寡佔市場結構下的最適環境政策
Optimal Environmental Policy in Oligopolistic Markets

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一、摘要

本文探討污染稅與污染排量標準這兩種政府環保政策，在污染性寡佔市場中對廠商行為的影響。有別於其它的研究，本模型中廠商的選擇變數，除了產量之外，尚有除污投入的決策。結果顯示，當政府提高了污染稅率時，廠商的污染排放量卻有可能反而增加；同時，當政府制定更嚴格的環保政策時(即更高的污染稅率或者更低的排放量標準)，廠商的最適利潤卻也不一定因而下降。也就是說，廠商可能得利於一個嚴格的政府環保政策，而社會卻反而可能不利。不過，我們發現，當一個產業是相對的屬於低污染時，那麼最佳社會福利水準是可以達到的，但是，這只有在政府同時採用補貼政策時才有可能出現。有了補貼政策，廠商的最佳反應模式，不論是在那一種環保政策之下，就會趨於一致，因此，當某一固定程度的社會福利水準(如最佳水準)成為追求目標時，這兩種政策也就有了相同的效應。不過，當補貼政策不為採用時，排放總量標準這一環保政策，顯然的就能夠比課污染稅這一政策好，因為它可以帶給社會更高的均衡福利水準；不過，不論那一種政策都沒有辦法達到最佳結果，同時，廠商都會傾向於多生產。

關鍵詞：排放標準、排放稅、庫諾競爭

Abstract

This paper investigates the impact of two environmental instruments -- emission tax and emission standard -- to the firm's equilibrium behaviors in a polluting oligopoly. Different from others, the abatement investment is also a choice variable of the firms in additional to output. The findings show that pollution emission may increase when the government sets a higher tax rate. Even though a stricter environmental policy is employed, a firm's optimal profit is not necessarily lowered. That is, a firm may benefit from a stricter environmental policy, while the society may suffer. However, we do find the optimal social welfare could be achieved when the industry is relatively low polluting, only by the use of a subsidy. Through this, the firms under each instrument in the second period have the same best reactions, which in turn cause to a same effect on achieving the optimal social welfare. But, without the subsidy scheme, an emission standard turns out to be superior; the first-best outcome cannot be achieved; and each firm tends to overproduce.

Keywords: emission standard, emission tax, Cournot competition

二、緣由與目的

Unlike the market structures of perfect competition and monopoly, an oligopoly is complicated due to its interdependent behaviors among firms, which distort production, and therefore pollution and the social welfare. This certainly affects the government choice of an optimal environmental policy.

To remedy this sort of distortion, environmental instruments are adopted. Their purpose is to reduce pollution down to a desired level by creating incentives to firms. Two types of incentives can be identified. One is to induce firms to invest in abatement technology upgrading, while the other is to reduce their outputs. The direct effect increases a firm's cost, while the indirect effect decreases a firm's output, which causes a contraction of market output and a markup of market price. Therefore, there must exist some sort of tradeoff.

The government, in face of the market structure, needs to choose an instrument and its regulating level so as to achieve the highest social welfare, which as has been noted, is influenced by the market output, each firm's abatement cost, as well as the pollution damage. This paper, confined to the oligopoly, models the interactions between the firms and the government to demonstrate the policy effect on social welfare.

In this paper two common types of environmental instruments will be discussed. One is an emission tax, where emissions are taxed at a rate t; see e.g. Levin (1985), Kim and Chang (1993), Requate (1993), Katsoulacos and Xepapadeas (1995), and Damania (1996), and Hoel (1998). The other is an emission standard, where the government announces an upper limit e_0 on emissions; see e.g. Harford (1975), Dewees (1983), Watson and Ridker (1984), and Bohm and Russell (1985).

This paper differs from the existing literature in several features. First, it sets up a two-period model. The government in the first period chooses one of the two environmental instruments, an emission tax or an emission standard, and sets its regulating level. Each firm, which competes in an oligopoly, then chooses output and abatement investment. Second, it centers on the effect comparison of a firm's behavior between the two instruments. Third, the first-best welfare is compared. Therefore, not only are the firms' equilibrium behaviors explored, but the government's optimal policies are also discussed.

A two-period model is employed. In the first period, the government sets an environmental policy, then in the second period each firm under an n-firm homogeneous-product oligopoly chooses an output q_i and an abatement investment a_i simultaneously. Through these settings, we analyze the impact of the government environmental policies -- emission tax and emission standard.

三、結果與討論

The findings of this paper are as

follows:

Proposition 1. In a polluting oligopoly, a higher tax rate may lead to increased pollution. Increased profit may also result when the government imposes a stricter policy.

Resembling Levin (1985), it says that pollution may increase when a tax policy gets stricter. In contrast to Katz and Rosen (1983), it states that a stricter policy -- a tax or a standard -- will cause an ambiguous change in optimal profit.

Lemma 1. When the marginal social damage is small enough, a negative tax rate becomes necessary to achieve the optimal social welfare.

Lemma 2. With a target level of emission, a firm's best-reaction strategies in the second period under both instruments -- emission tax and emission standard -- are identical.

Even though a different instrument is employed, a firm has the same best reactions in the second period. Therefore, on achieving the optimal social welfare, an emission tax and an emission standard turn out to have the same effect.

Lemma 3. The emission standard instrument can lead to any result of an emission tax instrument.

That is, an emission standard becomes superior when a negative tax is not allowed.

Proposition 2. In a polluting oligopoly, if a subsidy is possible, then the environmental instrument of an optimal emission tax and an optimal emission standard are equivalent. Otherwise, an optimal tax is no better than an optimal standard.

Due to the double distortions -- pollution and strategic behavior -- in an oligopoly, the first-best outcome cannot be achieved by either of the optimal instruments. Internalization of marginal damage to a firm by a tax, shown in many of the literature, is no longer an effective tool.

Proposition 3. In a polluting oligopoly, the first-best outcome cannot be achieved by the use of either instrument.

Therefore, on optimality with either instrument, a firm overproduces.

四、成果自評

This paper differs from the existing literature in several features. First, it sets up a two-period model. The government in the first period chooses one of the two environmental instruments, an emission tax or an emission standard, and sets its regulating level. Each firm, which competes in an oligopoly, then chooses output and abatement level. Second, it centers on the effect comparison of a firm's behavior between the two instruments. Third, the first-best welfare is compared. Therefore, not only are the firms' equilibrium behaviors explored, but the government's

optimal policies are also discussed.

Surprisingly, we find the two instruments in general turn out to be equivalent except for an industry with a very low pollution damage, in which an optimal emission standard turns out to be a better one if a subsidy scheme is assumed away. The firms tend to overproduce in a dirty oligopoly industry even though an environmental instrument is employed.

With different settings from the existing literature, we also reprove some traditional wisdom.

五、參考文獻

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