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WHAT FACTORS INFLUENCE INNOVATIONS IN CLEAN COAL TECHNOLOGIES?

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OVERVIEW

At present, the greatest share of electricity generation is based on conventional fossil fuels. This share amounts to 70%, coal accounts for more than half of it. Given that global electricity demand will almost double until 2030, coal will remain an important resource for the production of electricity in the near future. It is unlikely that alternative energy sources are able to substitute fossil energy carriers completely. “Clean coal technologies” seem to offer one possibility to achieve the aims of using coal as energy carrier and simultaneously reducing emissions. In this paper we examine innovative activities in selected clean coal technologies by the use of patent counts as an output measure of innovation. In an empirical analysis using panel data from 22 countries for the time period between 1974 and 2005 we examine determinants of patenting activity in the field of clean coal technologies. The dependent variable is patent counts as an output measure of innovation. Among our explanatory variables we consider coal-specific energy R&D expenditures, coal-generated energy consumption and variables indicating the ratification of the Kyoto Protocol.

METHODS

In our econometric analysis we examine determinants of this patenting activity. We use panel data of 22 countries from 1974 to 2005. The dependent variable is patent counts as an output measure of innovation. Among our explanatory variables are coal-specific energy R&D expenditures, coal production, dummies that indicate ratification of the Kyoto Protocol, and, as a control variable, total patent filings at the European Patent Office (EPO). An appropriate method when count data serve as dependent variable is to use a negative binomial model with fixed country effects. We estimate determinants of overall patent counts in clean coal technologies as well as for each single technology outlined above.

RESULTS

First results show that energy-related R&D investments in coal combustion are significant and positive. This outcome is in general not surprising and implies that higher investments in specific R&D induce higher patenting activity. Coal-generated electricity consumption as an indicator for the potential market size for innovations in clean coal technologies is only significant for CCS and for the total patent counts of both technologies. This outcome indicates that increasing demand for electricity does generally not result in a higher patenting activity for clean coal technologies. It is possible that an increasing market for electricity affects inventive activity in new energy types, e.g. renewables, and in technologies aiming at direct emission reductions (CCS) instead of fossil fuel technologies with higher energy efficiency. The impact of the Kyoto Protocol is significant and positive for CCS and not significant for IGCC. A possible reason is that the results of the Kyoto Protocol, e.g. support for tradable emission allowances, support for R&D on renewable energy types and also CCS,

may have led to more inventive activity in the field of renewables instead of promoting cleaner and more efficient ways of coal combustion. This explanation is supported by the fact that in the CCS regression the Kyoto variable is positive

CONCLUSIONS

Our findings suggest that there is a positive relationship between energy R&D for coal combustion technologies and patenting activity in the considered clean coal technologies. Moreover, coal-generated electricity consumption has in most cases no significant impact on clean coal innovations. The impact of the Kyoto Protocol is twofold. Whereas our outcomes indicate an increasing number of patents in the CCS field, no significant influence on IGCC inventions can be detected. One reason for this might be that signals sent in the Protocol resulted in more innovation in renewable energy types and mitigation technologies, such as CCS, in general. A high share of renewables may indicate stronger support by public authorities for this energy type leading to relatively higher expected returns of inventive activities compared to more efficient methods of coal combustion. Furthermore, a public opinion against fossil fuels in many countries might explain why the larger awareness of climate change issues since the 1990s did not result in higher inventive activities that increase energy efficiency of fossil fuel technologies.

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