

# Combining Formal and Informal IP

Evidence from Queen's Awards for Innovation

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# Introduction

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- Firms' incentives to innovate depend on their ability to appropriate returns, which is related to the way they protect their IP from imitators.
- The literature largely addresses formal and informal mechanisms as substitutes, trying to assess their relative effectiveness.
- Firms set up barriers to imitation relying on a range of tools and it is paramount to understand the complementarities between them (Somaya 2012).

## Limitations of firm level surveys

1. Fail to identify the extent to which inventions are actually patentable
2. The main sector of activity may differ from the technological class of the invention
3. Cannot disentangle between individual or joint adoption of IP tools on a single invention or product.

## Research gap

Based on an original survey addressing products winning a Queen's Award for Innovation, the aim of this paper is to go beyond the trade-off view of different mechanisms and to consider their complementary use.

## Paper contributions

1. We investigate whether and to which extent formal and informal IP are substitutes or complement by testing their tendency to be combined.
2. We assess their relative importance when jointly adopted, devoting special attention to the perceived effectiveness of patents.
3. We focus on the long standing trade-off between the use of patents and trade secret, providing new insights on their possible joint adoption.

# Literature review

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# Relative effectiveness of formal and informal IP

**Table 1:** Summary of main survey results (Hall et al, 2014)

	Levin et al 1987	Cohen et al 2000	Arundel 2001	Blind et al 2006	Hall et al 2013
Period	1981–1983	1994	1990–1992	2002	1998–2006
Country	US	US	DE, LU, NL, BE, DK, IE, NO	DE	UK
Coverage	650 lines of business, R&D–doing mfg. publicly traded firms	1,165 large R&D–doing mfg. firms	2,849 R&D doing mfg. firms	522 firms with 3 EPO patent applications	31722 firms innovators and non R&D–doing and non
High imp. Patent	Prod:4.3* Proc:3.5*	Prod: 35% Proc: 23%	Prod: 11% Proc: 7%	79%	12%
Lead time	Prod: 5.4* Proc: 5.1*	Prod: 53% Proc: 38%	Prod: 54% Proc: 47%	88%	27%
Secrecy	Prod: 3.6* Proc: 4.3*	Prod: 51% Proc: 51%	Prod: 17% Proc: 20%	58%	24%
% of patenting companies	n.a.	Prod: 49% Proc: 31%	n.a.	100%	All: 1.7% R&D doing: 4% R&D doing and innovating: 16%

[1.] Notes: DE: Germany, LU: Luxemburg, NL: Netherlands, BE: Belgium, DK: Denmark, IE: Ireland, NO: Norway, prod.: product innovation; proc.: process innovation; \* mean scores (range: 1=not at all effective, 7 = very effective).

## Patent uses and misuses

- Several empirical studies report that the vast majority of the innovations has been developed outside of the patent system (Arundel and Kabla, 1998, Moser, 2005, Fontana et al., 2013, Hall et al., 2013).
- Mansfield (1986) found that patents were important for 30% of the innovation in the chemical industry, while in the remaining 10 the ranges were from 10% – 20% to not relevant at all.
- Hall and Ziedonis (2001) show that there is an increasing gap between the perception of patent effectiveness as to appropriate returns and their actual adoption.
- Different reasons to patent patent emerged such as to block competitors (Blind et al. 2006) or to 'signal' their innovative capacity (e.g. Baum and Silverman, 2004).

### **IP complementarity**

Firms capture the returns from individual innovations by combining different tools, creating an 'appropriability strategy' (Cohen et al. 2000)

## Data collection

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# The Queen's Award for Innovation

- **Purpose:** The Queen's Award for Innovation is a prestigious prize introduced in 1965 as part of a broader strategy to stimulate inventive activities in the British industry.
- **Eligibility criteria:** UK based companies introducing an innovation resulting in substantial improvement in business performance and commercial success, sustained over two to five years (Report, 2013).
- **Selection:** The applications are then subject to a process of technical assessment performed at different levels by the competent Committee, the number of winners varies depending on the quality of the applications.
- **Significance:** Every year major British newspapers such as the Financial Times and The Guardian publish the list of winners. Awarded firms benefit mostly from the reputation of the prize which fosters marketing performance and motivation within the firm.

- The QAI survey targets the 793 innovations awarded from 2000 to 2017
- Both the managers and the inventors who worked on the innovations are suitable participants for our study.
- We first emailed each company asking to identify the right person for our survey; at this stage we obtained 269 contacts.
- Before sending the survey on full scale, we checked the clarity of the questions and the appropriateness of our target respondents through a pilot test.
- Within a month from the full scale launch we collected 196 (25% of the total) full responses and 22 partially completed questionnaire, which we disregarded.

# Survey structure

1. **The innovation process:** we assess the propensity to patent by considering innovation-level rather than firm level determinants.
2. **IP ranking:** we ask respondents to select and rank the different appropriability mechanisms in place during three stages of the innovation process: proof of concept, testing and commercialization.
3. **Patents:** we address the reasons to patent or not, patents' current uses and perceived importance.
4. **Background info:** on the inventors'/managers' experience, on the application and selection process of the QAI and on the incentives and rewards related to winning the prize.

# Descriptive statistics

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# Propensity to patent

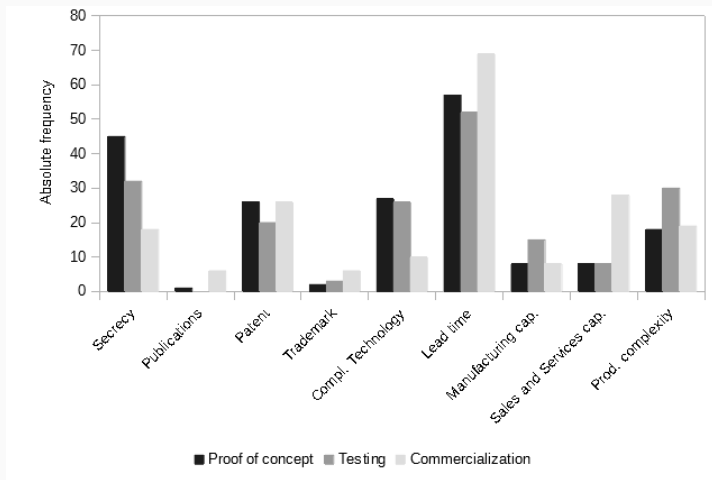
- We reached a diverse sample of responses both in terms of firms' characteristics and products' features
- **54%** of the innovations in our sample have at least one feature patented
- **9%** of the respondents affirmed that patent protection was essential for the development of their innovation.

**Table 2:** Percentage of patented innovations per technological class

Sector	Does the awarded product have at least a major feature patented? (% Yes)	if patent protection could not be obtained, would the invention in question have been developed? (% No) <sup>1</sup>
Chemistry	58	7
Electrical Eng.	35	0
Instruments	60	3
Mechanical Eng.	78	32
Other fields	71	0
Services	0	NA

<sup>1</sup>Those responding 'Yes' to this question are less than the remaining share because we allowed respondent to select 'Do not know'.

# Preferred IP mechanism



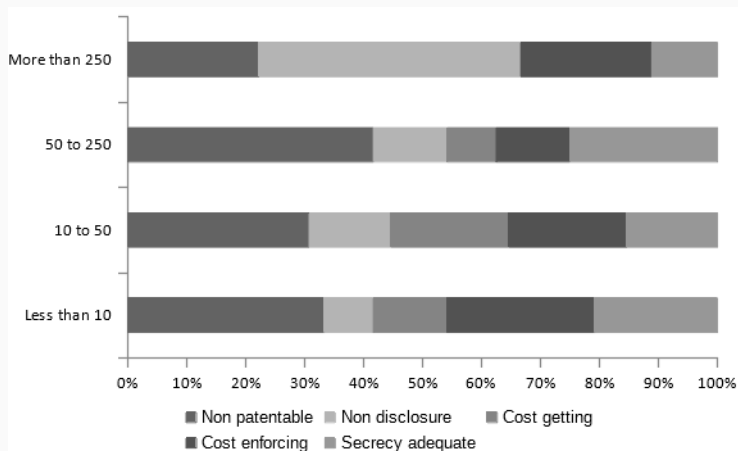
**Figure 1:** Absolute frequency of top ranking positioning for each IP tool

**Table 3:** Most adopted IP bundles

	# obs.	Bundle freq.	%	Secrecy	Lead time	Formal IP	Compl. assets	Prod. complexity
<b>Phases</b>								
Concept	196	26	14	–	X	–	X	X
Testing	196	26	14	–	X	–	X	X
Commercialization	196	26	14	–	X	–	X	X
<b>Size</b>								
Less than 10	99	17	17	–	X	–	X	X
10 to 50	282	48	17	–	X	–	X	X
50 to 250	129	17	13	–	X	X	X	–
More than 250	78	12	15	–	–	X	X	–
<b>Tech. class</b>								
Chemistry	72	15	21	X	X	–	X	–
Electrical Eng.	207	38	18	–	X	–	X	X
Instruments	141	17	12	–	X	–	X	X
Mechanical Eng.	81	9	11	–	X	(X) <sup>2</sup>	X	–
Other fields	72	16	22	–	X	X	X	–
Services	15	9	60	–	X	–	X	X
<b>All</b>	<b>588</b>	<b>78</b>	<b>14</b>	<b>–</b>	<b>X</b>	<b>–</b>	<b>X</b>	<b>X</b>

<sup>2</sup>Same frequency as a bundle including only lead time and complementary assets

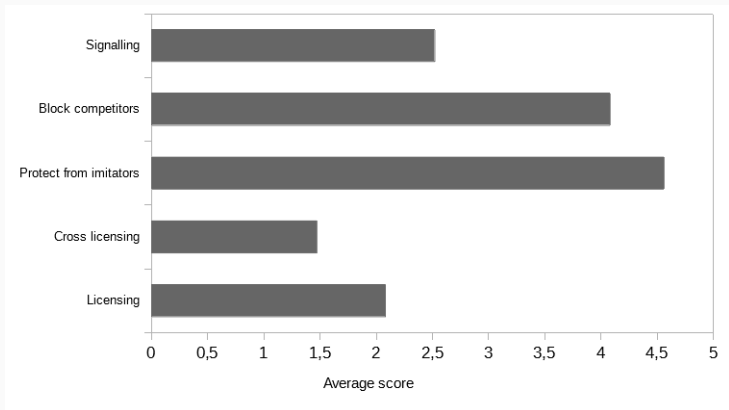
## Reason not to patent



**Figure 2:** Reasons not to patent per firms' size



# Reason to patent



**Figure 3:** Reasons to patent, 1=Not at all important – 5=Extremely important

## Regression results

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	Logit: Propensity to patent		Oprobit: Patent rank				
	Model 1	Model 2		Model 3		Model 4	
	OR(se)	Proof of concept		Testing		Commercialization	
		Coef.	ME (1)	Coef.	ME (1)	Coef.	ME (1)
Incr_innovation	5.44*** (2.46)						
Ext_knowledge	0.19** (0.15)						
Collaborations	1.43 (0.6)						
Funding	2.7* (1.54)						
Turbulence	1.04 (0.18)						
Secrecy	1.35 (0.54)	0.95*** (0.34)	-0.26	0.88** (0.39)	-0.21	-0.02 (0.36)	0.01
Publishing	0.82 (0.4)	0.28 (0.67)	-0.07	-0.04 (0.59)	0.01	0.41 (0.47)	-0.10
Trademarks	3.44*** (1.53)	-0.42 (0.39)	0.11	-0.49 (0.46)	0.12	0.27 (0.34)	-0.7
Com_techology	0.35*** (0.14)	0.84** (0.33)	-0.21	1.60*** (0.49)	-0.33	-0.78* (0.41)	0.21
Lead_time	1.15 (0.6)	0.83*** (0.31)	-0.22	0.89** (0.37)	-0.22	1.31*** (0.42)	-0.39
Mfr_capabilities	2.37** (0.96)	0.68* (0.35)	-0.17	0.98** (0.39)	-0.24	0.68** (0.35)	-0.18
Sales_services	1.04 (0.46)	0.32 (0.35)	-0.08	-0.1 (0.48)	0.02	0.74** (0.33)	-0.21
Prod_complexity	0.31*** (0.13)	0.48 (0.34)	-0.13	-0.09 (0.42)	0.02	0.48 (0.40)	-0.12
Size_dummies	Yes	Yes		Yes		Yes	
Tech_dummies	Yes	Yes		Yes		Yes	
No. of Obs.	184	73		54		69	
Pseudo R2	0.26	0.22		0.27		0.18	

[1.] \*\*\* (\*\*, \*) indicate a significance level of 1% (5%, 10%).

**Table 4:** Combining patents and secrecy

Patent use	Patent& secrecy	n	Mean	S.D.	Min	Median	Max	p-value
Licensing	0	79	1.87	1.35	1.00	1.00	5.00	0.06
	1	22	2.82	1.62	1.00	3.00	5.00	
Cross-licensing	0	78	1.35	0.87	1.00	1.00	5.00	0.31
	1	21	1.95	1.43	1.00	1.00	5.00	
Protect from imitation	0	80	4.56	0.76	2.00	5.00	5.00	0.84
	1	22	4.55	0.74	2.00	5.00	5.00	
Blocking	0	81	4.09	1.25	1.00	5.00	5.00	0.95
	1	22	4.05	1.29	1.00	5.00	5.00	
Signalling	0	72	2.24	1.35	1.00	2.00	5.00	0.00
	1	21	3.48	1.40	1.00	4.00	5.00	

## **Discussion and conclusions**

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# Findings

1. Our analysis shows the presence of a complex appropriability strategy protecting innovations, confirming the complementary role of formal and informal IP.
2. We observe a contrasting outcome which is in line with the 'Patent paradox' (Hall and Ziedonis 2001):
  - (+) 54% of the innovations in our sample have at least one feature patented
  - (+) Non-patentability is the main reason not to choose formal IP
  - (–) Patents are significantly less effective than most of the alternatives
  - (–) In 8% of the cases they are considered crucial for the development of the product
3. We witness a tendency to adopt patents for a range of purposes that go beyond appropriability

- The different roles of patents within the bundle require a reinterpretation of the concept of 'complementarity'.
- Future research should keep on focusing on 'why' firms use patents rather than 'if' they do that.
- The diverse nuances behind the use of patents call for a more careful and comprehensive assessment of the balance between social benefits and social costs which assumes that patents provide incentives to innovate.
- It is necessary to analyze in depth the strengths and the limitations of informal mechanisms, learning from the appropriability strategies which are built outside of the patent system.

# Limitations

## **Numerosity**

The low number of observations at our disposal, which is the drawback of running such a micro-level, product-based analysis.

## **Validation**

The design of the investigation and the structure of the data prevented us from having multiple respondent per product, which would have represented an important validation instrument for the survey.



**Thank you! Questions?**

**Table 5:** Tabulation of responses

Year	Winners	Contacted		Full response		
	#	#	% winners	#	% winners	% contacted
2000	32	8	25%	4	13%	50%
2001	42	4	10%	3	7%	75%
2002	37	7	19%	2	5%	29%
2003	51	13	25%	10	20%	77%
2004	39	9	23%	3	8%	33%
2005	41	8	20%	5	12%	63%
2006	48	12	25%	7	15%	58%
2007	40	9	23%	4	10%	44%
2008	42	15	36%	11	26%	73%
2009	49	25	51%	12	24%	48%
2010	38	17	45%	13	34%	76%
2011	44	14	32%	14	32%	100%
2012	50	17	34%	13	26%	76%
2013	27	7	26%	6	22%	86%
2014	39	19	49%	15	38%	79%
2015	25	16	64%	11	44%	69%
2016	92	52	57%	47	51%	90%
2017	57	17	30%	16	28%	94%
<b>Total</b>	<b>793</b>	<b>269</b>	<b>34%</b>	<b>196</b>	<b>25%</b>	<b>73%</b>