A market for green patents? Analysis of ownership changes in environmental technologies from Spain.

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1. Introduction

**Aim**

Analyze the current situation of environmental innovation and the market for environmental technologies in Spain.
1. Introduction

Definition of technological eco-innovation

Alternative product or process innovations with a lower environmental impact than available technology (Carrillo-Hermosilla et al, 2009)
1. Introduction

Definition of transfer of technology

Formal and informal transmission of knowledge, skills and technology between organizations that allows the local context to get adapted to the demands of the environment by absorbing and spreading that knowledge, both within and between countries (Roessner, 2000; Chung, 2001; Kanyak 1985).
1. Introduction

Indicators to measure eco-innovation processes

Several indicators  Focus on patents  “Green patents” to designate patents in environmental-related technologies

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1. Introduction

Contribution of the study

1. Use of patent registers to assess to what extent environmental technologies have experienced changes of ownership
2. Focus on green technology transfer within a developed country
3. Preliminary analysis of the behaviour of green patent owners in Spain
4. Providing a first statistical light on the market for green patents of Spanish origin
2. Spanish context

In Spain...

- Renewable energy technology segment increased considerably from 2000 to 2009 because of regulation (REN21, 2013)
- Patents applications of Spanish residents in this field represented 0.9% in 2000 and 3.9% in 2009 (OEPM, 2010)
- Spain ranks fifth in the world ranking of countries with renewable energy technology patents applications (OEPM, 2013)
- Spain situation is good mainly in solar-thermal and wind energy technologies
- In the last decade companies have exceed individual inventors as main generators of innovation in green technologies in Spain (Casado and Calles, 2010)

Source: Own elaboration using IEA data

A market for green patents? Analysis of ownership changes in environmental technologies from Spain
2. Spanish context


European renewable energy patent applications of Spanish origin published in the period 2000-2013

Source: REN21, 2014

Source: Own elaboration using OEPM data

A market for green patents? Analysis of ownership changes in environmental technologies from Spain
Technology plays a relevant role in the reduction of environmental impacts and costs derived from mitigation and adaptation actions (Albino et al, 2014)

Ensuring the efficient allocation of environmental technology ownership is important to society in order to get the maximum diffusion to fight against environmental problems

The concept of "technology markets" is receiving increasing attention among researchers in economics and management of innovation (Meniere et al., 2012)

Transfer of green technology is influenced not only by IPR but also by regulation, human assets, networks and knowledge institutions among others (Johnson and Libecker, 2009)
2. Links to the existing literature

- Analysis, from an economic and econometric perspective, of technology transfer using national registries for US patents.
- Individual inventors and SMEs sell patents to a greater extent than big companies.
- Reallocation of technology from innovative small companies to big ones with complementary assets.
- Pr (patent trade) depending on several factors like the age and citations of the patent among others.
- Patent transfer varies with the technology field and the type of ownership.

**Meniere et al. (2012)**
- Analysis of patent market in France. French origin patents in INPI and EPO. Transfer of patents represent relatively low volumes, but with a strong increase 1997-2009. They show a higher quality than the average.
- Prevalence of patent portfolios transfers between companies and intra-group transactions.

**Dechezlepretre et al. (2011)**
- Patented inventions in Climate Change Mitigation (CCM) technologies and their transfer from 1978-2005.
- Quantitative description of geographic distribution and temporal trend of invention and diffusion of CCM technologies at global level.
- Technology transfer- high in the political agenda. Up to date, green tech. transfer mostly between developed countries.

**A market for green patents? Analysis of ownership changes in environmental technologies from Spain**
2. Links to the existing literature

Environment-related technology transfer

Legal links between companies

Technological field

Applicant typology

Reallocation of property rights

Market of property rights/Real transfer

Administrative transfer
- Administrative changes or changes of name
- Transfer between companies with parent-subsidiary relationships
- Transactions between applicants of the same patent

Commercial transfer
3. Data and methodology

a) The data

- PATSTAT- April 2014
- Patent applications filed from Spain related to the environment (Green patents)
- Resulting dataset: 1276 environmental EPO patent applications
- 52% are green patents in energy generation from renewable and non-fossil sources
- Period: 1979-2013

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3. Data and methodology

a) The data

31 environmental technologies after grouping some categories of OECD’s classification

Environmental related technologies classification

- General environmental management (5)
- Energy generation from renewable and non fossil sources (10)
- Combustion technologies with mitigation potential (4)
- Technologies specific to climate change mitigation (2)
- Technologies with potential or indirect contribution to emissions mitigation (3)
- Emissions abatement and fuel efficiency in transportation (4)
- Energy efficiency in buildings and lighting (3)
3. Data and methodology

b) The Methodology

- Number of requests for environmental patents filed by Spanish applicants at EPO between 1979 and 2013
- Property changes recorded in EPO on applications for environmental patents of Spanish origin
- Typology of property changes registered using BvD SABI on Spanish firms, corporate reports and internet searches and classification of environmental technology areas
- Type of environmental patent applicants in Spain
- Patent characteristics: granted, claims...
3. Data and methodology

b) The Methodology

1. Transfer of green patents: administrative vs. Real transactions
2. Transfer of green patents across type of patentees
3. Transfer of green patents across technology fields
4. Green patent characteristics and the transfer of green patents

Descriptive analysis
Probit model

A market for green patents? Analysis of ownership changes in environmental technologies from Spain
4. Main results

The patent registry documents provide insight into the types of applicants. Of the 1276 green patent applications, 22.81% have been granted to date.

Only 13% of patented environmental technologies have registered changes in ownership. 46.5% have been granted to date.

Just over a quarter of these changes can be considered truly business transactions (commercial transfer).

A market for green patents? Analysis of ownership changes in environmental technologies from Spain
4. Main results

Transfer of green patents: Administrative vs. Commercial transactions

Green technology transfer distribution by typologies (Commercial vs. Administrative)

- Commercial transfer:
  - Merger or acquisition: 2%
  - Sale: 57%
  - No info: 41%
  - N=49

- Administrative transfer:
  - Administrative/name change: 2%
  - Parent-subsidiary transfer: 13%
  - Applicant-company transfer: 51%
  - Transfer between applicants: 29%
  - N=123

Truly transactions are mainly due to mergers and acquisitions

Administrative transfers are mainly due to transactions between parent and subsidiary companies

Source: Own elaboration using PATSTAT information

A market for green patents? Analysis of ownership changes in environmental technologies from Spain
4. Main results

<table>
<thead>
<tr>
<th>Administrative change/Name change</th>
<th>Green patents with commercial transfer</th>
<th>Green patents with administrative transfer</th>
<th>Green patents without registered transfer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Administrative change/Name change</td>
<td>0</td>
<td>36</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>2. Parent-Subsidiary transfer</td>
<td>0</td>
<td>63</td>
<td>0</td>
<td>63</td>
</tr>
<tr>
<td>3. Applicant-company transfer</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>4. Transfer between applicants</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>5. Merger or acquisition</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>6. Sale</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Without specific info</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Without registered changes</td>
<td>0</td>
<td>0</td>
<td>1104</td>
<td>1104</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>123</td>
<td>1104</td>
<td>1276</td>
</tr>
</tbody>
</table>

Source: Own elaboration using PATSTAT information

- Although they are not commercial transfers, changes of ownership between companies in the same group represent 37% of registered changes.

- Conclusions of some studies demonstrate the importance of the subsidiaries as a driver of innovation (Tsai and Wen, 2009), but regarding intra-country transfers, we must consider the high probability that these intra-group transfers occur because of either institutional, economic or fiscal strategic reasons that have nothing to do with an intended acquisition of knowledge flows (De Vicente et al., 2010)
4. Main results

Transfer of green patents across technology fields

Environmental patent applications in Spain included in the sample and registered changes of ownership by technology

Source: Own elaboration using PATSTAT information
4. Main results

Analysing in which green technologies transfer is more dynamic...

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Green patents with commercial transfer</td>
<td>22.91%</td>
<td>52.08%</td>
<td>0%</td>
<td>0%</td>
<td>10.42%</td>
<td>16.67%</td>
<td>0%</td>
<td>49 (100%)</td>
</tr>
<tr>
<td>Green patents with administrative transfer</td>
<td>25%</td>
<td>52.42%</td>
<td>0.81%</td>
<td>0%</td>
<td>8.87%</td>
<td>8.06%</td>
<td>4.03%</td>
<td>123 (100%)</td>
</tr>
<tr>
<td>Green patents without registered transfer</td>
<td>29.26%</td>
<td>52.54%</td>
<td>1.09%</td>
<td>1%</td>
<td>6.07%</td>
<td>7.16%</td>
<td>2.90%</td>
<td>1104 (100%)</td>
</tr>
</tbody>
</table>

[Diagram showing the percentage distribution of green patents in different technologies.

Source: Own elaboration using PATSTAT information

Renewable energy and non-fossil generation technologies: the most dynamic/ Also IPR in these techs have been the most easily transferred in terms of total changes of ownership.]

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4. Main results

In relative terms compared to the total number of green patents in each field, specific technologies for propulsion using internal combustion engines (11.5%) and those for generating fuels from waste (11.1%) are both the categories which have registered more real ownership changes.

Although by groups in absolute terms renewable energy technologies are the ones with a higher number of commercial transfers, category by category, the largest transfer of technology can be seen in the group for reducing emissions and fuel efficiency for transport.
## 4. Main results

### Transfer of green patents across type of patentees

<table>
<thead>
<tr>
<th>Applicant</th>
<th>Typology of applicant</th>
<th>%</th>
<th>Typology of green patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamesa</td>
<td>Business group</td>
<td>8.94%</td>
<td>Wind/ Hybrid propulsion</td>
</tr>
<tr>
<td>Alstom</td>
<td>Business group</td>
<td>6.17%</td>
<td>Wind/ Solar PV</td>
</tr>
<tr>
<td>Abengoa</td>
<td>Business group</td>
<td>3.41%</td>
<td>Waste management/ Solar Thermal/ PV/ Hybrid/ Hydrogen/ Fuel cells</td>
</tr>
<tr>
<td>Consejo Superior de Investigaciones Científicas (CSIC)</td>
<td>Research Center</td>
<td>2.56%</td>
<td>Air pollution abatement/ water pollution abatement/ Waste management/Solar Thermal/ PV/ Biofuels/ CCS/ Hydrogen/ Fuel cells/ Propulsion using ICE/ Isolation</td>
</tr>
<tr>
<td>Acciona</td>
<td>Business group</td>
<td>2.41%</td>
<td>Air pollution abatement/ Wind/ PV/ Hydrogen/ Propulsion using ICE</td>
</tr>
<tr>
<td>Ingeteam</td>
<td>Business group</td>
<td>1.92%</td>
<td>Wind/ PV/ Hydrogen/ Hybrid propulsion</td>
</tr>
<tr>
<td>Exide Technologies</td>
<td>Business group</td>
<td>1.63%</td>
<td>Energy storage</td>
</tr>
<tr>
<td>Universidad Politécnica de Madrid (UPM)</td>
<td>University</td>
<td>1.28%</td>
<td>Water pollution abatement/ Wind/ Solar Thermal/ PV/ Non-conv. Hydro/ Energy storage/ Isolation</td>
</tr>
</tbody>
</table>

26% individual applicants among Spanish green patents applicants

74% others → 85% companies/15% universities or research centers

Green innovation in Spain is quite atomized. There is no a main agent

Gamesa with a 8.94% of the total green patent applications is the leader
4. Main results

<table>
<thead>
<tr>
<th>Type</th>
<th>Company</th>
<th>Univ/RC</th>
<th>Individual</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial transaction</td>
<td>45</td>
<td>1</td>
<td>3</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>3,53%</td>
<td>0,08%</td>
<td>0,24%</td>
<td>3,84%</td>
</tr>
<tr>
<td>Administrative transaction</td>
<td>95</td>
<td>10</td>
<td>18</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>7,45%</td>
<td>0,78%</td>
<td>1,41%</td>
<td>9,64%</td>
</tr>
<tr>
<td>No transaction</td>
<td>724</td>
<td>113</td>
<td>267</td>
<td>1104</td>
</tr>
<tr>
<td></td>
<td>56,74%</td>
<td>8,86%</td>
<td>20,92%</td>
<td>86,52%</td>
</tr>
<tr>
<td>Total</td>
<td>864</td>
<td>124</td>
<td>288</td>
<td>1276</td>
</tr>
<tr>
<td></td>
<td>67,71%</td>
<td>9,72%</td>
<td>22,57%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Pearson chi2(4) = 20,776  
Cramér's V = 0,091  
Pr = 0,000

There is a substantial difference in the rates of transfer across types of patentees.

Universities and Research Centers are the ones who show the lowest rate of transfer.
## Results of the probit model (Marginal effects)

<table>
<thead>
<tr>
<th></th>
<th>Change</th>
<th>Real Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant</td>
<td>0.1385***</td>
<td>-0.0245</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.090)</td>
</tr>
<tr>
<td>Claims</td>
<td>0.0046</td>
<td>0.1054</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.066)</td>
</tr>
<tr>
<td>Family_size</td>
<td>0.0053</td>
<td>0.1476*</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.082)</td>
</tr>
<tr>
<td>Bwd_citations</td>
<td>-0.0001</td>
<td>0.0760</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.057)</td>
</tr>
<tr>
<td>Applicant (ref: Firms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Univ/PRO</td>
<td>-0.0881***</td>
<td>-0.2615**</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.113)</td>
</tr>
<tr>
<td>Individuals</td>
<td>-0.0913***</td>
<td>-0.1931*</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.106)</td>
</tr>
<tr>
<td>Green technology field (ref: Renew/non-foss)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Env. Management</td>
<td>-0.0536**</td>
<td>0.0247</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.097)</td>
</tr>
<tr>
<td>Combustion mitigation potential</td>
<td>-0.1066*</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>(0.060)</td>
<td></td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Emission mitigation</td>
<td>0.0176</td>
<td>0.0698</td>
</tr>
<tr>
<td></td>
<td>(0.047)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>Efficiency transport</td>
<td>-0.0342</td>
<td>0.3463***</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.129)</td>
</tr>
<tr>
<td>Efficiency Buildings</td>
<td>0.0759</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>(0.084)</td>
<td></td>
</tr>
<tr>
<td>Fyear</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>1151</td>
<td>142</td>
</tr>
<tr>
<td>Wald Test (X²)</td>
<td>129.58</td>
<td>28.98</td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(0.000)</td>
<td>(0.088)</td>
</tr>
</tbody>
</table>

(***): Significant at 1% level  (**): significant at 5% level and (*): significant at 10% level.
5. Conclusions

- Market for environmental technology transfer in Spain is still small.

- Most of technologies that have experienced changes in ownership, have been through relationships between companies in the same group (37% of changes) → Administrative transactions.

- The patent sale or transfer by merger or acquisition is much smaller, representing only 27% of registered changes → Commercial transactions.

- Technologies related to energy generation with renewable energy and non-fossil fuels → most patented in Spain.

- Although, in absolute terms, the patents in wind energy have been the largest in number of registered changes, technologies for the improvement of internal combustion engines are the most dynamic in relative terms.

- Although innovation is highly fragmented in terms of the types of applicants, in Spain the private company profile dominates, being Gamesa Business Group who shows the higher percentage of total environmental patent applications (8.94%).

- Finally, from an econometric preliminary analysis the, likelihood of reallocation or trade may be influenced by the quality of green patents.
Thank you very much

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