Balancing basic and applied research outputs: a study of the trade-offs between publishing and patenting

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“Publications and patents: Mutually exclusive or complementary outputs of scientific research?”
Berbegal-Mirabent & Sabaté

Introduction

The context

- Universities play a **key role** in the provision of **knowledge** (Arbo & Benneworth, 2007)
- **Basic research** outcome is expected to turn out into **applicable results**
- **Controversy** in reorienting science to the needs of industry (Ranga et al. 2003)
  - Hypothesis of **complimentary versus rivalry** relationships between **basic** and **applied** scientific achievements (Klitkou & Gulbrandsen, 2010)

Research objectives

- Relationship between publishing and patenting
- Patterns followed by universities in the way they align their strategies with regard to publications and patents
Favorable regulatory environments for university’s involvement in commercialization (Calderini et al., 2007)

Duality of the academic career

Academic scientists build their careers upon reputation and accreditation systems.

Involvement in patenting derive from specific opportunities that emerge irregularly over an academic career (Calderini et al., 2007)

IPR laws entail publication restrictions → publication delays (Geuna & Nesta, 2006)

Papers as the main criterion for academic promotion (ANECA) (26-35% papers; 3-12% patents)
"Publications and patents: Mutually exclusive or complementary outputs of scientific research?"

**Literature Review**

**No effect**
- The adoption of an applied research orientation is not at the expense of publications
- Academic discoveries has no negative implications on publication counts

  - Czarnitzki et al. (2007), Van Looy et al. (2006)

**Positive effect**
- Patents and publications as complementary outputs
- Differences among fields
- Co-active researchers
- The probability to apply for a patent is related to previous experience in publishing


**Negative effect**
- Patenting suppresses scientific publishing
- Norms of secrecy and interdictions
- Patenting is a time-consuming task
- Lack of practice

Data & Method

Two-stage empirical analysis

- **Stage 1:** Potential drivers for publishing and patenting
  - Publications Model → Linear regression
  - Patents Model → Negative binominal regression

- **Stage 2:** Relationship between patents and publications
  - Accumulated number of patents vs. papers published → Linear regression
  - Patterns followed by universities → Cluster analysis

Sources of information

- **Data sources:** CRUE and RedOTRI
- **Sample:** Public Spanish universities (47)
- **Time span:** 2006-2010
1st stage: Potential drivers

Regressions

<table>
<thead>
<tr>
<th>Factor</th>
<th>Model 1: Publications</th>
<th>Model 2: Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>[DLF] PhD faculty (%)</td>
<td>0.6183 (0.4579)</td>
<td></td>
</tr>
<tr>
<td>[DLF] Faculty involved in KT activities (%)</td>
<td>0.5595 (1.2047)</td>
<td>0.5531 (0.8872)</td>
</tr>
<tr>
<td>[SLF] Staff library support (%)</td>
<td>0.7132 (0.4637)</td>
<td>4.3013** (2.0516)</td>
</tr>
<tr>
<td>[SLF] Staff research support (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[SLF] TTO staff in IPR tasks (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[KA] Papers Q1 (%)</td>
<td>2.2229** (1.0895)</td>
<td></td>
</tr>
<tr>
<td>[KA] Patents granted / invention disclosures</td>
<td>-0.2966 (0.4271)</td>
<td>0.0940 (0.0580)</td>
</tr>
<tr>
<td>[S] Age HEI</td>
<td>0.0858** (0.0420)</td>
<td>-0.0940 (0.0580)</td>
</tr>
<tr>
<td>[S] Age TTO</td>
<td>0.9253** (0.4323)</td>
<td></td>
</tr>
<tr>
<td>R&amp;D income</td>
<td>0.5034*** (0.1024)</td>
<td>0.1413 (0.2374)</td>
</tr>
<tr>
<td>Budget TTO</td>
<td></td>
<td>0.0473** (0.0213)</td>
</tr>
<tr>
<td>Polytechnic university</td>
<td>-0.2001 (0.1320)</td>
<td>1.0630* (0.5795)</td>
</tr>
<tr>
<td>Medicine school</td>
<td>0.0887 (0.1172)</td>
<td>0.7604** (0.3288)</td>
</tr>
<tr>
<td>University size</td>
<td>0.2376** (0.1422)</td>
<td>0.6382*** (0.2460)</td>
</tr>
</tbody>
</table>

Robust standard errors adjusted by heteroskedasticity are presented in brackets. *; **; *** indicate significance at the 10%, 5%, and 1%, respectively. * Significant without robust standard errors treatment.
2nd stage: Cluster analysis

Relationship between the accumulated number of Papers and Patents

Linear Regression

R²=0.163  p-value=0.009
Positive but moderated lineal relationship. Not conclusive.

Cluster analysis

Estimation of the number of clusters

A non-hierarchical cluster analysis (K-means)

Calinski & Harabasz (1974)
CH(k) = 4
(pseudo-F value=79.93)
2nd stage: Cluster analysis

Relationship between the accumulated number of Papers and Patents

C1 (n=4)
- Large universities
- Performance: low rates
- UZA: outperforming rates
- Relationship: inconclusive

C2 (n=21)
- Performance: the lowest
- HHRR: scare
- FR: constrained
- Relationship: no substitution

C3 (n=9)
- Young and large universities
- Performance: ↑ Papers, ↑↑ Patents
- HHRR: important
- FR: accessible
- Relationship: no substitution (polytechnic)

C4 (n=7)
- Performance: ↑↑ Papers / ↑ Patents
- UVA: Influential point
- Relationship: substitution
Conclusions

From the empirical analysis...

- Universities are carrying out basic/research activities at different levels of commitment
- Structural, normative and cultural factors are important
- Polytechnics may have a greater capacity to accumulate knowledge
- Regional factors may play a role (Cluster 3)

In terms of policy making...

- Design specific incentives to foster the valorization of academic research
- Commercialization activities should be fully integrated with mainstream research activities
Thank you!

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This study examines the relationship between academic publications and patents. First, we use regression models to investigate those factors that act as potential drivers when considering papers and patents individually. Second, we run a cluster analysis in order to test whether universities follow different patterns in the way they align their resources in regard to research objectives. The empirical application considers the Spanish public higher education system for the period 2006–2010. The overarching conclusion is that cross-fertilisation relationships between academic research and its commercialisation are found. There are, however, important differences in how universities are disseminating research results, particularly when we analyse the resources and capabilities universities possess. Results also stress the need to look at contextual and normative factors.

Keywords: linkages between science base and commercialisation; public research organisations; patents; publications; university; quantitative

1. Introduction

In a context where the intensity and the quality of university–industry links are assumed to generate technological spillovers and determine effective returns on investment in research, bridging the gap between science and industry has become a major concern for academics, managers and policy-makers (Lai 2011). A number of initiatives and regulatory frameworks have been established aiming at involving scientists in commercialisation activities and facilitating the usage and exploitation of scientific discoveries through appropriate property rights protection mechanisms. One example is the passage of the Bayh–Dole Act in 1980 in the USA and other similar favourable regulatory environments. The result is a natural increase in the number of patents granted to universities (Czarnitzki, Glanzel, and Hussinger 2007).

Patents are commonly seen as playing a major role in markets for intellectual property, facilitating the disclosure of technical information. Although they do not guarantee the future marketability of the technology, they represent a key tool for safeguarding its potential. However,
### Appendix - 2nd stage: Cluster analysis

**Relationship between the accumulated number of Papers and Patents**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Cluster 3</th>
<th>Cluster 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome</td>
<td></td>
<td></td>
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<tr>
<td>Papers (2006-10)</td>
<td>3,139.00</td>
<td>1,814.05</td>
<td>5,046.44</td>
<td>7,663.14</td>
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<tr>
<td></td>
<td>(1264.35)</td>
<td>(770.19)</td>
<td>(2242.783)</td>
<td>(3367.83)</td>
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<tr>
<td>Patents Granted (2006-10)</td>
<td>21.50</td>
<td>17.14</td>
<td>56.33</td>
<td>44.00</td>
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<tr>
<td></td>
<td>(16.03)</td>
<td>(12.92)</td>
<td>(41.57)</td>
<td>(19.37)</td>
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<tr>
<td>Age HEI</td>
<td>178.00</td>
<td>20.67</td>
<td>36.89</td>
<td>554.86</td>
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<tr>
<td></td>
<td>(208.04)</td>
<td>(7.05)</td>
<td>(6.97)</td>
<td>(114.60)</td>
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<tr>
<td>Papers Q1 (%)</td>
<td>46.00</td>
<td>45.60</td>
<td>46.40</td>
<td>45.40</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.06)</td>
<td>(0.03)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>R&amp;D income</td>
<td>25,559.34</td>
<td>15,653.84</td>
<td>62,626.99</td>
<td>53,206.10</td>
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<td></td>
<td>(17,109.62)</td>
<td>(8,535.59)</td>
<td>(28,828.61)</td>
<td>(18390.86)</td>
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<tr>
<td>University size</td>
<td>348,801.30</td>
<td>170,112.60</td>
<td>373,016.30</td>
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<td></td>
<td>(170,995.00)</td>
<td>(81,984.80)</td>
<td>(128,049.70)</td>
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<td>Age TTO</td>
<td>19.25</td>
<td>16.048</td>
<td>19.89</td>
<td>20.857</td>
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<td></td>
<td>(3.30)</td>
<td>(3.74)</td>
<td>(2.80)</td>
<td>(2.27)</td>
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<td>Budget TTO</td>
<td>208.77</td>
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<td>333,190.40</td>
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<tr>
<td></td>
<td>(86.07)</td>
<td>(42,809.59)</td>
<td>(103,834.60)</td>
<td>(131,779.80)</td>
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<td>Medicine school</td>
<td>1.00</td>
<td>0.76</td>
<td>0.67</td>
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<td></td>
<td>(0)</td>
<td>(0.44)</td>
<td>(0.50)</td>
<td>0</td>
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<td>Polytechnic university</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
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<td>0</td>
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<td>TTO staff in IPR tasks (%)</td>
<td>5.60</td>
<td>8.00</td>
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<td></td>
<td>(0.04)</td>
<td>(0.06)</td>
<td>(0.08)</td>
<td>(0.05)</td>
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<tr>
<td>Observations</td>
<td>4</td>
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