

# **IP and performance: Empirical evidence from the UK**

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# Overview

- What do we know about the relationship between patenting and small firm performance?
- Data on firm performance and patenting (& trademarking)
- Matching of data sets
- Definition of ‘small’ firms
- How to assess link between patenting and performance:
  - Patenting and survival of small firms
  - Patenting and growth of small firms

# 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) - Overview

Main characteristics:

- Covers population of UK firms over the period 2000-2007
- Firm-specific characteristics and information on IP
- Result of matching FAME database and firm-level IP datasets (Rogers and Helmers, 2009; Rogers et al., 2007)

## Oxford Firm Level IP database (OFLIP) - FAME

- Commercial database by Bureau van Dijk
- 2 versions of FAME ('inactive' firms kept only for 4 years)
  - October 2005: 2.19 million 'active' & 0.9 million 'inactive' firms
  - March 2009: 2.79 million 'active' & 1 million 'inactive' firms
- Available information:
  - Basic information: name, registered address, directors and registered number
  - Entry and exit dates (exit: dissolved, liquidated, entered receivership, declared non-trading)
  - If filed annual accounts, then financial data available
  - Availability varies substantially across firms
  - Smallest firms legally need only report very basic balance sheet data (shareholders' funds and total assets)
  - Largest firms provide a wide range of Profit and Loss information & detailed balance sheet data
- Due to unique identifier (registered number) data can easily be added: examples ZEPHYR M&A and Edina Digimap Code-Point data

# Oxford Firm Level IP database (OFLIP) - IP

- Patent data
  - PATSTAT (version September 2008): UK, EPO, and PCT patents
  - UK IP Office: UK patents and trade marks
  - Marquesa Ltd.: Community and UK trade marks
  - EPO ESPACE Bulletin: EPO patents

## Oxford Firm Level IP database (OFLIP) - MATCHING

- Method of matching: Company name from FAME and applicant name from IP data (IP data does not include registered numbers)
- Difficulties:
  - Need to 'standardize' names
  - 'Standardized' names different although same company
  - 'Standardized' names same although different companies
  - Name changes
  - Ownership structure
  - Ownership changes
  - Transfer of patents (exit or sell-off)
- Also matched directors' names...but even more difficult

## Oxford Firm Level IP database (OFLIP) - MATCHING SUCCESS

- Success difficult to assess
- No comparable matches of patents to UK firms
- Compare with official data on all patenting activity
- UK patents: Official sources count all patents from UK residents (corporate & personal)
- EPO patents: Official sources contain inventors which biases the number upwards
- FAME: Contains only registered firms



# Oxford Firm Level IP database (OFLIP) - PATSTAT MATCHING SUCCESS

**Table:** Benchmarking the matching outcome in 2003 (Rogers and Helmers, 2009)

	Official Data	Matched Data	Percentage (%)
UKIP - UK patents	5,708	3,555	62.3
EPO - European patents	6,786	4,793	70.6

*Notes:*

The number for 'Official data' for British-based applications published are from UKIP Office Facts and Figures 2004/5.

The EPO figure is obtained from PATSTAT.

## Oxford Firm Level IP database (OFLIP) - MATCHING SUCCESS

**Table:** Benchmarking the matching outcome in 2003 (Rogers, Helmers and Greenhalgh, 2007)

	Official Data	OFLIP Data	Percentage (%)
UKIP - UK patents	5,708	4,084	71.5
UKIP - UK trade marks	18,071*	12,484	69.1
OHIM - Community marks**	6,301	4,478	71.1
EPO - European patents	4,361	4,132	94.7

*Notes:*

The number for 'Official data' for British-based applications published are from UKIP Facts and Figures 2004/5.

\*Estimate of the number of publications based on UKIP correspondence. 21,260 applications in 2003 and UKIP estimate 85% are published. EPO and OHIM figures are taken from web-sites.

\*\* Community trade mark data refer to registrations.

For patents, official data refers to the nationality of first applicant, whereas our data are based on whether any applicant is British.

## Firm size

- Enormous differences in availability of data by size group - very little information available on SMEs and micro firms (total assets has largest coverage)
- Define firm sizes according to EU definitions
  - Large firms > £29 million assets (88,832 in 2005)
  - £29 million > SMEs > £2 million assets (159,399 in 2005)
  - £2 million in assets < Micro (1,950,594 in 2005)
- Firms with employment  $\geq 250$  reclassified as large (only around 3% of FAME firms report employment)

- FAME reports 'ultimate holding company' of any subsidiary based on last available accounts)
  - Micro or SME wholly-owned by large firm, reclassified as large
  - Micro wholly-owned by SME, reclassified as SME
  - If firm owned by two or more different sized holdings, reclassify into the largest holding firm size group
  - Reclassifying according to the size of their holding company only possible if data on holding company size available
  - Available for UK holding companies but not for foreign owned firms
- In general, when a firm has missing asset data it is classified as a micro firm
- Adjustment for missing accounting data - classify firms with missing data as the same category as the previous year

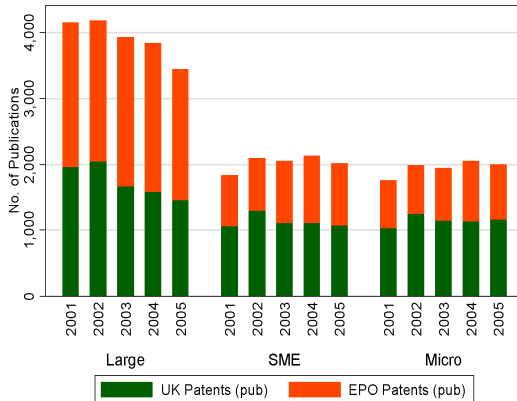
## **Some descriptive evidence**

(Rogers and Helmers, 2009; Rogers, Helmers and Greenhalgh, 2007)

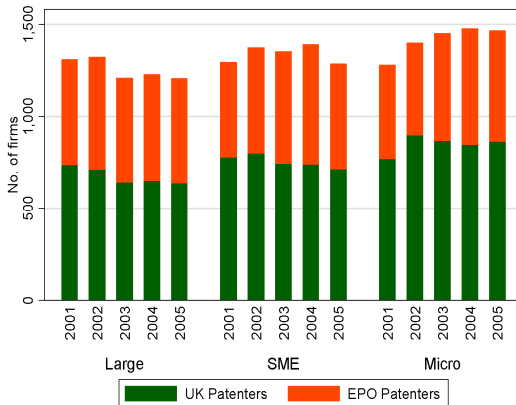
## How many firms in UK use IP?

- 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

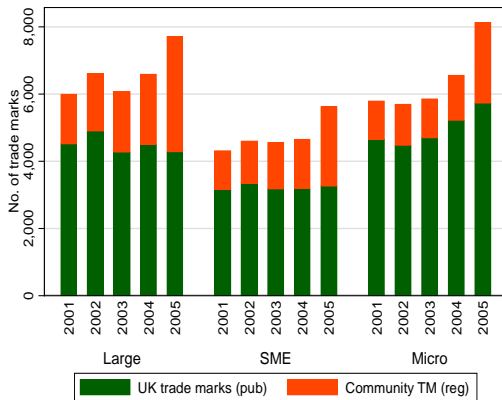


# Number of patenting firms (UK and EPO patents) by firm size category 2001-2005

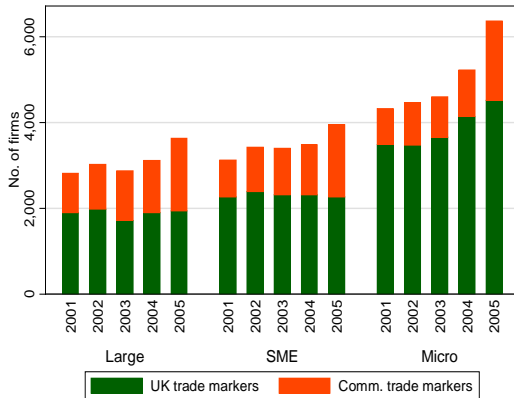




# Number of UK and Community trademarks by firm size category 2001-2005



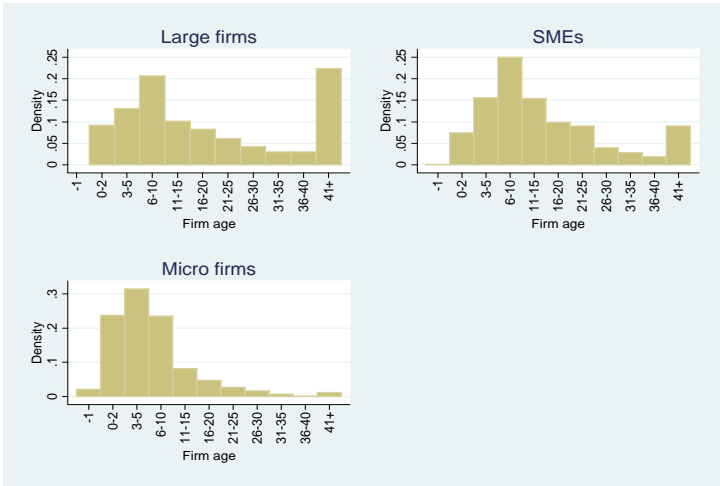
# Number of trademarking firms (UK and Community trademarks) by firm size category 2001-2005



## Micro and SME patenting activity, by sector (2000-2007)

sector	2000	2001	2002	2003	2004	2005	2006	2007
Agric./ Mining	30	29	55	41	45	33	38	44
High-tech	286	280	378	320	365	390	354	321
Medium-tech	334	310	378	341	320	379	354	355
Other Manufacturing	754	820	745	715	775	809	801	769
EGW, Constr.	64	55	99	101	93	94	107	108
Whole, Retail, Hotel	415	461	462	517	583	671	699	672
Transport, Telecom	50	38	99	63	73	52	51	61
Finance, Real Estate	39	27	49	37	44	58	52	45
Computer	167	345	443	499	479	457	328	411
R&D Services	568	535	610	768	784	984	962	1,090
Business Services	760	933	995	1,080	1,111	1,077	1,091	1,307
Health, Educ., Cult.	227	246	255	261	278	252	272	259
Total	3,694	4,079	4,568	4,743	4,950	5,256	5,109	5,442

# Age of firm when patent(s) published in 2007, by firm size



## Outcome of 2001 SME cohort in 2004

Outcome in 2004	IP inactive in 2001		IP active in 2001		All firms	
	No.	%	No.	%	No.	%
Large	8,115	6.39	240	7.69	8,355	6.42
SME	98,974	77.96	2,460	78.85	101,434	78.0
Micro	13,200	10.40	265	8.49	13,465	10.35
Exited	6,673	5.26	155	4.97	6,828	5.25
Total	126,962	100	3,120	100	130,082	100

Note:  $\chi^2$  test of differences between IP active and inactive significant at 1%.

## Growth of assets (2001 to 2004) and IP activity (2001)

Growth quartile	Non-IP active	IP active	UK TM active	Com TM active	UK patent active	EPO active
Poor growth (1st qtr)	24.9	27.9	24.4	33.4	31.3	35.3
Weak growth (2nd qtr)	25.2	16.7	15.9	15.1	20.6	16.6
Solid growth (3rd qtr)	25.0	24.9	26.2	21.6	24.6	21.7
High growth (4th qtr)	24.9	30.6	33.6	29.9	23.6	26.5

Note: Table shows the percentages of SMEs in each of the four growth groups: poor, weak, solid and high. If there were no association between the column header and the growth groups, we would expect 25.0 in all growth groups. Deviations from this suggest growth and IP are not independent. A  $\chi^2$  test confirms that each of the IP types have a significantly different distribution to non-IP active firms.

## Summary: Descriptive evidence

- By 2005, large firm category overtaken by the combined set of SMEs and micro firms in terms of total number of patents
- Absolute number of trademark applications by SMEs and micro firms together considerably exceeds that of all large firms
- In proportion to their asset base, SMEs and micro firms are more IP intensive than large firms
- Share of IP-active SMEs (out of all SMEs) is between 2.1 and 2.4% for the years 2001 to 2005. There is no clear evidence of a trend over these years.

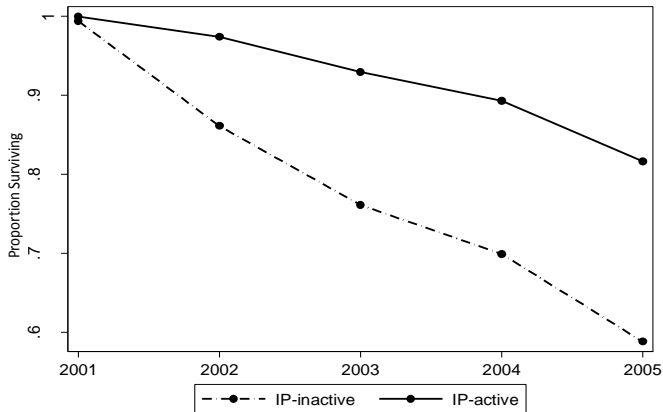
**Innovation and firm survival**  
(Helmers and Rogers, 2008)



# 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



## Summary: Innovation and firm survival

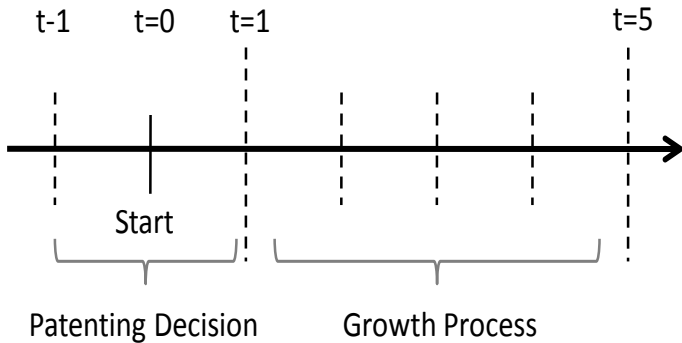
- IP matters
  - 3,750 (2.3 %) of 2001 start-up firms IP-active - most common form of IP is UK trade mark
  - IP-active firms experience lower hazard rate of failure
  - Being a patentee reduces chances of exit (by 55% relative to non-patentee)
  - Addition of one UK patent reduces exit (40%)
  - Addition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

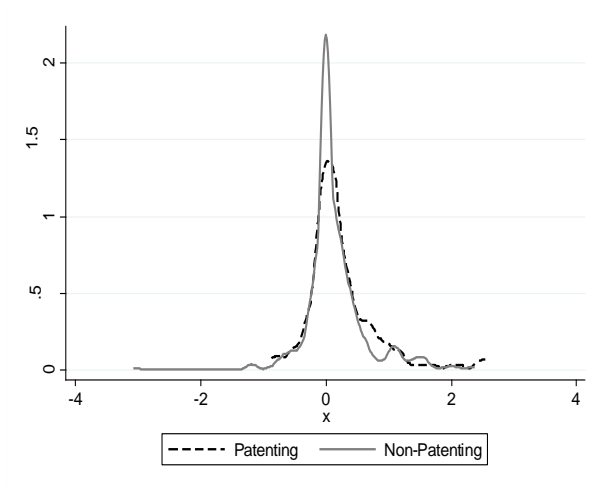
# Innovation and firm growth

- 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?

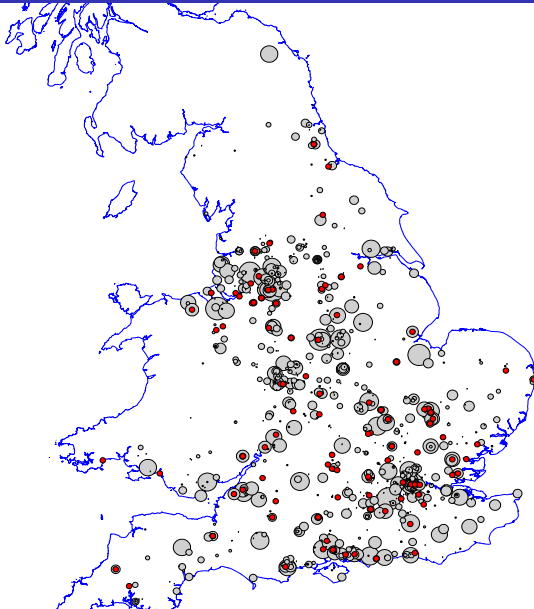
## Identification Strategy - Time Line



## Density Distributions of Patenting vs. Non-Patenting Firms

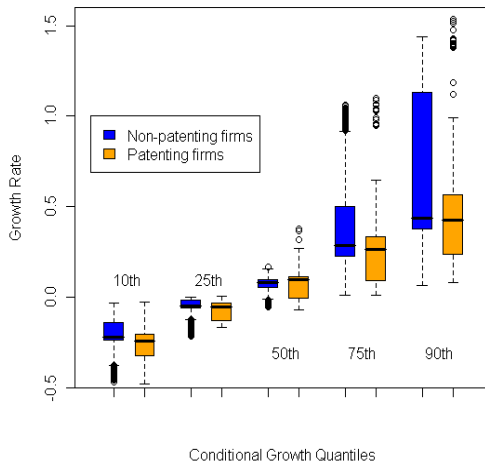


## Map of Firms' Location





# 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.
- ⇒ Patents do not have any statistically robust effect on firm growth.

## Conclusion

- **Getting the match right is crucial!**
- Produce standardized descriptive evidence
- Assess link between patenting and performance using fundamental measures:
  - Firm survival
  - Firm growth

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