The Effect of Using Carbon Tax Revenue on Green Technology Innovation
- Based on R&D Expenditure -

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Overview

There are many challenges that Korea should face in relation to environments such as climate change and environmental degradation, energy problem, reduction of CO2 and pollutants and so forth. During the rapid economic development in Korea, environmental problems did not receive much attention and stronger emphasis was given on economic development as environment and economic development could not go together.

Green technology innovation is the essence to achieve green growth. Green growth committee defines green growth as a strategy to minimize environmental load based on new green technologies and achieve economic growth by advancing into the world market with the newly developed green technologies.

The purpose of this study is to estimate carbon tax revenue and to conduct quantitative analysis for the effect on the number of green technology related patent applications that are the representative index of green technology innovation when the carbon tax revenue is used for R&D expenditure as a method to use it.

Methods

In order to R&D expenditure we construt the panel data which inclide 10 selected industrial data and the time series data from 2000 to 2009. And then we perform the pooled OLS, fixed effects and randome effects estimation models. In addition, we divied R&D expenditure data into 3 categorries, public sector, private setor, and total R&D expenditure to provide R&D expenditure elasiticity of green technology innovation proxied by patent application.
The concrete function is as follows.

$$\log(\text{Patents}_{it}) = \beta_0 + \beta_1 \log(\text{Value}_{it}) + \beta_2 \log(\text{Asset}_{it}) + \beta_3 \log(\text{Wage}_{it}) + \beta_4 \log\left(\text{R\&}D_{itj_{123}}\right) + \epsilon_{it}$$

Here i means 10 industries and t means the period from 2000 to 2009. j_{123} means total R&D, public sector R&D that include the government and public institutions and the private sector R&D.

The dependent variable is the number of patent applications. The patent, which is the proxy index of technology innovation activity includes patent application and patent registration data. The dependable variables that affect the number of patent applications for each industrial area include value added, tangible fixed assets, level of wage, total R&D expenditure, R&D expenditure of the government and public institutions and the R&D expenditure of the private sector. All variables went through log transform.

Results

First, the element that significantly affects the green technology innovation for each industry appeared to be labor cost. The level of wage, which is the proxy variable of labor cost, is analyzed to have a negative correlation with the number of green technology related patent applications, which is the proxy variable of green technology innovation activity, and an industry with a high level of wage can have negative effects on green technology innovation activity.

Second, as a result of estimating carbon tax revenue, the carbon tax estimation for each energy source will be between 9 trillion and 300 billion won and 10 trillion and 600 billion won.

Third, we found that there is a positive correlation between the R&D expenditure for each area and green technology innovation and the effect appeared to be different. The public sector R&D expenditure was analyzed to have a bigger coefficient than the private sector R&D expenditure, and it was revealed that the public sector R&D expenditure has bigger effects on green technology innovation.

Fourth, in the R&D expenditure for each area, public sector R&D expenditure was analyzed to have a bigger elasticity about green technology innovation. While 1% increase in the public sector R&D expenditure brings 1.737~1.897% increase in green technology related technological innovation, the private sector R&D expenditure has the elasticity of 0.778~0.991% about green technology.

Fifth, when the estimation equation of log linear model was converted into amount variable and the effect of a unit (million won) of R&D expenditure for each area on the number of green technology related patent applications was estimated, it was revealed that the number of green technology related patent applications increased by 2.3~2.8 cases by a unit of the total R&D expenditure. The public sector R&D expenditure and the private sector R&D expenditure were analyzed to increase 5.7~6.7 and 2.2~2.7 cases per a unit of expenditure.

Conclusions

The implication of the research is that the use of carbon tax revenue on R&D investment when carbon tax is introduced in Korea and its effect on green technology innovation were analyzed quantitatively. When considering the use of carbon tax in the future, this thesis can be used as a policy data to use carbon tax revenue for R&D expenditure in order to encourage green technology innovation activity by considering the characteristic of corporations as well as the characteristics of industries. However, the limits of the research are as follows. The technology innovation activity is one of corporation's strategies to have competitiveness and therefore direct support is necessary for the corporation and analysis is necessary about whether R&D expenditure through corporate analysis can be effective on green technology innovation activity in which corporate characteristic and environment. In addition, it is necessary to analyze the effect of green technology related R&D expenditure on green technology rather than R&D expenditure for each financial resource for the sake of precise analysis. Such analysis will remain as study assignment for the future.

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