***POLLUTION TAXES AND EXECUTIVE COMPENSATION FOR ENVIRONMENTAL R&D INCENTIVE***

Youngho Chang, Singapore University of Social Sciences, +65-6248-0159, yhchang@suss.edu.sg

Soo Keong Yong, International Business School Suzhou, +86 512 88166532, sk.yong@xjtlu.edu.cn

## Overview

Studies have shown that emissions taxes, such as a tax on carbon dioxide emissions, are effective in inducing firms to invest in environmental research and development (R&D) (see, for example, Milliman and Prince, 1989; Jung et al., 1996; Popp et al., 2010). As a market-based instrument, an emissions tax forces private firms to internalize the external effect of pollution into their cost function, and this provides an incentive for firms to invest in clean technologies as a long-term solution. However, some research has shown that an emission tax may not necessarily create adequate incentives (see OECD, 2010) and an optimal solution requires additional policies such as subsidies to R&D investment to complement the emissions tax (Acemoglu et al., 2012).

One way to raise the effectiveness of emissions tax in inducing environmental innovation is to ensure that the internal management of firms respond cooperatively to government policy. Henriques and Sadorsky (1996) provided empirical evidence that firms’ internal formulation of an environmental plan is influenced by specific types of government policies. In particular, some studies have identified positive effects of government regulations on firms’ technological change (e.g., Jaffe and Palmer), and Arimura et al. (2007) found that perceived regulatory stringency increases the likelihood of manufacturing facilities in Organisation for Economic Co-operation and Development (OECD) countries to conduct environmental R&D. However, the modern management of firms is characterized by a division of ownership and management, whereby owners such as shareholders delegate the management responsibility to managers and chief executive officers (CEOs). This has resulted in a principal-agent problem because the shareholders want the CEO to engage in management practices that maintain the firm’s long-term profitability but CEOs may take actions to maximize their own short-term gain (see, for example, Jensen and Meckling, 1976; Jensen and Murphy, 1990). With climate change becoming a global issue, shareholders are increasingly concerned about their firms’ exposure to environmental costs and risks, whereas their corporate CEO may be more concerned about short-term profitability, to which under standard executive compensation their wages are indexed during their period of employment. An example is the case of Chevron, one of the largest North American oil and gas companies: during the company’s annual meeting in 2015, its shareholders proposed to redirect capital away from costly high-carbon extraction projects but its CEO refused to engage in any environmental sustainability practices.

In view of the potential principal-agent problem, some firms, such as Intel and Xcel Energy, have incorporated environmentally based performance into the variable wage component of its executives’ compensation packages. These firms link their executive pay to performance metrics related to environment, social and governance (ESG) issues. In particular, the CEO of the Dutch-British consumer company Unilever, Paul Polman, received a “green” bonus sum of $722,230 in 2014 for achieving sustainability targets that included reducing greenhouse gas emissions, water and waste as part of the company’s “sustainable living plan.” According to the global consultancy firm Sustainalytics, 168 public companies in their total global database in 2013 explicitly tied executive compensation to ESG performance targets: eight of 60 companies in Canada (13%) and 39 of 600 in the United States (7%). However, since environmental initiatives have minor effects on short-term financial performance most of the time, not many companies integrate related variables into executive pay. According to Sustainalytics, 13% of the companies they tracked tied their executive compensation to environmental measures in 2010, but the proportion of such companies increased only modestly to 16% in 2012. A prospective solution to speed up the adoption of such an environmental wage scheme is to allow for public policy intervention in the form of a market-based instrument.

## Methods

This paper proposes a public-private cooperative mechanism in which manufacturing firms include direct incentives for emissions reduction in their executive wage compensation in relation to government enactment of an emissions tax. In particular, the emissions reduction takes the form of investment in environmental R&D in the production process. To formalize the idea, we consider a simple partial equilibrium model where a monopolist firm delegates production responsibility to a CEO. The firm produces a homogeneous good but creates pollution emissions as a by-product. The government imposes a price on the firm’s pollution with an emissions tax. We consider an emissions tax as the policy instrument, such as a carbon tax, because large polluters, such as Chevron, Shell, and ExxonMobil, have publicly declared their preference for a carbon tax if governments were to implement new environmental policy in the future. To reduce the tax burden, the manufacturer can either produce less or invest in pollution abatement R&D. To align the firm’s profit objective with the CEO self-interest, the compensation package is designed in two different types of structure. The first type is a standard CEO wage contract that is partially associated with the profitability of the firm. The second type is partially associated with pollution abatement, in addition to the firm’s profitability. The model highlights the central role of the second type of CEO compensation design in curbing pollution.

## Results

The main results are summarized as follows: (1) social welfare is higher through lower emissions and higher production under the new CEO wage structure with the abatement incentive compared with the standard CEO wage contract; (2) the CEO wage is higher compared with the standard CEO wage contract; (3) the government raises environmental R&D and reduces pollution without resorting to a high emissions tax; and (4) the firm’s profit is higher as long as R&D investment is not too efficient. These results show that environmental objectives can be achieved with a simple cooperative mechanism between the government and the monopolist without excessive policy intervention or sacrificing firm profitability. Moreover, a lower emissions tax under such a cooperative mechanism encompasses the additional benefit of avoiding excessive economic distortion in a single tax policy.

## Conclusions

This paper proposed a new cooperative mechanism between the government and firms to improve the efficacy of an emission tax to raise environmental R&D. Under the public-private mechanism, firms implement a CEO wage compensation that is partially indexed to R&D outcome in abatement. The aim is to align the CEO’s private incentive with the firm owner’s concerns about the costs and risks associated with climate change and ensure the firm’s survival over the long run. We characterized the structure of the equilibria under a precommitted emissions tax and a monopolist firm characterized by separation of ownership and management. Under an emissions tax, the firm owner writes its CEO remuneration contract as partially related to the firm’s profits and abatement outcome through investment in environmental R&D.

By comparing the equilibrium outcome of the conventional CEO compensation package with that of the new CEO remuneration scheme that is partially related to performance in environmental R&D, the results are derived as follows: (i) the environmental R&D investment is higher, which in turn allows for higher production under the new wage scheme; (ii) under such a cooperative arrangement, the government sets a lower emissions tax level; (iii) the social welfare is higher through more consumer and producer surplus with environmental improvement under the new CEO wage structure; (iv) as long as investment in R&D is substantially costly and inefficient, the firm reaps higher profit under the new wage scheme.

There are direct policy implications for such a potential cooperative mechanism. Environmental improvement through the cooperation of the government and private sector achieves better results than the efforts of a single entity. The government should be committed to implementing the emissions tax so that it sends a clear signal about the future price of pollution. In response, firms should be encouraged to include explicit abatement targets when formulating their CEO wage contracts. A prospective arrangement is to engage in cooperative resolution between the government and firms to ensure social welfare improvement. A foreseeable outcome of such cooperation is that firms will be able to negotiate for a lower emissions tax as long as the executive compensation is shown to include measurable environmental targets such as reduction in energy intensity, various greenhouse gas emissions, and radioactive waste. In view of the wide adoption of voluntary pollution reduction (VPR) programs in the United States and Europe, the new CEO compensation design can also be encouraged through the VPR arrangement between the regulator and private firms.

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