Pigovian tax and Pareto efficiency

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The Pigovian tax is widely known as a method to internalize a negative externality by   imposing on polluters a tax equal to the value of the marginal loss suffered by the victims of pollution. There are two aspects regarding efficiency under this tax. One is efficiency in the sense that net social benefit becomes maximized. The other is efficiency realized in terms of cost, that is, efficiency in the sense that a certain pollution reduction target is achieved with minimal social cost. This study aims to identify the problem related to Pareto efficiency arises when, after taxation, firms install pollution control equipment or develop new pollution control technology.

In general, the ways in which firms, as sources of emissions, reduce emissions of pollutants include reducing output, installing pollution control equipment, improving production processes, and developing new technologies. In response to environmental regulations, firms combine such pollution abatement methods while seeking profits. Therefore, total abatement cost (TAC) must be the sum of the direct cost of pollution abatement and its opportunity cost represented by output reduction.

The optimal Pigovian tax rate is determined and social welfare is optimized if policy authorities have complete information on firms and markets. If after taxation, however, firms reduce pollutants by improving production processes and developing new pollution reduction technologies, exogenous factors that neither authorities nor even firms can control disturb the optimal tax rate. As a result, social welfare is not optimal and the market remains stuck in a state of Pareto inefficiency.

This paper sheds light on this point, reexamines the concept of a firm's marginal abatement cost, and proposes a new marginal abatement cost curve (MAC) that connects both output reduction and pollutant reduction.