

Wind of change

On the use of patents in the wind power industry

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- Is the patent system an efficient instrument in promoting innovation?
 - Long-time debate: strategic behaviors and *patent thickets* may ultimately hamper technology development
- Subsequent issue: patent data is commonly used as a proxy for the innovative activity of firms or countries
 - Information widely available...
 - ... but relies on an alleged relationship between patent counts and the output of the innovative process
- This thesis analyzes the exact nature of the link between patents and innovation

- The promotion of *green* innovation
 - Consciousness about the global warming issue makes the advent of low-carbon technologies desirable
- Patents have a key role to play to that end
 - As a metric, to assess the direction of technical change
 - Made easier by the Y02 class of the Cooperative Patent Classification
 - As a policy instrument, to spur private investments in green R&D
 - *Fast-tracking* of green patent applications
- The case of the European wind power industry
 - Ambitious deployment objectives + massive public support
 - Objective, patent-independent measures of technical change

Research question

Can patents be safely used as a measure and a driver of technical change in the wind power industry?

- Do patent oppositions highlight strategic uses of patents?
➔ **Chapter 1**
- Distinguishing *product* patents from *process* patents:
➔ **Chapter 2**
- The more patents, the more innovation?
 - With respect to product innovation: ➔ **Chapter 3**
 - With respect to process innovation: ➔ **Chapter 4**

Chapter 1

Use or abuse of patent oppositions?

Context

- Any patent filed at the European Patent Office (EPO) can be challenged through the opposition procedure within a 9 months delay following its grant
 - Objective: correcting the first-stage examination process
 - Re-examination by the office can lead to opposition rejection, patent amendment or patent revocation
- Literature has shown that oppositions might be used for strategic purposes
 - Concept of *sham* oppositions
 - Around 25% of opposed wind power patents are finally upheld
- In this chapter, we rely on opposition data to assess whether wind patent holders behave strategically
 - We take full advantage of the available data

Methodology: two step procedure

- Step 1: determinants of probability and extent of opposition
 - Count data model : number of opponents per patent
 - Accounts for the over-representation of 0 values
- Step 2: determinants of opposition outcomes
 - Beta and inflated beta models
 - Accounts for the continuous nature of the amendment decision

Data: sample of 3,245 granted wind power patents filed at the EPO over the 1990-2019 period (among which 457 opposed)

- PATSTAT: collection of wind power patents and associated metrics
- ORBIS: information about applicants

Main results

- Strategic opposition is not a common practise in the wind power industry
 - Patents with high private value are more likely to be opposed...
 - ... but are also more likely to get their scope reduced in opposition
- Results suggest the absence of defensive blocking strategies
 - Patents filed close to their applicants' portfolio are more likely to be opposed...
 - ... but also more likely to “resist” oppositions
 - This suggests they are mostly not part of a fence surrounding a key technology

Chapter 2

On the identification of product and process innovations

Context

- Innovation is a multifacet notion
 - A careful analysis of the link between patents and innovation requires to account for this fact
- Patentable subject matters include *product* inventions as well as *process* inventions. In economic terms:
 - Product innovation translates into improvements in the performance of goods
 - Process innovation translates into lowering the cost of technologies
- Objectives of this chapter:
 - Identifying product, process and “mixed” patents
 - Exploring the (non) neutrality of public support to renewables

Methodology: text-mining techniques

- Set of product and process keywords from the literature
- Frequency in the occurrence of these keywords provides information about the product or process character of a patent
- The in-between case is considered: a given patent can contribute to both product and process innovation
 - Continuous measure of the “productness” of patents

Data: population of 5,478 wind power patents granted by the EPO between 1990 and 2017

- PATSTAT: identification of relevant patents
- EPO’s ESPACENET website: collection of patent descriptions

Main results

- Process innovation is gaining ground over time
 - The increase in the number of product patents has preceded the one of process patents
 - A relative switch operates from the mid-2000s and process innovation becomes more prominent
 - However, product innovation still dominates
- Public technology support is a legitimate candidate to explain these dynamics
 - A *feed-in tariff* scheme seems to favor process innovation, while a *carbon pricing* mechanism seems to foster product innovation
 - The latter is more sensitive to demand

Chapter 3

Do patent holders push the technology frontier forward?

Context

- The patent system is supposed to induce R&D effort from private actors
 - We can expect products incorporating the patented technologies to exhibit improved performance
- Relates with the concept of *social value* of inventions
 - Welfare derived from the set of available products
 - Based on both technical characteristics and the price of goods
- In this chapter, we wish to assess whether turbines from patent-holding manufacturers prove more efficient
 - In the absence of price information, the focus is on product patents (*cf* Chapter 2)

Methodology: frontier analysis, panel data analysis

- Data Envelopment Analysis is used to construct the *technology frontier*
 - Based on characteristics of individual turbines
 - Turbines entering the market at year t are considered innovative if they lie above the $t - 1$ frontier
 - Contributions of firms to technical change over time are computed based on the location of their turbines with respect to the frontier
- We assess the relationship between patent counts and contributions to technical change at the firm level

Data: 17 wind turbine manufacturers observed between 2000 and 2017

- THEWINDPOWER: identification of WT manufacturers, collection of technical information about turbines
- PATSTAT: patents held by these firms

Main results

- We highlight a positive and significant relationship between patent counts and contributions of firms to technical change
 - However, this effect is heterogeneous (e.g. conglomerates)
- Patented technologies reach the market after a 4-years period
 - Contribution to technical change is correlated with a 4-years lagged version of patent counts
- Importance of taking into account renewals and the product character of patents

Chapter 4

Patents, process innovation and the cost of wind turbines

Context

- Following the above discussion, one can wonder whether patents are helpful in promoting process innovation
- Literature has shown that patents are best suited to promote product innovation relative to process innovation
 - Secrecy appears as the main appropriability mechanism as process innovation is less subject to public scrutiny
 - Based on survey data
- This chapter dives into the relationship between patents and process innovation
 - On the basis of objective data

Methodology: discrete choice model

- Idea: all characteristics being equal, wind park developers select the less expensive turbine
 - Selection criteria: expected production, size (observed), price (unobserved)
- The unobservables reflects differences in prices charged by manufacturers
- Appreciation of the relationship between relative prices and patent counts

Data: 1,365 wind parks commissioned between 2008 and 2016

- THEWINDPOWER: commissioned turbines and reconstitution of the choice set
- GLOBAL WIND ATLAS: average wind speed at parks' locations
- PATSTAT: patent information

Main results

- Results suggest that process innovation effort translates into lower prices
 - Patents seem to prove useful in promoting process innovation
- Results from discrete choice modeling are consistent
 - The expected revenue from energy production affects the probability for a turbine to be chosen in a positive and significant manner
 - Wind farm developers tend to select smaller turbines: in line with the so-called *square-cube law* of wind power

General conclusion

- Based on the wind power case study, patents appear as efficient in their original purpose of promoting innovation
 - There is no evidence of the presence of strategic uses of patents
 - Patent counts are positively associated with improvements in the performance of turbines
 - Also, it seems there is a relationship between patent counts and process innovation
- This thesis supports the idea that patents can be safely relied on in the context of “greening” the economy
 - For instance, the idea of implementing a dedicated patent policy for green innovation should be given increased attention

Thank you for your attention!