IP and performance: Empirical evidence from the UK

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April 2009
WIPO-PPO-KIPO
Eastern European Regional Forum
Overview

- Overview of patenting & trademarking by UK firms with focus on small firms
- What do we know about the relationship between patenting and small firm performance?
- Innovation and survival of small firms
- Innovation and growth of small firms
- Innovation and inter-firm spillovers
The relation between small firms and IP

- SMEs may invest less in innovation because
  - Face higher risk & uncertainty (consequences more severe, e.g., bankruptcy)
  - Less able to diversify risk than large firm which spreads risk over many products/projects
  - Internal & external liquidity constraints

- SMEs may apply for less IP per innovation because
  - Lacking information about procedures
  - Cannot afford legal counsel
  - Cannot afford professional IP management
  - Fixed costs proportionately larger (cannot spread over range of projects)
  - Potential litigation costs extremely high

▷ Do we see too few innovative SMEs?
▷ Does the IP system help innovative SMEs?
Oxford Firm Level IP database (OFLIP)

Main characteristics:
- Covers population of UK firms over the period 2001-2005
- Firm-specific characteristics and information on IP
- Result of matching FAME database and firm-level IP datasets (Rogers et al., 2007)

Components:
- FAME
  - 2.04 mio active & 0.9 mio inactive firms
  - Allows to identify all firms entering and exiting
- UK IP Office: UK patents and trade marks
- Marquesa Ltd.: Community trade marks
- European Patent Office (EPO): EPO patents
- ZEPHYR: M&A
Define firm sizes according to EU definitions
- Large firms > £29 million assets (88,832 in 2005)
- £29 million > SMEs > £2 million assets (159,399)
- £2 million in assets < Micro (1,950,594)

Subsidiaries of large UK firms are not classed as SMEs/micro firms

Enormous differences in availability of data by size group - very little information available on SMEs and micro firms (total assets has largest coverage)
Some descriptive evidence
(Rogers, Helmers and Greenhalgh, 2007)
How many firms in UK use IP?

- Registered IP (UKP, EPO, UKTM, CTM)
- Over five year period 2001 to 2005
- 5.3% of large firms use some registered IP
- Figure much higher for largest few thousand
- 4.8% of SMEs
- 0.8% of micro firms
Number of UK and EPO patents by firm size category 2001-2005
Number of UK and Community trademarks by firm size category
2001-2005
Number of trademarking firms (UK and Community trademarks) by firm size category 2001-2005
## IP active SMEs and average publications (by sector, 2001-2005)

<table>
<thead>
<tr>
<th>Sector</th>
<th>UK TM</th>
<th>Av</th>
<th>Com. TM</th>
<th>Av</th>
<th>UK Pat</th>
<th>Av</th>
<th>EPO Pat</th>
<th>Av</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agric. Mining</td>
<td>420</td>
<td>1.6</td>
<td>148</td>
<td>1.7</td>
<td>35</td>
<td>2.1</td>
<td>38</td>
<td>2.1</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2,226</td>
<td>1.7</td>
<td>1,307</td>
<td>1.6</td>
<td>1,734</td>
<td>1.6</td>
<td>1,202</td>
<td>1.7</td>
</tr>
<tr>
<td>EGW, construction</td>
<td>204</td>
<td>1.4</td>
<td>33</td>
<td>1.5</td>
<td>94</td>
<td>1.4</td>
<td>33</td>
<td>1.3</td>
</tr>
<tr>
<td>Whole, retail, hotel</td>
<td>2,507</td>
<td>1.8</td>
<td>1,004</td>
<td>1.8</td>
<td>243</td>
<td>1.7</td>
<td>131</td>
<td>1.4</td>
</tr>
<tr>
<td>Transport, telecom.</td>
<td>292</td>
<td>1.7</td>
<td>154</td>
<td>1.6</td>
<td>43</td>
<td>5.0</td>
<td>26</td>
<td>2.3</td>
</tr>
<tr>
<td>Finance, real estate</td>
<td>445</td>
<td>1.5</td>
<td>150</td>
<td>1.3</td>
<td>21</td>
<td>1.2</td>
<td>15</td>
<td>1.2</td>
</tr>
<tr>
<td>Computer related</td>
<td>576</td>
<td>1.6</td>
<td>596</td>
<td>1.6</td>
<td>185</td>
<td>2.0</td>
<td>158</td>
<td>1.8</td>
</tr>
<tr>
<td>R&amp;D services</td>
<td>128</td>
<td>2.4</td>
<td>127</td>
<td>1.5</td>
<td>227</td>
<td>3.4</td>
<td>372</td>
<td>2.6</td>
</tr>
<tr>
<td>Business Services</td>
<td>1,383</td>
<td>1.6</td>
<td>699</td>
<td>1.6</td>
<td>321</td>
<td>1.9</td>
<td>262</td>
<td>2.3</td>
</tr>
<tr>
<td>Health, educ, culture</td>
<td>1,073</td>
<td>1.6</td>
<td>428</td>
<td>1.5</td>
<td>99</td>
<td>1.4</td>
<td>116</td>
<td>1.7</td>
</tr>
<tr>
<td>Missing in FAME</td>
<td>191</td>
<td>1.7</td>
<td>136</td>
<td>1.5</td>
<td>99</td>
<td>1.3</td>
<td>70</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>All sectors</strong></td>
<td>9,445</td>
<td>1.7</td>
<td>4,782</td>
<td>1.6</td>
<td>3,101</td>
<td>1.8</td>
<td>2,423</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Note: Columns show the number of IP active firms in each sector and also the average number of publications (or registrations for CTMs) for each firm.
Number of patents published by region (SMEs only, 2001-2005)
Number of trade marks by region (SMEs only, 2001-2005)
## Outcome of 2001 SME cohort in 2004

<table>
<thead>
<tr>
<th>Outcome in 2004</th>
<th>IP inactive in 2001</th>
<th>IP active in 2001</th>
<th>All firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Large</td>
<td>8,115</td>
<td>6.39</td>
<td>240</td>
</tr>
<tr>
<td>SME</td>
<td>98,974</td>
<td>77.96</td>
<td>2,460</td>
</tr>
<tr>
<td>Micro</td>
<td>13,200</td>
<td>10.40</td>
<td>265</td>
</tr>
<tr>
<td>Exited</td>
<td>6,673</td>
<td>5.26</td>
<td>155</td>
</tr>
<tr>
<td>Total</td>
<td>126,962</td>
<td>100</td>
<td>3,120</td>
</tr>
</tbody>
</table>

Note: $\chi^2$ test of differences between IP active and inactive significant at 1%.
Innovation and firm survival
(Helmers and Rogers, 2008)
Innovation and firm survival

- Large part of new firms fails:
  - Disney et al. (2003) for UK: Around 35% of new firms survive after five years
  - In our data around 30% of new firms survive five years
- Assume that failure is caused by
  1. Underlying quality of the firm’s idea relative to others in the market
  2. Resources available to the entrepreneur to capitalize on the idea
- IP as proxy for quality of idea, as well as resources (management and human capital)
- Does IP affect the most fundamental measure of firm performance - survival?
Survival rates for IP-active and IP-inactive firms
Survival rates across British regions

![Graph showing survival rates across British regions from 2001 to 2005 for different regions: South West, South East, London, East of England, East Midlands, Yorkshire, North West, West Midlands, North East, Wales, Scotland, and Highland. The graph displays the proportion surviving over the years with a downward trend for all regions.]
Failure rates of IP-inactive firms by county / unitary authority
Summary: Innovation and firm survival

- **IP matters**
  - 3,750 (2.3 %) of 2001 start-up firms IP-active - most common form of IP is UK trade mark
  - IP-active firms experience lower hazard rate of failure
  - Being a patentee reduces chances of exit (by 55% relative to non-patentee)
  - Addition of one UK patent reduces exit (40%)
  - Addition of one EPO patent reduces exit (41%)

- **Geography matters**
  - Large differences across regions
  - Not explained by range of industry and firm-level variables

- **Identification issue:** patentees may be better managed with better ideas?
Innovation and firm growth
(Helmers, 2008; Helmers and Rogers, 2009)
Innovation and firm growth

- Fundamental role of patents:
  - Allow innovators to profit from their inventions
  - Encourage entry of new firms based on inventions
- If true: Patenting firms and patenting start-ups in particular should be more successful than their non-patenting counterparts
- Very few studies about patent effect on firm growth
- Do patents improve performance measured as growth of start-up firms compared to start-ups that do not patent?
Challenges

■ Difficult to single out patent effect from confounding factors:
  1. Data availability on patenting of start-up firms
  2. Financial data on performance measure - before & after the patent filed, published or granted
  3. Absence of the counterfactual - need a control group of non-patentees
  4. Role of unobservables - spillovers

■ Link between patent value distribution and new firm performance distribution
  ⇒ Association of a firm’s performance and patenting activity may vary across the distribution of growth rates
  1. Need to track all outcomes
  2. Looking only at averages not sufficient to unveil patent effect

■ Use data on high- and medium-tech start-ups in UK (2000-2005)
Identification Strategy

- No data from a randomized experiment - firms choose whether to patent!

1 **Firm heterogeneity**: Restrict our sample to a cohort of high- and medium-tech firms incorporated in 2000
  ⇒ Assume firm incorporated to capitalize on a patentable invention made before date of incorporation

2 **Simultaneity between a firm’s decision to patent and its performance**: Decision to patent made *before* a firm starts competing in the market & ‘selection on observables’
  ⇒ Assume that a firm’s observed decision to patent conditional on determinants exogenous w.r.t. performance

3 **Selection bias due to firm exit**: Condition on firm’s propensity to survive ⇒ Model exit

4 **Unobserved localized spillovers**: Incorporate measure of spillovers based on geographical proximity
Identification Strategy - Time Line

- t-1
- t=0
- t=1
- t=5

Start
Patenting Decision
Growth Process
<table>
<thead>
<tr>
<th>Description</th>
<th>SIC-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of Chemicals and Chemical Products</td>
<td>24</td>
</tr>
<tr>
<td>Manufacture of Machinery and Equipment</td>
<td>29</td>
</tr>
<tr>
<td>Manufacture of Office Machinery and Computers</td>
<td>300</td>
</tr>
<tr>
<td>Manufacture of Electrical Machinery and Apparatus</td>
<td>31</td>
</tr>
<tr>
<td>Manufacture of Radio, Television and Communication Equipment</td>
<td>32</td>
</tr>
<tr>
<td>Manufacture of Medical, Precision and Optical Instruments</td>
<td>33</td>
</tr>
<tr>
<td>Manufacture of Motor Vehicles, Trailers and Semi-Trailers</td>
<td>34</td>
</tr>
<tr>
<td>Manufacture of Railway and Tramway Locomotives</td>
<td>352</td>
</tr>
<tr>
<td>Manufacture of Aircraft and Spacecraft</td>
<td>353</td>
</tr>
</tbody>
</table>
Density Distributions of Patenting vs. Non-Patenting Firms

![Graph showing density distributions for Patenting and Non-Patenting firms from 2001 to 2005.]

- The x-axis represents asset growth from 2001 to 2005.
- The y-axis represents density.
- Two curves are shown: one for Patenting firms and another for Non-Patenting firms.
- Patenting firms show a more centralized distribution around the x-axis, indicating a higher concentration of asset growth.
- Non-Patenting firms show a more dispersed distribution, indicating a wider range of asset growth values.
Nonparametric Quantile Regression Plot: Patenting vs Non-patenting Firms
Summary: Innovation and firm growth

- High-growth firms cluster
- Patenting firms are better at locating next to high-growth firms within a distance band of approximately 40 miles
  ⇒ Closeness to high-growth firms associated with considerable positive effect on own growth performance.
- Statistically significant effect of patenting on firm growth result of arbitrary linear parametric specification
- Using flexible functional form - no statistically significant effect of patents on firm growth
  ⇒ Patents do not have any statistically robust effect on firm growth.
Findings

- **Descriptive evidence:**
  - Evidence refutes view that small firms innovate less (proportionately) than larger firms.
  - Some evidence that SMEs gain from IP.

- **Innovation and firm survival:**
  - Evidence that survival positively correlated with IP.

- **Innovation and firm growth**
  - Little *robust* evidence for correlation between growth and IP.

- **Innovation and spillover**
  - Some evidence for importance for IP active firms of inter-firm spillovers.


