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Transaction Costs, Third-Party Patents and Academic Scientists' Choice of Research Projects

Paul H. Jensen and Beth Webster
IPRIA, University of Melbourne

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THE UNIVERSITY OF MELBOURNE

Introduction

- There has been a lot of concern in recent years about patents in academe. For example:
  - BRCA gene case
  - Oncomouse
- Specifically, patents may have “direct” effects:
  - Crowd-out scientific publication
  - Lower the quality of publication
  - Promote *more* secrecy
- ... and “indirect” effects:
  - Slow down rate of innovation
  - Discourage diversity of experimentation
  - Alter the direction of scientific progress

Background

- Do patents crowd-out publication? Probably not
  - (*Azoulay et al. 2009*; *Fabrizio and Di Minin 2008*; *Buenstorf 2009*)
- Do patents affect research quality? Possibly
  - (Murray and Stern 2007)
- Other effects of patents in academia:
  - *Secrecy*: patents may promote more secrecy than would otherwise be the case (Blumenthal et al. 1997)
  - *Publication delay*: industry imposes conditions on publication timing (Czarnitzki et al. 2010)
  - *Diversity of experimentation*: patents may discourage diversity (Murray et al. 2009; Aghion, Dewatripont and Stein 2009)
  - *Direction of scientific progress*: much harder to analyse since 'progress' is hard to measure objectively in the short run

This Paper

- We use survey data to analyse how patents shape *other scientists'* research project choice:
  - Is the effect moderated by workplace culture?
  - Is the effect shaped by commercial orientation?
  - What role do transaction costs play?
- Our survey is large and comprehensive, with rich information on workplace culture/mission
- However, we do not observe:
  - Whether scientists are attracted or repelled by the patent
  - The degree of "unlicensed use" of patented inventions
- And this is not welfare analysis
- NB: at the time of survey, Australia had a common-law research exemption

Why is this Important?

- With perfect information, scientists know the relative benefits from each research trajectory
- If patents “block” the way, they can negotiate such that normal rates of return are achieved
- But: uncertainty and serendipity abound in science
- Given this, scientists should be able to explore, tinker and wander over a given research terrain
- Any imposition on this will introduce costs
- History abounds with examples where taboos, prohibitions, etc have retarded scientific progress

Are Patents a Problem?

Faculty	1=no effect	2	3	4	5	6	7= major effect	TOTAL (%)
Medicine	50.6	16.8	7.5	11.3	7.6	3.9	2.3	100
Science	57.5	13.3	6.2	8.9	7.2	4.1	2.9	100
Engineering	44.3	17.9	9.2	11.0	8.9	4.6	4.1	100
Architecture	77.7	5.3	4.3	7.5	3.2	1.1	1.1	100
ALL	**53.3**	**15.2**	**7.1**	**10.1**	**7.5**	**4.0**	**2.8**	**100**
					24.4			

Survey

- In 2007 and 2009, we surveyed Australian scientists about their experience with patents
- Survey sent to 9,597 academic scientists
- Sample covers universities plus research institutes
- “Pooled” sample: 4,513 obs. (3,243 scientists)
- Response rate: ≈24%
- Survey contains information on:
  - funding source, age and faculty
  - workplace culture
  - patenting activity
  - transaction costs
  - beliefs about research exemption law

Survey Questions

- Questions about four types of transaction costs:
  - the costs of negotiating with patent owners,
  - the conditions imposed by patent owners,
  - the costs of getting access to information, and
  - the costs of getting access to materials.
- Note that two are directly related to patents while the others are more general
- Thus we can separate the effects of access to patents versus access to materials
- We also asked about the scientists' patent history

Culture and Mission

- Workplace culture is quantified using questions on:
  - the importance of publishing vs patenting
  - incentives to present at conferences
  - incentives to share information with other scientists
- Organisational mission is quantified using questions on:
  - management pressure to patent significant inventions
  - % of funds that come from private industry
  - research-only versus research-teaching environment
  - number of patents (and recent patent applications)

Scientific Environments (1)

- We used this information to construct 3 clusters reflecting different scientific environments:
  - Open-&-Non-commercial: traditional teaching/ research environments (a la Merton)
  - Open-&-Commercial: hybrid organisations (a la Murray) that may patent but embrace openness ethos
  - Proprietorial-&-Commercial: new institutes who attempt to patent aggressively and don't share
- Clustering done on the individual scientist using Euclidean distance measures

Scientific Environments (2)

	Cluster 1 (n= 1,321)	Cluster 2 (n= 1,757)	Cluster 3 (n= 1,155)		
Type of employing unit	**Open-&-non-commercial %**	**Open-&-commercial %**	**Proprietorial-&-commercial %**	**Total %**	**Number**
University - department	34.5	43.2	22.4	100	3,247
University - institute or centre	33.3	41.7	25.0	100	156
Research institute	11.0	32.0	57.0	100	363
Hospital-based institute	23.6	37.3	39.2	100	467
Total	**31.2**	**41.5**	**27.3**	**100**	**4,233**

Patents & Research Choice

- Consider the scientist's decision tree:
  - Chooses a new research project/topic
  - Examines the literature (patent and scientific databases) to determine novelty of the project
  - Becomes aware of another scientist's blocking patent which affects novelty of their project
- How do they proceed from here? They can:
  - Simply ignore the patent and proceed as is
  - Continue with project - negotiate with patent owner
  - Modify the project and work around the patent
  - Abandon the project

Patents & Research Choice (2)

- This decision depends on the following factors:
  - Beliefs about research exemptions
    - If the scientist holds this belief, they will "ignore patent" Evidence this is a dominant norm in science
  - Expectation of (costly) detection if they infringe
    - If this is low, the scientist will also simply ignore the patent
  - Credibility of threat to sue if infringement is detected
    - This may depend on where the scientist works
  - Experience with regard to requesting permission to use patented research tools
  - Expectation of transaction costs associated with negotiating a license
    - If expectation is high, they might ignore the patent

Empirical Model (1)

- We constructed the following variables:
  - *Dep. Variable*: other researchers' patents have no (=1) / major (=7) effect on choice of research projects
  - *Legal Understand:* average of 3 statements regarding beliefs about research exemptions
  - *Experience:* # times permission sought to use another's patented technology (past year) minus # times permission was granted
  - *Transaction Costs:* mean of non-missing responses to 4 statements about difficulties getting data and patented research tools

Empirical Model (2)

$$ChRes_i = \beta_1 LegalUnderstand_i + \beta_2 Experience_i + \beta_3 TransactionCosts_i + \gamma_i X_i + \varepsilon_i$$

- *Transaction Costs* variable is endogenous:
  - Scientists can reduce transaction costs by avoiding patent-intensive areas. Thus, causality may run in reverse
- Thus, we use an IV model: we instrument *Transaction Costs* using the average survey response in the scientist's dept
- Should be correlated with individuals' response
- But individual's response shouldn't affect dept average (average # in dept = 15)

Empirical Model (3)

- In our preferred model, we pool responses across survey Waves and compare results across scientific environments
- We cluster standard errors to account for the fact that some scientists (n=1,100) responded to both Waves
- Note that a panel IV-RE model produced similar results. We don't present these results here.

Explanatory variables	IV nested regression		
	Open-&-non-commercial	**Open-&-commercial**	**Proprietorial-&-commercial**
LegalUnderstand	0.153***	0.155***	0.239***
	(0.0424)	(0.0471)	(0.0756)
Experience	-0.565	-0.520	-0.0751
	(0.507)	(0.341)	(0.461)
TransactionCosts-IV	0.247***	0.331***	0.319**
	(0.0674)	(0.0857)	(0.135)
Ln(research team size)	0.0309	0.182***	0.270***
	(0.0541)	(0.0530)	(0.0805)
Age	-0.0610*	-0.138***	-0.141**
	(0.0349)	(0.0426)	(0.0630)
Constant	1.637***	1.764***	1.980**
	(0.566)	(0.529)	(0.791)
Observations		4,289	
Groups		3,224	
R-squared		0.673	

Robustness Check

- To check for endogeneity, we estimated the effects of lagged explanatory variables (Wave 1) on the dependent variable (Wave 2).
- 1,113 scientists responded to both survey waves
- Our pooled results indicate that:
  - *Lag-TransactionCosts*, *Lag-Legal Understand* and *Lag-Ln(research team size)* are +ve and significant
  - *Experience* is not significant and *Age* is significant at the 10 percent level
- This confirms our original findings

Conclusions

- There are similarities in the moderating factors across scientific environments:
  - Transaction costs and legal understanding matter
  - Previous experience doesn't seem to matter
- However, there are big differences in the size of effects across scientific environments:
  - Work culture matters (the constant is different)
  - There is an "age effect": older scientists are less inclined to change research project due to patents
  - Effect is largest in the Proprietorial & Commercial scientific environment

Caveats

- We don't observe the following:
  - Quality of the other patent
  - Ownership of the other patent
  - Direction of the observed change (toward/away from patented subject matter)
- Are the observed changes in research trajectory good for society? We don't know
- To answer this, we need to know more about the complex way in which science "progresses"