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## Can privatization be a catalyst for environmental R&D and result in a cleaner environment?



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### ABSTRACT

In this paper we explore whether privatization helps to catalyze a firm's environmental research and development (ER&D) and improve environmental quality. By defining ER&D as the effort undertaken by a firm to reduce its pollution per unit of output, we find in a duopoly framework that privatization cannot catalyze both public and private firms' ER&D efforts simultaneously; it can increase one but decrease the other firm's investment, or it may even lower both firms' ER&D investments. Moreover, when production causes severe environmental damage, or the imposition of environmental taxes poorly internalize the pollution externality, privatization may result in a poorer environment. For the sake of having a cleaner environment, policy-makers can impose higher environmental taxes on a highly polluting industry when it is being privatized.

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## 1. Introduction

In 2007, China's Environmental Protection Agency announced that environmental protection is a major concern when privatizing state-owned enterprises.<sup>1</sup> This announcement signifies that privatization in China may further deteriorate the already polluted environment. It also seems to challenge

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<sup>1</sup> This news was reported in the *Wall Street Journal* on January 12, 2007.

the commonly held belief that privatization can stimulate economic activities and result in a cleaner environment because privately owned enterprises often have better environmental performance than state-owned enterprises.<sup>2</sup>

In line with the discourse on privatization and the environment, we are surprised that the role of environmental research and development (ER&D) has not been taken into account in this dispute. Even in the mixed oligopoly regime, both state-owned and privately owned firms are obligated to undertake ER&D activities to abate pollution. Many world institutions have also called for more ER&D investment to reverse the negative impacts of climate change on the environment (Ulph and Ulph, 2007). To further explore the impact of privatization on the environment, we shall analyze firms' ER&D behaviors in a mixed oligopoly market.<sup>3</sup>

Although analyzing a firm's research and development (R&D) behavior is common, most researchers focus on process R&D but not on ER&D in the mixed oligopoly literature. For example, Ishibashi and Matumura (2006) examine a process R&D race, and Lin and Ogawa (2005) and Heywood and Ye (2009) investigate a process R&D rivalry in a mixed oligopoly. However, as is commonly known among researchers, process R&D and ER&D are not the same. Investments in process R&D seek to reduce a firm's production costs and expand its output. In contrast, investments in ER&D seek to reduce a firm's pollution per unit of output, which may not necessarily result in a boost of its output.

Current mixed oligopoly studies that incorporate environmental issues into their analyses have not reached a unanimous agreement on the impact of privatization on the environment. By applying environmental tax as a regulatory instrument in a closed economy, Bárcena-Ruiz and Garzón (2006) and Wang et al. (2009) observe that the environment is cleaner after privatization because privatization results in a reduction of output and thus generates less pollution. On the other hand, Beladi and Chao (2006) claim that privatization increases the total output when the demand function is highly convex; thus, privatization may further damage the environment.<sup>4</sup>

To resolve the dispute regarding the impact of privatization on the environment, we set up a duopoly model in which firms are competing in either a pure or a mixed duopoly regime. There are two stages in the model: in the first stage, both a public and a private firm determine their optimal investments in ER&D; in the second stage, both firms compete in terms of output. We focus on two research issues in this model. First, we examine each firm's optimal ER&D efforts before and after privatization. Second, we investigate the circumstances in which the environment has improved after privatization.

There are three major findings in this paper. First, the public firm may not necessarily undertake greater ER&D activities than the private firm in a mixed duopoly regime. Second, privatization cannot catalyze both the public and the private firms' ER&D efforts simultaneously; it can increase one, but it decreases the other firm's investment, or it may even lower the efforts of both firms. Finally, depending on the degree to which the negative externality is internalized through tax, the impact of privatization on the environment is non-monotonic. When production causes severe environmental damage, the environment may further deteriorate after privatization unless the environmental tax is sufficiently high to correct for the environmental distortion.

The remainder of this paper proceeds as follows. The following section presents the model. Section 3 provides analyses of firms' output and ER&D decisions in the pure and mixed duopoly regimes. In Section 4, we compare the results derived from Section 3 and rank the firms' ER&D activities in both regimes. The impact of privatization on the environment and social welfare is also analyzed in

<sup>2</sup> Wang and Jin (2007) use empirical data from China and find that privately owned enterprises have better environmental performance than state-owned enterprises.

<sup>3</sup> Note that Wang et al. (2009) and Bárcena-Ruiz and Garzón (2006) use 'pollution abatement technology' instead of 'ER&D' in their articles. In this paper, these two concepts are identical, i.e., pollution abatement is a type of environmental research and development.

<sup>4</sup> Here, we review only those studies that apply environmental tax as a regulatory instrument in a closed economy. For other regulatory instruments, see Kato (2006), who compares the impact of privatization on levels of social welfare under tradable and non-tradable emission permits. Kato (2011) compares the different effects of emission tax and emission quotas on social welfare after privatization has taken place. In an open market framework, Otori (2004) considers a situation in which two public firms, each located in different countries, export their products and compete in a third country. He shows that a country's privatization program may lower the overall environmental quality.

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