International Knowledge Spillovers from the Wind Power Industry: The Effect on Related Energy Machinery

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Overview

If a government adopts a fiscal R&D spending policy directed towards wind power technology other technologies might be crowded out due to fiscal constraints and changes in relative prices. The purpose of this paper is to provide an analysis of how the accumulation of wind energy patents and public R&D spending affected the domestic and neighboring country output of granted patents in the related energy machinery field. The econometric analysis, a negative binomial regression model, relies on a data set consisting of eight countries in Western Europe with the highest rates of patent production in the field of wind power between 1978 and 2008.

There is an increasing interest in assessing the effects of wind power R&D policies which plays an important role in stimulating innovation in the wind power sector (De Vries and Withagen, 2005; Johnstone et al., 2012; and Johnstone, Hascic, and Popp, 2010). The aphorism "a rising tide lifts all boats" is associated with the idea that the improvements for some will eventually lift everyone else up as well. The aphorism suggests an argument for public R&D spending in renewable energy technologies where the spending will enhance, and hence lift up, other technologies through knowledge spillovers (see e.g., Cohen and Levinthal, 1989; Hussler, 2004; Antonelli, 2008; Costantini and Crespi, 2008a; Antonelli and Quatraro, 2010).

However, while knowledge spillovers can have both a positive and negative effect there are also under investigated potential downsides with public R&D policies: crowding out effects are such downsides. The presence or absence of knowledge spillover (and possible crowding out effects) are likely to influence government policies on R&D spending (e.g., Söderholm and Sundqvist, 2007; Peters et al., 2012). There are incentives for national governments to be the second mover and free-ride on others' efforts (Fischer 2008; Jaffe, Newell, and Stavins 2005; Popp 2005). Private firms have, to some extent, also weak incentives to make R&D investments (Jaffe et al., 2005; Acemoglu et al., 2012, Aalbers et al., 2013). To our knowledge there are few spillover and R&D crowding out studies on renewable energy in general, and on wind power in particular.

In this paper the renewable energy spillover literature is extened to focused on intra-industry knowledge spillovers. I.e., how have the fiscal founding and development process of renewable energy affected (spilled over to) the development of related industry fields? T*wo* questions are considered.

- Knowledge spills over and investments in renewable energy have a positive effect on fields that are closely related (e.g., R&D investment in wind power machinery will enhance the output of other energy machinery as well).
- There is a crowding out effect. Where research is directed towards fields that are subsidized, and leaves other fields i.e. public allocation of R&D may drive out private investments (Baccini and Urpelainen, 2012).

The paper focus on EU 8, where there are good data from 1978 and onwards and also a considerable part of renewable energy research were done. For example, Breyer et al. (2010) found that 85–90% of global energy R&D was at least up until reassembly performed in OECD countries. The paper consern wind energy machinery field which is defined in a good way by the British patent office and the related energy machinery is a good other source of comparison.

Table 1: Related wind technology (Braun, 2010)

Field	IPC Classes	Except for wind technology IPC Class
Energy machinery	B23F, F01B, F01C, F01D, F03B, F03C, F03D, F03G, F04B, F04C, F04D, F15B, F16C, F16D, F16F, F16H, F16K, F16M, F23R	F03D

Methods

We follow the traditional knowledge production function framework for determining knowledge spillovers steaming from Griliches (1979, 1992, but also in Grafström 2017 and Grafström and Lindman, 2017). In our context this approach means, is laid out in equation (1), a production function of patents commonly encountered in the literature:

$$PC_{nt} = \beta_0 + \beta_1 RES_{nt-2} + \beta_2 R\&D_{nt-2} + \beta_3 K_{nt} + \alpha_n + \varepsilon_{nt}, \qquad (1)$$

where the dependent variable, PC_{nt}, is a count of energy machinery patents granted in country n (n = 1, …, N) for a given year t (t = 1, …, T). Public R&D expenditures $(R\&D_{nt})$, and the number of researchers per capita (RES_{nt}) are used to explain the general level of patents granted; these two control variables are lagged two years. For example, public R&D expenditures taking place in period t may lead to a patent application and, eventually, to a patent being granted no earlier than in period $t + x$ ($x = 2$) (Nicolli et al., 2012). K_{nt} is a domestic wind power energy machinery patent-based knowledge stock in country n in period t.

Results

By doing the above we achieve the following:

- Test for intra-industry spillovers within countries and across country boarders. The reason why this may be interesting is in part due the political economy of imposing stricter targets for renewable energy; if there are positive spillover effects there are more incentives for policy makers to fund research projects.
- The paper adds to the literature of economic growth concerning technological change.

The results show that an accumulation of a national wind power stock is a statistically significant determinant of a country's related energy machinery patenting outcomes. However, there are a crowding out effects of public R&D spending where the development in related energy technologies was negatively affected by an increase in public wind power R&D spending.

Conclusions

Public R&D spending might help to create long-term incentives for innovation and/or diffusion of new technology. Investments in public R&D to wind power may also be necessary for gaining absorptive capacity, and thus for being able to benefit from the knowledge development activities taking place in other countries. Nonetheless, the results concerning the presence of international knowledge from wind power to related industries seem to be there on a makro level but more precition of investigation is still needed, to determine this would require a more thorough method of investigation (e.g., addressing the exact channels through which such spillovers occur). For example, firm data could be used to look at domestic knowledge spillovers.

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