H-11 Empirical Studies on the Policy Instruments (Emission Trading, Environmental Tax, Voluntary Program, etc.) for the Compliance with Kyoto Protocol (Abstract of the Interim Report)

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1. Introduction and Research Objectives

For the policy design to comply with the target set by Kyoto Protocol, the carbon tax, emission trading, voluntary program, etc have been more important policy instruments. However, there are few empirical studies by econometrics of the impact of these instruments on the behavior of the firms in Japan.

The purpose of this project is to analyze how the policy instruments affect the decision making of each facility or firm using the facility or firm level micro data.

This project consists of the following 3 sub-projects.

(1) Empirical Studies on the Effect of the Environmental Tax on the Behavior of the Firm
(2) Empirical Studies on the Voluntary Action of the Firm
(3) Studies on the Emission Trading – Empirical Studies on SO2 Allowance Market

The research objectives of each subproject are as follows.

(1) Empirical Studies on the Effect of the Environmental Tax on the Behavior of the Firm

We explore the impact of policy instruments on environmental burden from the facilities using cross-section data which we collected by conducting the facility survey.

(2) Empirical Studies on the Voluntary Action of the Firm

The first objective is to explore the incentive of the voluntary action of the firm. We especially focus on the adoption of the environmental management system, ISO14001, as

the voluntary action.

The second objective is to examine whether the market values the voluntary action such as introduction of the environmental management system. We analyzed the impact of the acquisition of the certification of eISO14001 on Tobin's q representing response of the stock market.

(3) Studies on the Emission Trading – Empirical Studies on SO2 Allowance Market

The research consists of two parts. Each part has following objectives:

A) Part A investigates electric utility behavior under the SO_2 allowance market in Phase

B) Part B examines banking by quantifying the cost savings due to allowance banking. Further, it investigates effectiveness of bonus allowances for installing a scrubber.

2. Research Method and Results

(1) Empirical Studies on the Effect of the Environmental Tax on the Behavior of the Firm

We explore the continuous impact of the policy instruments on the reduction in the environmental burden by facilities. For firms' environmental performance, we use self-reported ordered responses obtained from a survey.

In the survey, each facility is asked how the environmental burden (the resource (energy, water, etc) use, air pollution emission, etc) per output has been changed in these three years. Therefore we apply the ordered probit model to the facility's environmental performance function. We should note that we use the change in the environmental burden per output as a dependent variable. This enables us to explore what types of variables, especially the policy instruments (performance standard, environmental tax, etc), give the facilities the continuous incentive to reduce the environmental burden.

We develop two environmental performance models for the resource use and air pollution separately to investigate the continuous impact of the policy instruments on the environmental performance.

Our main findings are as follows;

(a) The facilities implementing the environmental management have an incentive to continuously reduce the resource use and the air pollution.

(b) The policy instruments such as performance standard, environmental charge, etc. give the facilities no incentive to make an effort to continuously reduce the environmental burden.

(c) The facilities with the pressure from the bank have more incentive to continuously reduce the environmental burden.

(2) Empirical Studies on the Voluntary Action of the Firm

We have made 2 analyses in this subproject.

(a) Analysis on the incentive of the firm to acquire the certification of ISO14001.

We have developed an econometric model to explore the incentive of the firm to adopt ISO14001. We apply the probit model to the model for adoption. The estimation is conducted using the data of the publicly held firms in the first section of the Tokyo Stock Exchange in September 2002.

From the estimation results, we obtain the following conclusions.

① The firm with smaller scale has less incentive to be certified by ISO14001.

② The firms in the medical industry, the metal industry, the automobile industry, the precision machinery industry have less incentive to be certified by ISO14001.

③ The firms with larger R&D and more export less more incentive to be certified by ISO14001.

(b)Analysis of the market: Does the stock market values the firm certified by ISO14001?

Following Konar and Cohen (2001)[1)], we investigate the relation between Tobin's q and the acquisition of the certification of ISO14001 for the objective of this analysis. Tobin's q is an index of the valuation of the firm by the stock market. This means that the stock market values it by more than its tangible asset, if Tobin's q of a firm is more than 1 and that otherwise, the market values it by less than its tangible asset.

Estimation result shows that the parameter on ISO14001 adoption is positive and statistically significant at the 1% level. From this result, we can conclude that the market positively values the acquisition of the certification of ISO14001 and that it probably gives the incentive of the firm to be certified.

(3) Studies on the Emission Trading – Empirical Studies on SO2 Allowance Market

A) In order to investigate electric utility behavior under the SO_2 allowance market in Phase I, we estimated a probit model of fuel switching using information on Phase I units.

B) We constructed a dynamic programming model of power plant mangers who makes decision on 1) fuel switching, 2) scrubber installation and 3) purchase of the allowance over years. Then, the paper characterizes the dynamic equilibrium of the allowance market by giving attention to allowance banking and the dynamic discrete choice of scrubber installation. Finally, the dynamic programming model is numerically solved *with* and *without* allowance banking.

Our main findings are as follows,
A) The probit model shows that cost recovery rules promoted high sulfur coal usage for utilities located in states with coal mines. A simulation shows that protecting these local coal industry increased high sulfur coal usage by 50%. Another finding is that the uncertainty of PUC regulations pushed utilities from the allowance market toward fuel switching/blending. Since the second effect was stronger than the first, the overall PUC regulations contributed to an unexpectedly low allowance price at the beginning of Phase I

B) The cost savings by trading through time is fairly large though it is relatively small compared to the savings by trading across spaces. Moreover, banking can potentially decrease unnecessary investment in pollution abatement technology. The effectiveness of bonus allowances is confirmed.

3. Discussion

Even if some environmental policy is implemented, the environmental burden from facilities continues to increase in accordance with the economic growth. Hence, it is important to examine the policy which can give facilities the incentive to continuously reduce the environmental burden. In the first study (Empirical Studies on the Effect of the Environmental Tax on the Behavior of the Firm), we find that the conventional environmental policy instruments can not give such an incentive to facilities. On the other hand, we find that existence of the pressure from the bank and adoption of environmental management system(EMS) contributes to giving such an incentive to facilities. The disclosure of the information on the environmental performance of facilities/firms enables banks evaluate the facilities/firms properly in lending money. The pressure from the bank based on proper evaluation gives a proper incentive to facilities. These findings suggest that information disclosure and encouragement of EMS play an important role as the complementary policy to the conventional policy instruments.

In the second study (Empirical Studies on the Voluntary Action of the Firm), we find that the Japanese financial market positively values adoption of ISO14001, a kind of firm's action to improve environmental performance. Hence the market gives the firms an incentive to self-regulate to improve their environmental performance. This suggests that the disclosure of the information on the firm's environmental performance plays an important role to enable the market evaluate the firms based on proper information.

In the third study (Studies on the Emission Trading – Empirical Studies on SO2

Allowance Market), the results from substudy (A) shows the importance of clarities on accounting rules on emission trading and the results from substudy (B) show that the amount of the cost savings due to banking is limited. This result indicates the importance of incorporating low/medium income economies with low marginal abatement cost into the Kyoto Protocol through clean development mechanism and international emission trading.

Reference

1) Shameek Konar and Mark A. Cohen (2001), "Does the Market Value Environmental Performance?," ***The Review of Economics and Statistics*** , Vol.83, No.2, pp.281-289