertically linked price discriminating spatial duopoly

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ABSTRACT

We show that, in a vertically linked duopoly where neither firm can produce all varieties demanded, spatial competition between a public and a private firm induces them to deviate from the socially optimal location. We identify specific conditions under which a change in the degree of privatization induces one firm to move toward, while the other moves away from the socially optimal location. There exists a critical level of privatization above (below) which the public and private firms will come close (drift apart) with a rise in the degree of privatization.



## 1. Introduction

We capture the responsiveness of equilibrium locations of public and private firms selling different varieties of a product in a vertically related industry to a change in the degree of privatization. Examples of such vertically structured industries, where the co-existence of public and private firms is a "fundamental feature", are abundant (e.g., auto, steel, banking, insurance, housing, health, education, energy, transportation, telecommunications, etc.).[2] Empirical evidence by Hollas and Stansell (1988) and Hollas (1990) indicate that property rights, as evidenced by public and private ownership, affect pricing patterns. The latter study provides evidence that, holding demand and cost characteristics constant, public and private pricing patterns vary across customer groups. The evident "movement towards (at least partial) privatization of public firms"[3] operating in such industries motivates us to enquire whether the location decisions of firms operating in mixed oligopolies, when vertically structured, vary with the degree of privatization. In this paper, we build on Braid (2008) and Beladi et al. (2008, 2014) to find an answer to this question.

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[2] See De Donder and Roemer (2006) and De Fraja (2009).
[3] See De Donder and Roemer (2006).

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Braid (2008) established that the equilibrium locations of any two firms are partially centralized to a social optimum in case of spatial discrimination in price when neither of them can supply all varieties demanded. Beladi et al. (2008) demonstrated that vertical integration with an upstream manufacturer will tempt each downstream retailer (whether part of a merger or not) engaged in spatial competition for a market where neither of the downstream firms can produce all varieties demanded to deviate from Braid's (2008) socially optimal location. With the interest in the role of public firms in location decisions continuing to mount since the dramatic financial events of this millennium have given rise to new sectors where public and private companies compete to serve the same market, Beladi et al. (2014, 2015) showed that the equilibrium locations of two spatially price discriminating firms (none of which can produce all varieties demanded) are invariant with the degree of privatization when firms move simultaneously, but sensitive to the degree of privatization when the public and private firms move sequentially.[4]

We demonstrate that the Nash equilibrium locations of a public and a private firm competing spatially in a vertically structured mixed duopoly are not socially optimal and can vary with the degree of privatization when no firm can produce all varieties demanded and the demands for all product varieties are not identical. When the degree of privatization rises, the private firm will move toward, while the public firm moves away from, the socially optimal location if the fraction of consumers wanting to buy the commonly produced good falls short of the fraction of those wanting to buy one of the goods produced exclusively by either firm. The public firm moves toward, while the private firm moves away from, the socially optimal location if the degree of privatization rises when the fraction of consumers wanting to buy the commonly produced good exceeds the fraction of those wanting to buy one of the goods produced exclusively by either firm. There exists a critical level of privatization below which the public and private firms will drift apart and above which the firms will come closer with a rise in the degree of privatization.

The practical relevance of our results follows directly from the apparent "movement towards (at least partial) privatization of public firms" operating in vertically structured mixed oligopolies ranging from "network industries (energy, transportation, telecommunications) to the service sectors (banking, insurance), and from health care provision to education".[5] The policy implications are particularly important for transition economies experiencing unprecedented scales of privatization as they are moving away from economic systems based on central planning. For instance, while the former Soviet Union and Central and Eastern Europe led the waves of privatization in transition economies, there is significant cross-country variation in the degrees of privatization, with some governments opting for low degrees relative to others. Our analysis suggests that different degrees of privatization can induce varying deviations of the location of private and public firms from the social optimum. As such, the choice of the degree of privatization must take into cognizance the consequent impact on firm locations.

## 2. Model and results

Following Beladi et al. (2008), visualize a stylized representation of a vertically related industry where an upstream manufacturer (M) produces an intermediate good and sells this good to two downstream retailers ($R_j$:$i = 1, 2$). The downstream retailers transform each unit of the intermediate good into one unit of a differentiated final good. The final good is sold to consumers that are uniformly distributed with unit density on a linear (uni-dimensional) market interval. The location of $R_1$ and $R_2$ are denoted by $x$ and $y$, respectively, on this market interval with support [0,1]. $R_1$ sells products A and C and $R_2$ sells products B and C. A fraction $c$ of buyers demand good A; a fraction $c$ of buyers demand good B; and a fraction $b$ of buyers demand good C.[6] Suppose, as in Beladi et al. (2014, 2015), that one of the downstream retailers (say $R_2$, without loss of any generality) is publicly owned with $\alpha \in (0, 1)$parameterizing the proportion of privately held shares in $R_2$.

We assume that there is spatial price discrimination for good C of the sort originally examined by Lerner and Singer (1937), where a Nash equilibrium exists in delivered price schedules. Consumers are willing to pay a maximum reservation price ($k$) that is sufficiently high so that it becomes relevant only in the absence of any inter-firm competition. $td$ measures the costs of transportation, with $t$ being a constant and $d$ the distance covered. Monopoly goods A and B are priced at a uniform delivered price that is infinitesimally below $k$.

As in Beladi et al. (2008), the downstream retailers choose their locations simultaneously, while the upstream manufacturer's offer takes the form of a two-part tariff. The role of the two-part tariff, *ceteris paribus*, is instrumental since this allows no perturbation in retail prices to raise the profits of any of the retailers, leaving no incentive for any deviation from the Nash equilibria identified in Beladi et al. (2008). Decisions are taken in stages with perfect monitoring, with each past action becoming common knowledge at the completion of every stage. At the initial stage, a two-part tariff contract is offered to each of the downstream retailers by the upstream manufacturer on a take-it-or-leave-it basis: $M$'s offer takes the form $(F_j, w_j)$, extracting all the profits from $R_j$, where $w_j$ is a uniform wholesale price and $F_j$ is a fixed fee. It is at this same

[4] More specifically, Beladi et al. (2015) have shown that a rise (fall) in the degree of privatization will induce the public and private firms to move closer to (farther from) the socially optimal Nash equilibrium when the public firm leads.

[5] See De Donder and Roemer (2006).

[6] It is possible to contemplate an equivalent scenario where one of the downstream firms sells one variety while the other sells a different variety, and some consumers want to buy only one of the two varieties and some are indifferent between the two. Following Braid (2008), if neither firm can price discriminate, it is possible to assume mixed price strategies. Unlike Dasgupta and Maskin (1986), who had a single mixed-strategy Nash equilibrium in mill prices for any given set of firm locations, there would be a different mixed-strategy Nash equilibrium in delivered prices for any given locations of firms.