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Consumers awareness and environmental policy in differentiated mixed oligopoly

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ABSTRACT

In this paper, we show that the implications of consumer awareness on environmental policy in both mixed and private oligopolies under regulated entry and free entry. The emission taxes are charged when the market imperfection and consumer cognition of pollution are low, while the consumption externality is substantial. However, when the consumers' cognition of pollution damage is increasing and the consumers are willing to pay (WTP) less for the polluted good, the government should choose a lower emission tax.

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. In some highly polluting industries, the 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, and such entry increases the market competition but may harm the environment. Indeed, we have witnessed mixed markets to exist in a broad range of industries such as oil, steel, electricity and telecommunications, 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 this paper, we investigate the optimal environmental policies in a mixed oligopoly, wherein firms produce the differentiated goods with environmental damage that is measured by the government and observed by the consumers. Furthermore, we re-examine the emission taxes or output subsidies that are levied or provided at regulated entry and free entry. In the literature, many works have

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already pointed out that welfare implications of public policies in free entry markets are in sharp contrast with those in entry-regulated markets.[1]

On early studies of environmental policies in oligopolistic framework, 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. 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. 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.

In a free-entry modeling, Lahiri and Ono (2007) showed that in a polluting oligopoly with homogenous goods, when the number of firms is fixed, (i) a relative emission standard is welfare-superior to an emission-equivalent emission tax, and (ii) an emission tax is emission-superior to a welfare-equivalent relative emission standard. However, under free entry and exit, the results are just the opposite when the inverse demand function is concave. Fujiwara (2009) further constructed a model of polluting oligopoly with product differentiation, considering how product differentiation, together with the presence and absence of free entry, affects optimal emission tax/output subsidy policies. It showed that the sign of the short- and long-run optimal pollution taxes are highly sensitive to the parameter measuring product differentiation as well as the presence of free entry.

On the literature of environmental regulation under mixed markets, 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 & 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). 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 did not consider the role of product differentiation in a pure or mixed oligopoly, however.

Wang and Wang (2009) re-examined whether privatization improves (or deteriorates) the environment in a mixed duopolistic framework with differentiated product and pollution abatement. They showed that when the product is highly substituted, the industry profit is increased because it softens the intensity of the product market, but the social welfare is deteriorated accompanied with the path of privatization because the loss of consumer surplus and tax revenue exceed the increases in profits even if the environment is less damaged.[2] The mentioned papers did not consider the optimal strategic policies under free entry which motives us to incorporate the environmental awareness of individuals into a free-entry mixed oligopoly with product differentiation and further investigate the optimal environmental and competition policies.[3]

The environmental awareness of individuals has been incorporated into the analysis in the literature as the (perceived) environmental quality attributes which are additive to the physical quality attributes, which are assumed to be exogenously given (see Eriksson (2004), Conrad (2005) and Rodriguez-Ibeas (2007)), while the notions of endogenous environmental awareness is considered by Yakita (2009), and Yakita and Yamauchi (2011). When a developing country transforms its industrial structure and the consumer is highly sensitive with the environmental damage, it is pertinent to consider whether anti-competition entry regulation policies should be relaxed and reconsider how to choose an optimal emission tax or output subsidy. The above studies in the literature on free entry neglect the possibility of the consumer's cognition of pollution damage and how it will affect the consumer's willingness to pay for the polluted good in a polluting industry.

In this paper, we show that with the presence of consumer awareness in both mixed and private oligopolies under regulated entry or free entry, the emission tax/output subsidy could be provided. The emission taxes are charged when the market imperfection and consumer cognition of pollution are low, while the consumption externality is substantial. However, when the consumers' cognition of pollution damage is increasing and the consumers are willing to pay (WTP) less for the polluted good, the government should choose a lower emission tax.

This paper is organized as follows. Section 2 provides the basic model. Section 3 provides the results of the environmental policies in a differentiated mixed oligopoly with differentiated goods with restricted entry and at free entry. Section 4 does a similar analysis in private oligopoly at restricted entry and free entry. Section 5 presents conclusions.

[1] See for example, Matsumura and Okumura (2014) on comparison between specific taxation and volume quotas in a free entry Cournot oligopoly. Wang (2016) demonstrates that both optimal import tariff rate and output subsidy rate under free entry of domestic firms is lower than the one at regulated entry when the scale of domestic market is moderate. Furthermore, free entry of domestic firms or foreign firms is always socially excessive irrespective of the policy regimes rate in an open economy.

[2] Pal and Saha (2014) mainly showed that the government can implement the socially optimal output and abatements by a tax-subsidy scheme and keeping the public firm fully public. Xu, Cho, and Lee (2016) compared a Cournot with a Bertrand duopoly in a differentiated mixed market when both emission tax and privatization policies are used together. They found that the optimal emission tax is always lower than the marginal environmental damage, and it is always lower under Cournot than under Bertrand; the optimal privatization is always a partial privatization, and it is always higher under Cournot than under Bertrand.

[3] We appreciate the referees pointing out the issue of policy trade-offs.