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Environmental policy instruments in an international duopoly with feedback investment strategies☆

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Abstract

This paper analyses the effects of the environmental policy instruments taxes and standards on the investment behaviour of firms in the context of an international duopoly. Two production factors are considered: the capital stock and a polluting input. The government of each country values high profits for its firm and a good environmental quality. Through standards on the polluting input firms get commitment on output which is not the case under taxes. Standards thus seem a better environmental policy instrument, because for the same use of the polluting input, taxes lead the duopolists to higher investment with lower profits. This result was derived in a two-stage game model. It was confirmed in a differential game model with open-loop strategies. The paper shows that in a differential game model with feedback strategies an effect occurs that counteracts the first effect. The cause of this is that taxes induce substitution between capital and the polluting input. The conclusion is that, under taxes, firms invest more due to the absence of commitment but invest less due to substitution between the inputs. The net effect depends on the values of the parameters. Taxes are

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better than standards for low rates of depreciation and discount, for low investment costs and for high productivity of capital. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Flexibility is an important reason to advocate economic environmental policy instruments like emission taxes. More than under traditional command and control measures, polluters can choose to what degree and in which way they decrease their pollution. Consequently, the regulator may reach a high allocative efficiency, even with inadequate information about the cost structure of the polluting firms.

In case of imperfect competition, however, flexibility has also another effect, because in such markets commitment plays an important role (see, e.g., Tirole, 1988). In some cases it is advantageous for a firm in oligopoly to be able to 'burn its bridges'. The ability to bind itself to certain actions gives the firm a relatively strong position towards a competitor. More flexibility by its nature decreases the possibilities to commit.

The characteristics of government policy influence the flexibility of a firm. If government policy is implemented by rigid prescriptions, it is a commitment for the firm. If, on the contrary, the government bases its policy on incentives, firms are more flexible so that they have less commitments. Brander and Spencer (1983) analysed the differences between trade policies when trade can be characterized as an international oligopoly. If governments want high profits for their home firms, they may want to provide home firms with commitment via their trade policy.

Similarly, the type of environmental policy instrument affects the international competitiveness of firms. In a multistage model of international rivalry where allocative efficiency is neglected, it was found that environmental standards are unambiguously 'better' than taxes (Ulph, 1992). Ceteris paribus, under standards, firms gain commitment, so that they earn more profits.

This paper analyses an international duopoly where the firms use two production factors: capital and a polluting input. It shows that Ulph's result depends on an (implicit) assumption on the investment behaviour of firms. In these multistage models investment decisions are taken once and for all which is also a form of commitment in the analysis. If, however, firms are more flexible in their investment behaviour, strategic interaction is increased and standards are not always better than taxes. This can be shown by using the richer framework of differential games, because then a distinction can be made between so called

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