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## Optimal privatization policy with Bertrand competition

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## ABSTRACT

This article endogenizes the degree of privatization under a mixed oligopoly market in which a less efficient public firm engages in price competition with a private firm. The results are substantially different from those obtained in quantity competition situations. First, the public firm's price may be lower or higher than the private firm's price. Second, privatization should not necessarily increase both firms' prices. Finally, the relationship between the optimal degree of privatization and the efficiency of the public firm is nonmonotonic. Hence, the optimal privatization policy in price competition situation is not always partial privatization; it might also be full privatization or full nationalization.

## 1. Introduction

Privatization has been a worldwide phenomenon over the past three decades, and its effects on output, efficiency, and welfare have been extensively studied in the mixed oligopoly literature.<sup>1</sup> One strand of literature analyzes the effect of privatization on welfare by comparing the two polar cases: full privatization and full nationalization (De Fraja & Delbono, 1989; Fershtman, 1990; Pal & White, 1998). Matsumura (1998) further considers the possibility of partial privatization and shows that neither full privatization nor full nationalization is optimal under moderate conditions. Another strand of literature broadens Matsumura (1998) to analyze the optimal degree of privatization, which has subsequently become a principal focus in the mixed oligopoly literature (Fujiwara, 2007; Nakamura & Takami, 2015; Wang & Chen, 2011; Wang & Chiou, 2015; Wen & Yuan, 2010).

Most studies analyzing privatization policy are based on the environment of quantity competition between public and private firms. In the real world, however, the competition between such firms is not limited to quantity competition. In fact, price competition is widely observed between public and private firms; an example of such competition can be found in the oil industry. The type of competition between firms may be vital in determining the optimal degree of privatization, because different competition strategies have different properties. For example, quantity competition is characterized by strategic substitution, but price competition is characterized by strategic complements. The optimal privatization policy and the effects of privatization in price competition environments are rarely discussed. Therefore, the main purpose of this study is to analyze the optimal privatization policy when public and private firms engage in price competition.

Most studies on price competition in a mixed oligopoly consider the degree of privatization as exogenous. Anderson, de Palma, and Thisse (1997) analyze the effect of full privatization on social welfare in the short run and long run. Bárcena-Ruiz (2007) and Sanjo

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E-mail address: [jrchiou@livemail.tw](mailto:jrchiou@livemail.tw) (J.-R. Chiou).<sup>1</sup> In recent decades, many developing and transition economies have undertaken privatization policies.<http://dx.doi.org/10.1016/j.iref.2017.12.008>

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(2009) endogenize the order of moves involved in firms allowing prices sequentially or simultaneously.<sup>2</sup> Some studies compare the results between the Bertrand and Cournot equilibria in mixed duopoly from different aspects: the choice of a price or a quantity contract (Matsumura & Ogawa, 2012; Nakamura, 2013, 2015), production subsidies (Ohnishi, 2012; Scrimitore, 2014), emission taxes (Ohori, 2014), foreign penetration (Haraguchi & Matsumura, 2014), and advertisements (Matsumura & Sunada, 2013; Park, Li, & Lee, 2016). However, these studies consider the degree of privatization as exogenous.

To the best of our knowledge, only two articles analyze the optimal privatization policy in a mixed duopoly with price competition. Ishibashi and Kaneko (2008) consider a Hotelling spatial model with a quality dimension of product differentiation, and they analyze price and quality competition in a mixed duopoly. They find that any degree of privatization is optimal if the firms compete only in price, and therefore, partial privatization is crucially concerned with quality competition. Xu, Cho, and Lee (2016) perform a Cournot–Bertrand comparison when both emission tax and privatization policies are used together. They report that the optimal degree of privatization is always partial privatization, regardless of whether in Cournot or Bertrand competition.

The main purpose of this article is to endogenize the degree of privatization and analyze the optimal privatization policy when firms engage in price competition with differentiated goods. In addition, the accuracy of the popular view that public firms are inefficient and should therefore be privatized is examined in this article.

This article also highlights the effect of price competition when a public firm is less efficient than the private firm. Public firms are widely recognized to have lower efficiency. However, the aforementioned studies, except for Matsumura and Ogawa (2012), assume that public and private firms are identically efficient. Thus, we re-examine the relative price of public and private firms. Moreover, the effect of privatization on firms' prices is addressed in this article.

We provide a model of mixed duopoly that is consistent with casual observation. Our model consists of the following two features. First, we consider a partially privatized firm that maximizes the weighted average of social welfare and profits. Therefore, in a mixed duopoly market, we assume that a partially privatized firm and a private firm operate. Second, we assume that both firms simultaneously choose their prices because we aspire to focus on the effect of Bertrand competition.

Some results regarding Bertrand competition in a mixed duopoly are as follows. First, the partially privatized firm's equilibrium price may not be lower than, and may even be higher than, the private firm's equilibrium price. Second, in contrast to the popular view, we determine that privatization should not necessarily increase the public firm's price; it may even be lower than the pure public firm's price. Finally, the less efficient the public firm is, the less necessary the public firm's privatization is, as long as the two firms' costs are not too close.

We report some Bertrand competition results that are completely different from the results of Cournot competition, which can provide policy suggestions for the government. In Cournot competition situations, if a public firm is less efficient than a private firm, the optimal privatization policy is partial privatization, regardless of whether the efficiency difference between the two firms is large (Matsumura, 1998). However, in Bertrand competition situations, the optimal privatization policy may be full privatization, partial privatization, or even full nationalization, and this policy crucially depends on the level of difference between the two firms' efficiency. In addition, the effect of the public firm's efficiency on the optimal degree of privatization is monotonic in Cournot competition situations (Chiou & Hwang, 2006). The less efficient a public firm is, the more necessary it needs to be privatized. Nevertheless, the optimal degree of privatization is nonmonotonic with respect to the efficiency of a public firm. Less efficient public firm should even be less privatized.

The remainder of this article is organized as follows. Section 2 presents the model. In Section 3, we investigate the equilibrium outcomes of the price subgame. In Section 4, we characterize the optimal degree of privatization. Finally, in Section 5, we provide some concluding remarks.

## 2. The model

This article considers an economy that comprises a monopolistic sector and a competitive numeraire one. The monopolistic sector contains a public firm, 0, and a private firm, 1. Each produces a differentiated good. We assume that there is a continuum of consumers of the same type with a utility function that is separable and linear in the numeraire good. Hence, income effects on the monopolistic sector can be ignored, and partial equilibrium analysis can be applied.

The representative consumer maximizes  $U(q_0, q_1, I) - p_0q_0 - p_1q_1 - p_I I$ , where  $q_i$  is the output of firm  $i$ ,  $I$  is the quantity of the numeraire, and  $p_i$  is the price of firm  $i$  ( $i = 0, 1$ ). Let  $p_I$  equal 1. The utility function  $U(q_0, q_1)$  is assumed to be quadratic, strictly concave, and symmetric in  $q_0$  and  $q_1$ :

$$U(q_0, q_1, I) = \theta(q_0 + q_1) - (q_0^2 + 2\gamma q_0 q_1 + q_1^2)/2 + I,$$

where  $\gamma \in [0, 1)$  measures the degree of product differentiation.<sup>3</sup> If  $\gamma = 0$ , the goods are independent; hence, each firm has monopolistic

<sup>2</sup> Sanjo (2009) builds a Hotelling model to analyze simultaneous and sequential price choices in a mixed duopoly market and shows that social welfare is constant regardless of the degree of privatization. Martínez-Sánchez checks the robustness of the results in Sanjo's (2009) article and points out that when Sanjo extends the model to endogenize the firm's location, social welfare depends on the degree of privatization.

<sup>3</sup> The goods are substitutes, independents, or complements according to whether  $\gamma > 0$ . In reality, goods in a mixed oligopoly are seldom complements; therefore, we ignore the case of complementary goods represented by the case of  $\gamma < 0$ .

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