Universities and effective knowledge sharing:
Virtual integration vs. local needs

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Motivation

• Effective knowledge sharing: One of the features of the ideal European Research Area (ERA)
• ‘Both within and across borders’ (EC, 2007: 16)
• Clusters of partnerships with universities should ‘form and expand through virtual integration rather than geographical concentration’ (EC, 2007: 8)
• Public-private cooperation is a means for universities to ‘excel in addressing research and training needs at national and regional level’ (EC, 2007: 14)
• A policy need to map the degree of knowledge sharing inside and outside geographical borders
• And then, can we explain what we map?
But what is knowledge sharing?

- A term I have mainly seen in the ERA Green Paper (EC, 2007)
- No definition in there
- It takes place “notably between public research and industry”
- Related keywords: access to the public knowledge base; harmonised IPR; shared principles for knowledge transfer; cooperation between public research and industry; communication to the public at large of scientific knowledge
- In the literature on knowledge management, equivalent to knowledge flow
- Patent citation can be a good tool for analysis
Focus of this research

- Access to the public knowledge base
- Universities
- Patent citations
- In&out the country
Contributions of this research

• Theoretical explanation of access to the university knowledge base inside and outside national borders
• Patent citation analysis: from the usual distinction on the type of literature (patent vs. non-patent references) to a new one on the type of institution (university vs. non-university references)
• Measurement of the phenomenon at the macro level for a large number of countries
• Empirical explanation of observed variations
What does patent citation analysis already tell us about the geography of knowledge sharing?

- Inside and outside the country (Tijssen, 2001; Alcácer et al., 2009)
- Regional differences in the number of citations made (Acosta and Coronado, 2003)
- Distance and localisation (Jaffe and Trajtenberg, 1996; Almeida and Kogut, 1999; Thompson, 2006; Criscuolo and Verspagen, 2008)
Consequent hypotheses in the context of in&out

- Hypothesis 1 (distance). The larger the country, the higher the number of references to universities from the same country.
- Hypothesis 2 (localisation). The higher the share of research performed by firms in a country, the lower the number of references to universities from the same country.
- Hypothesis 2, quite intuitive, but… sure?
- Always based on samples from high-tech contexts.
Would Hypothesis 2 hold in other contexts?

- Not verified for a region with low absorptive capacity – the Valencian Community (Azagra et al., 2009)

- On the contrary, delocalisation

- A substantial reason to explain why: in regions with low absorptive capacity, innovation comes mainly from acquisition of foreign machinery

- A formal reason to explain why: in regions with low absorptive capacity, firms are more pushed to justify a certain degree of novelty and develop more international search strategies
The hypotheses to be tested – with Hypothesis 2 modified

• Hypothesis 1 (distance). The larger the country, the higher the number of references to universities from the same country

• Hypothesis 2 (delocalisation). The higher the share of research performed by firms in a country, the higher the number of references to universities from the same country
Patents data

- Production designed by IPTS
- Developed by INCENTIM and CWTS under the supervision of THG
- 649,156 direct EPO patents
- Source: PATSTAT
- Classified by applicant country
References data

- 1,938,818 references (3 references per patent)
- 20,630 identified university references (1%)
- Sources: PATSTAT (university-owned patents) and WoS (university-authored papers)
- Classified by country of cited university
- Match between applicant country and country of cited university: national (10%) vs. international (90%) university references
Panel

- 37 countries from Eurostat’s R&D statistics (99.9% of the patents)
- 18 years (1990-2007)
- 666 initial observations
Dependent variable

• Share of national university references over total number of university references
  
• $s_{NAT} = \frac{NAT}{UNIVREF}$

• $s_{NAT}$ exists only if $UNIVREF>0$

• Panel drops from 666 to 369 observations
The time stability in the share of national university references around 10%
The large variation across countries in the share of national university references

Non-EU average = 40%

EU average = 10%

United Kingdom, Belgium, Portugal, Czech Republic, Spain, Netherlands, Germany, Ireland, Hungary, Poland, France, Italy, Sweden, Denmark, Austria, Finland, Greece, Bulgaria, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Slovakia, Slovenia, United States, Russian Federation, South Korea, Japan, Switzerland, China, Norway
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Econometric model

- $sNAT = f(\text{research size, research structure, } z) + (\%BERD)$

- Still a large proportion of $sNAT=0$ (47%), ergo tobit models adequate
Independent variables

- Research size: GERD or its components (BERD, HERD, GOVERD, PNPERD)
- Research structure: sBERD, sHERD, sGOVERD, sPNPERD
- \( z \): GDP
- Source: Eurostat
- Panels drop to 250-325 observations
- Many of the variables, correlation over 0.9!
Initial models to be estimated

- $s\text{NAT}_{it} = f(GERD_{i,t-1}, s\text{BERD}_{i,t-1}, s\text{PNPERD}_{i,t-1})$
- $s\text{NAT}_{it} = f(BERD_{i,t-1}, s\text{BERD}_{i,t-1}, s\text{PNPERD}_{i,t-1})$
- $s\text{NAT}_{it} = f(HERD_{i,t-1}, s\text{BERD}_{i,t-1}, s\text{PNPERD}_{i,t-1})$
- $s\text{NAT}_{it} = f(GOVERD_{i,t-1}, s\text{BERD}_{i,t-1}, s\text{PNPERD}_{i,t-1})$
- $s\text{NAT}_{it} = f(PNPERD_{i,t-1}, s\text{BERD}_{i,t-1}, s\text{PNPERD}_{i,t-1})$
- $s\text{NAT}_{it} = f(GDP_{i,t-1}, s\text{BERD}_{i,t-1}, s\text{PNPERD}_{i,t-1})$
The evidence in favour of the hypotheses, including Hypothesis 2!

- All research size measures, positively associated to sNAT (H1✓)
- An unexpected result: GOVERD, the best predictor of research size
- sBERD, positively associated to sNAT (H2✓)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>sNAT</th>
<th>sNAT</th>
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</thead>
<tbody>
<tr>
<td>Number of observs.</td>
<td>256</td>
<td>323</td>
</tr>
<tr>
<td>Log likelihood function</td>
<td>-45</td>
<td>-42</td>
</tr>
<tr>
<td>ANOVA based fit measure</td>
<td>0.32</td>
<td>0.31</td>
</tr>
<tr>
<td>DECOMP based fit measure</td>
<td>0.42</td>
<td>0.41</td>
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</tbody>
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<tr>
<th>Coeff. (t-value)</th>
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</tr>
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<tbody>
<tr>
<td>Constant</td>
<td>-0.15 (-1.9) *</td>
</tr>
<tr>
<td>GOVERD</td>
<td>0.02 (10.35) ***</td>
</tr>
<tr>
<td>sBERD</td>
<td>0.21 (1.68) *</td>
</tr>
<tr>
<td>sPNPERD</td>
<td>-0.14 (-0.19)</td>
</tr>
<tr>
<td>σ</td>
<td>0.2 (15.99) ***</td>
</tr>
</tbody>
</table>
Limitations to live with

• Only access to the university knowledge base – for other aspects of knowledge sharing, other indicators needed

• Patent citations as indicators of knowledge flows – not direct causality links (Meyer, 2001), applicants vs. examiners references (Alcácer and Gittelman, 2006; Criscuolo and Verspagen, 2008; Azagra et al., 2009)

• Single-author university papers – representative? Little to do about it – perhaps robustness check, splitting sample by technology classes
Limitations to overcome

• Hypothesis and econometrics match, but what about descriptive results?
• UNIVREF, to be explained – tobit with selection
• Fixed effects, to be included
• z-variables, to be expanded, especially structure of economic sectors
Tentative conclusions

- Knowledge sharing as access to the university knowledge base: already very international and at a plateau
- Policy implication: understanding the limits of integration
- High variation across countries in the composition of access to the university knowledge base within and across borders
- Policy implication: refining objectives, not increasing everything but deciding where a country wants to go
- National absorptive capacity favours the share of access to the domestic university knowledge base
- Policy implication: increasing BERD faster than other components of GERD to enhance access to the domestic university knowledge base (i.e. reverting the current faster growth of HERD)
Other potential applications of the database on university references

- Breakdown by EU27 NUTS2 region
- ERA vs. non-ERA university references
- Distinction by type of university literature (paper or patent)
- Distinction by examiner and applicant citations
- Distinction by institutional sector of the applicant
- Link at the level of individual institutions with other databases, e.g. the R&D Investment Scoreboard
- The most referenced university contributions to patented inventions, etc.
- …and of course other possible uses for the patent data
A note on the determinants: lack of growth...
...compared to the growth of HERD

![Graph showing the growth of HERD compared to other indices from 1990 to 2006.](image)