

[AN OPTIMAL PRINCIPAL--AGENT HYBRID POLICY MODEL OF CARBON TAX AND EMISSION ALLOWANCE UNDER ASYMMETRIC INFORMATION]

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Keywords

hybrid policy; carbon tax; emission allowance; contract theory; asymmetric information

Overview

Different from the existing literature, we apply contract theory in this paper to study a hybrid policy with consideration of carbon tax and emission allowance under asymmetric information, in which the government (principal) is not able to observe the output type of the firm (agent). Thus, a principal--agent hybrid policy model considering both differential carbon tax rate and differential emission allowance is built to maximize the government's expected utility. Then, the equivalent formulation of this model is subsequently presented and the first-order condition is adopted to obtain the optimal solutions. Next, three degenerated models are set up to compare with this equivalent formulation for choosing the optimal hybrid policy. The results indicate that the policy including both differential carbon tax rate and differential emission allowance is the optimal hybrid policy. In addition, the carbon tax rate of the low-output-type firm would be higher than that of the high-output-type firm due to the information rent induced by asymmetric information. Finally, one numerical example is given to illustrate the effectiveness of these proposed models.

Methods

Under contract theory, a principal--agent hybrid policy model considering both differential carbon tax rate and differential emission allowance is built to maximize the government's expected utility. Then, the equivalent formulation of this model is subsequently presented and the first-order condition is adopted to obtain the optimal solutions. Next, three degenerated models are set up to compare with this equivalent formulation for choosing the optimal hybrid policy.

Results

The results presented that the hybrid policy considering both differential carbon tax rate and differential emission allowance is the optimal one. In this optimal hybrid policy, the carbon tax rate of the low-output-type firm is higher than that of the high-output-type firm due to the information rent induced by asymmetric information. It is noteworthy that, different from the existing researches, our paper focuses on designing the hybrid policy considering the firm's output type as asymmetric information rather than empirical analysis or known information.

Conclusions

This paper built a principal-agent model considering both the optimal hybrid policy of carbon tax and CO₂ emission allowance. Here, the government as a principal faces the firm with unknown output treated as private information. A hybrid policy model of differential carbon tax rates and differential emission allowance was built with the purpose of maximizing the government's expected utility. The equivalent formulation of this model was subsequently presented and the first-order condition was adopted to obtain the optimal solutions. Next, three degenerated models were set up to compare with the equivalent formulation for choosing the optimal hybrid policy. The results presented that the hybrid policy considering both differential carbon tax rate and differential emission allowance is the optimal one. In this optimal hybrid policy, the carbon tax rate of the low-output-type firm is higher than that of the high-output-type firm due to the information rent induced by asymmetric information. It is noteworthy that, different from the existing researches, our paper focuses on designing the hybrid policy considering the firm's output type as asymmetric

information rather than empirical analysis or known information. One numerical example was given to illustrate the effectiveness of the proposed model and the result implies that the government prefers to stimulate the firm to produce by allocating more emission allowance when the firm is low output type, but prefers to control CO₂ emissions by decreasing allowance when the firm is getting high output type.

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