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Deregulation in an energy market and its impact on R&D for low-carbon energy technology

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Abstract

This paper analyzes the impact of deregulation in an energy market on R&D activities for new energy technology when climate policy is implemented. A model of growth with vertical innovation is modified by including an oligopolistic energy supply sector for demonstrating to what extent deregulation in the energy supply sector will affect R&D activities for low-carbon energy technology, provided that carbon taxation is implemented. The analysis shows that, when the elasticity of substitution between input factors is less than unity, deregulation will drive energy R&D activities and reduce CO_2 accumulation if the energy market is highly concentrated in the beginning.

JEL Classification: L43; O32; Q28

Keywords: Deregulation; R&D behavior; Environmental policy

1. Introduction

This paper analyzes the impact of deregulation in an energy market on R&D activities for new energy technology when carbon taxation is implemented. A model of growth through creative destruction (Aghion and Howitt, 1992) is modified by including an oligopolistic energy supply sector, which demonstrates to what extent deregulation in the energy sector will affect R&D activities for low-carbon energy technology. In this analysis, when the elasticity of substitution between energy and labor is less than unity, deregulation

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will drive such R&D activities and reduce CO_2 accumulation if initially the energy market is highly concentrated.

Imperfections in energy resource markets have been considerably discussed ever since the 1970's oil shock period. Existing articles such as Dasgupta and Heal (1979) and Stiglitz and Dasgupta (1982) examine the extent to which market structures have an impact on an optimal depletion schedule of natural resources. Currently, deregulating energy supply sectors and enhancing market competition are one of the prevalent issues of public policy in developed countries for increasing efficiency of economies. In Europe, for instance, the markets of electricity and natural gas have been deregulated for the last decade. Power lines as well as gas pipelines are networked through all of Europe, and not only firms in a single market but also those in both markets compete with each other. In the U.S., deregulation in the power industry has been accelerated, although the effort has been hampered possibly by a failure in the deregulation process. In Japan, the deregulation of both electricity and natural gas markets is underway and progressing gradually.

However, what kind of consequences deregulation would have on R&D activities for new energy technology has not been intensively discussed so far. With regard to the technological aspect for tackling climate change issues, technologies decreasing ''carbon intensity,'' i.e., the amount of carbon emitted per unit of energy consumed, as well as those increasing ''energy efficiency,'' that is, the amount of energy consumed per unit of output, are essential for balancing economic growth and the mitigation of the problem. While a number of theoretical analyses shed light on the role of endogenous technological change for increasing energy efficiency,[1] this analysis focuses on improvements in carbon intensity, such as the development of photovoltaic technology. In the meantime, the impact of environmental taxation on R&D activities in general has been extensively examined by such as Verdier (1995); Elbasha and Roe (1996); Grimaud (1999); Ricci (2002) and Nakada (2004).[2] Therefore, the paper pays more attention to the impact of deregulation than the role of environmental policy on R&D activities for energy technology, although the implementation of appropriate climate policy or alternative energy policy is prerequisite for the analysis. Whether deregulating energy markets by increasing the number of energy suppliers affects R&D activities for new energy technology negatively or positively is analyzed, provided that a carbon emission tax is implemented.

On the one hand, deregulation may have an adverse impact on technological development. As the new growth theory (Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992) describes, monopolistic rent from product markets is the main source of technological progress. Thus, enhanced market competition negatively affects technological progress (Xie, 2000). A number of empirical studies, Scherer (1967) for instance, have displayed that firms with higher market shares tend to have higher rates of R&D and innovate more. In the context of energy market, the argument implies that

[1] Those who are interested in energy efficiency arguments should consult such as van Zon and Yetkiner (2003) and Mulder et al. (2003).

[2] The overlapping-generations model is intensively applied for examining the impact of environmental policy on economic growth by such as John and Pecchenino (1994); John et al. (1995); Ono and Maeda (2002) and Ono (2003).