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Environmental taxes in a differentiated mixed duopoly

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ABSTRACT

Beladi and Chao (2006) and Bárcena-Ruiz and Garzón (2006) considered the role of environmental policy on the decision whether to privatize a public firm in different market structures. This paper re-examines whether privatization improves (or deteriorates) the environment in a mixed duopolistic framework with differentiated product and pollution abatement. It is shown that, due to privatization, less attention is paid to pollution abatement by all the firms coupled with less environment taxes levied by the government in a differentiated duopoly, and the environment is more (less) damaged when the product is less (more) substitutable. When the product is highly substitutable, industry profits increase because this softens the intensity of the product market, but social welfare deteriorates accompanied with the path of privatization because the loss of consumer surplus and tax revenue exceeds the increases in profits, even if the environment is less damaged.

1. Introduction

Since the 1990s, concerns over environmental quality have been prominent in the public domain. Governments conduct environmental regulation by imposing taxes and use the proceeds to clean up firm-generated pollution. Moreover, the imposition of certain restrictive pollution standards requires the adoption of costly abatement technology by the firms.

Inefficient management of public monopolies may overshadow the possible benefits of public ownership, motivating the entry of profit-maximizing private firms to compete against a welfare-maximizing public firm. Indeed, we have witnessed mixed markets to exist in a broad range of

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industries such as oil, telecommunications, electricity and the postal sector, which were formerly dominated by public monopolies in many developing economies. Such mixed markets with competition between firms with different objectives deserve further study. In Goering (2008), three separate Cournot mixed market scenarios are analyzed: competition between a non-profit firm (NPO) and a private for-profit firm; competition between the NPO and a public firm; and a market scenario that includes all three firms. The author demonstrated that the technical efficiency of the NPO vis-à-vis the profit maximizer is crucial in determining whether social welfare rises or falls as the NPO places more weight on its stakeholders' surplus. In this paper, we intend to explore whether privatization improves or deteriorates the environment in a mixed duopolistic framework with product differentiation and pollution abatement.

Simpson (1995) derived the optimal pollution for a Cournot duopoly and found that if firms have different production costs, the optimal tax rate may exceed the marginal damage. Damania (1996) investigated the effects of an emissions tax on the incentives for oligopolists to acquire alternative pollution abatement technologies in the context of a repeated game, and demonstrated that there are circumstances in which firms may reject the option of acquiring pollution abatement equipment, even when this lowers their production costs. Yin (2003) examined corrective taxes under oligopoly with inter-firm externalities and pollution abatement, and showed that when externalities are substantial and/or the number of polluters is large, effluent levies on these firms do not necessarily result in a deadweight loss. Bárcena-Ruiz and Garzón (2002) analyzed environmental policy in a pure duopoly model with incentive schemes and showed that firm owners have to pay a higher environmental tax, and that both environmental damage and social welfare increase compared to the profit-maximization case. Ohori (2004) explored the interaction among privatization, environmental, and trade policies in international duopolistic markets with environmental damage, and demonstrated that the optimal environmental tax is lower than the marginal environmental damage and the optimal tariff is strictly positive, regardless of whether or not the home public firm is privatized.

Recently, Beladi and Chao (2006) restricted the discussion to the case of a monopoly without considering pollution abatement and proved that privatization paradoxically exerts a negative effect upon the environment. This paradox may be attributed to the failure of a monopolistic firm to control pollution, since public monopolies are believed to reflect inefficient management (Vickers and Yarrow, 1991). Kato (2006) investigated the effects of tradable emission permits in a mixed oligopoly, and found that under certain conditions social welfare is greater (respectively smaller) under Tradable Emission Permits (TEP) than under Non-Tradable Emission Permits (NTEP) when the weight of social welfare in each public firm's objective function and the degree of convexity of the production cost function and that of the abatement cost function are small (respectively large). Bárcena-Ruiz and Garzón (2006) explored how the decision on whether to privatize a public firm or not interacts with environmental policy, and showed that when the government sets a tax to protect the environment, the tax is lower in a mixed oligopoly than in a private one, and that the environmental damage is greater. The above papers do not consider the role of product differentiation in a mixed oligopoly.

China Steel Corporation (CSC), established in 1971, is the government-controlled corporation that competes with the private steel firm Yueh United Steel Corporation (YUSCO) in the Taiwanese domestic market, possessing the largest market share. In 1995, CSC was privatized by the Ministry of Economic Affairs of the government of Taiwan. These duopolists produce differentiated steel products and have been highly and constantly criticized by the public for contaminating the environment of Kaoshiung Metropolis. This industry scenario fits quite well into the model we present in this paper, which re-examines whether privatization improves or deteriorates the environment or social welfare in a mixed duopolistic framework with product differentiation and pollution abatement.

2. The model

We depict a single market made up of one public firm (indexed by 0) and one private firm (indexed by 1) producing a differentiated good. As in Singh and Vives (1984), a representative consumer's utility