

# **Environmental Regulations, Innovation, International Trade and Strategic Behavior**

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## **Abstract**

Will international trade lead to relaxation of environmental policies? Will the incentives of governments for acting strategically in setting their environmental policies be higher if producers competing in international markets behave strategically? What will be the Nash equilibrium of the strategic game between governments and producers in the presence of innovation, international trade and environmental regulations? How does the equilibrium change when we move from a simultaneous-move game to a sequential-move game?

Our paper attempts to provide answers to these questions. In a standard model used in earlier studies in this literature (see Ulph 1996), we analyze the behaviors of governments and producers related to environmental policy making and R&D investment, respectively. Governments may act strategically by recognizing that the output of the foreign producer depends on the emission level it sets, and thus, it may distort its environmental policy in order to generate competitive advantage to its producer. Producers may act strategically by adjusting the level of investment in R&D by considering the associated impact on the output of the rival producer. Our main objective is to determine the Nash equilibrium of this game including governments and producers in the presence of environmental regulations, international trade and innovation. Surprisingly, this has not been reported before.

We show that there is a unique Nash equilibrium in the simultaneous-move game, and both producers and governments behave strategically. Producers overinvest in R&D, and governments lower their emission standards. Both countries end up with a lower welfare, and higher emission level than the case in which none behaves strategically. This is like a prisoner's-dilemma-type outcome. In the sequential-move game, two equilibria exist, but one dominates the other in terms of both the welfare and emission levels. In the equilibrium, first-moving (leader) government acts strategically, the follower government will not act strategically, and none of the producers will behave strategically. The first-moving country gets higher welfare than the follower country. Similarly, producer in the first-moving country gets higher profits than the producer of the follower country; both producers will choose their R&D investment efficiently. Furthermore, as expected, emission level is higher in the first-moving country because of the strategic behavior.

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Our explicit analysis of the welfare levels and profits not only reveals the equilibrium behaviors but also puts doubt on some of the earlier findings in this literature. For example, Ulph (1996) states that allowing governments to act strategically increases the incentive for producers' to act strategically (overinvestment in R&D). As seen in the pay-off tables we have presented, producers will prefer to behave non-strategically (i.e. efficiently) when governments act strategically. Producers will prefer to act strategically only if the other producer is acting strategically. Finally, the highest welfare levels correspond to the cases in which only one government acts strategically and the other one efficiently, but this set of behaviors can not be sustained.

In this paper, only the identical-country case is analyzed. This analysis will be extended to non-symmetric cases in future works, and initial expectations for the impact of such an extension will also be presented.

**Keywords :** Environmental Policies, Trade, R&D Investment, Strategic Behavior, Welfare Analysis.