IMPACT OF ENERGY-EFFICIENCY POLICIES ON INNOVATION: THE CASE OF LIGHTING TECHNOLOGIES

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Overview

Globally fostering low-carbon technology development is crucial to mitigate greenhouse gas emissions. This paper analyzes the effect of energy efficiency policies on lighting patenting between 1992 and 2007. Using global patent data from the European Patent Office World Patent Statistical Database, we use the average of minimum energy efficiency standards to capture the stringency of the energy efficiency policies across 19 OECD countries. We find strong evidence that domestic demand-pull and technology-push policies positively affect domestic lighting patenting. On the other hand, we only find strong evidence that domestic demand-pull policies positively affect foreign lighting patenting. These findings show the importance of demand-pull policies for low-carbon technology transfer. This paper's main finding underscores the importance of the international dimension of energy efficiency policies for successful low-carbon technology innovation.

Methods

To measure the dependent variable, we collected patent data from the EPO/OECD World Patent Statistical Database (PATSTAT) to analyze inventive behaviors related to LEDs and CFLs across countries. PATSTAT contains patents filed in more than eighty patent offices and includes more than sixty-five million patent applications and thirty million granted patents. However, PATSTAT has a significant missing inventor/applicant-country information problem, especially for Japanese patents. To overcome this challenge, we filled in the missing country information from two patent families (i.e., simple [DOCDB] and extended [INPADOC]), as well as the individuals' names and identification. In order to better count the number of patents by country, we alternatively use the fractional count in the robustness checks. This method improves the international comparability of patent counts (Hélène Dernis & Guellec, 2001).

To measure demand-pull policies, we use the stringency of energy efficiency policies. As we explained earlier, diverse policy instruments come into play jointly. Finding data that are comparable across countries to measure these policy instruments' stringency is challenging. One way to measure their stringency across countries is to use the average of minimum energy efficiency standards as a proxy for the level of demand-pull policies. This approach is similar to measuring the building codes' stringency using the U-values (Noailly, 2012). It is expected that the sign of the stringency energy efficiency policies is positive in econometric models.

To measure technology-push policies, we use one-year lagged RD&D expenditure as a proxy variable (Dechezleprêtre & Glachant, 2014). RD&D expenditure for nineteen countries is included in IEA's energy technology research and development database. Ideally, we need lighting energy efficiency RD&D expenditures, but it is not possible to use them due to missing data. So residential and commerical buildings, appliances, and equipment RD&D expenditures are the most granular data that is comparable across countries. It is expected that the sign of RD&D expenditures is positive.

First, we estimate the effect of domestic demand-pull and technology-push policies on domestic lighting patenting using a negative binomial model. Second, we estimate the effect of the domestic demand-pull and technology-push policies on the number of foreign patent applications related to energyefficient innovations in lighting technologies. To estimate the econometric models, we prefer the negative binomial model to the Poisson model due to over-dispersion issue. We also use conditional maximum likelihood Poission with fixed effects (Hausman, Hall, & Griliches, 1984). RD&D expenditure may generate a simultaneity issue because they are inputs of the innovation processes. To account for the potential endogeneity issue of RD&D expenditures, we use an instrument variable approach similar to Dechezleprêtre and Glachant (2014). We use RD&D expenditures in transport energy efficiency in the same country and year, thereby satisfying two conditions of an instrument's validity. First, they do not directly affect the number of lighting energy efficiency patents because they are different from a technological point of view. Second, they are positively correlated with appliance energy efficiency RD&D expenditure, as they are both energy efficiency RD&D expenditures. To check the model's robustness, we use the number of patents by fractional country counts by the extended patent family as a dependent variable.

Results

First, we use patent data to examine the effect of domestic demand-pull and technology-push policies on innovation activity in lighting technologies between 1992 and 2007. We find that both domestic demand-pull and technology-push policies positively affect domestic lighting patenting. Second, we estimate the effect of domestic demand-pull and technology-push policies on foreign lighting inventive activities. The estimation results produce strong evidence that domestic demand-pull policies positively affects foreign lighting patenting in the fields of CFLs and LEDs.

Consistent with previous studies such as Dechezleprêtre and Glachant (2014) and Peters et al. (2012), we show that domestic demand-pull policies can be an effective policy tool to drive domestic and foreign patenting. However, we cannot find any evidence to prove that domestic technology-pull policies affect foreign lighting patenting. This lack of evidence indicates that domestic technology-pull policies can only affect domestic lighting patenting. In other words, our findings indicate domestic RD&D funding does not induce innovation abroad. One possible explanation is domestic RD&D expenditures' relative lack of emphasis on foreign patenting.

Conclusions

This paper identifies the effect of domestic demand-pull and technology-push energy-efficiency policies on domestic and foreign patenting in the field of lighting technologies. We found that there is a significant positive relationship between the domestic demand-pull and technology-push policies on domestic lighting patenting in line with previous studies. We also find evidence that domestic demand-pull energy-efficiency policy stimulates foreign energy-efficiency inventive activity. In a nutshell, foreign inventors have greater responsiveness to domestic energy efficiency standards than domestic technology-push policies. Policymakers should pay attention to international dimensions of energy-efficiency standard setting because policy and innovation are intertwined in an international domain.

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