# DO PEER SCHOOLS AFFECT UNIVERSITY PATENTING AND LICENSING? EVIDENCE FROM CHINA

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# UNIVERSITY: GROWING COMPETITION AND ENTREPRENEURIAL ORIENTATION

FINANCIAL TIMES June 23rd 2016

University challenge: the race for money, students and status

The Economist Feb 23rd 2017

Growing competition between universities is changing student life

Forbes Feb 6th 2018

The Changing Business Model For Colleges And Universities

REUTERS October 11th 2018

Reuters Top 100: The World's Most Innovative Universities - 2018

- The competition between universities became more and more intense and takes place along several dimensions:
  (1) competition for students;
  (2) competition for the best professors;
  (3) competition among professors for research support.

- Universities are often regarded as holding important intellectual property that could be leveraged for local/regional development and being viewed by policy makers as engines of economic growth. The rate of academic commercialization has been substantially growing.

# FIRMS WATCH VERY CLOSELY TO THEIR INDUSTRY PEERS, SO DOES UNIVERSITY

- Due to the competitive nature, firm's decisions and activities will be affected by their industry peers:
  a. Corporate capital structures (Leary and Roberts, *The Journal of Finance*, 2014);
  b. Stock splits (Kaustia and Rantala, *Journal of Financial Economics*, 2015);
  c. Investment decisions (Servaes and Tamayo, *Management Science*, 2013; Foucault and Frésard, *Journal of Financial Economics*, 2014);
  d. Corporate cash saving (Zhuang, 2017)
  e. Board appointments (Amore, *Regional Studies*, 2018)

- Similarly to firms, universities pay close attention to what their peer schools are doing

  *Every year, all 1,600 four-year colleges and universities in the United States are asked by department of education to submit a list of "peer schools", against which their finances, enrollments, graduation rates, and other data can be compared*

- Will the university's activities be influenced by their peer schools? More precisely, will peer school affect university patenting and licensing?

# UNEXPLORED FACTOR THAT INFLUENCES ACADEMIC COMMERCIALIZATION?

- Previous studies have argued that both internal and external factors will affect university commercialization, such as:
  a. *University culture (Jacob et al., 2003)*
  b. *Technology transfer office (Siegel and Wright, 2015)*
  c. *University science park (Hobbs et al., 2017)*
  d. *Government policy (Audretsch, 2014)*
  e. *Surrounding industry (Gulbrandsen and Smeby, 2005)*
  f. *…*
  g. *No studies in our field (we think) have looked at peer school effects (so far)*

- Schools typically have intimate knowledge of their competitors. A comparison of a university with its peers is usually of great importance to its strategic planning and decision-making. This study aims to provide the initial clues that how peer school affect university commercialization.

- Empirical analysis of a unique panel data covering 501 Chinese universities from 2008 to 2015 in this paper confirms that peer schools have a positive effect on university patenting.

# THEORY AND HYPOTHESIS

Two theoretical approaches relate to peer effects: rivalry-based theory and information-based theory.

- Rivalry-based theory (Lieberman and Asaba, *Academy of Management Review*, 2006) regards action in response to competitive rivalry. Universities that “match” peer knowledge commercialization activities could alleviate competitive risk from the actions of rivals, and hence maintain their relative position in the technology transfer market.

- Information-based theory (Banerjee, QJE, 1992) perceives peer effects from the aspect of social learning. A universities may imitate the patenting activities of peer universities when university management is uncertain about the best strategy of academic commercialization, or if direct analysis is difficult, costly, and time-consuming.

**Hypothesis 1 (Peer effect)** *University patenting and licensing activities are positively associated with peer school patenting and licensing patterns.*

# HYPOTHESIS (CONTINUED)

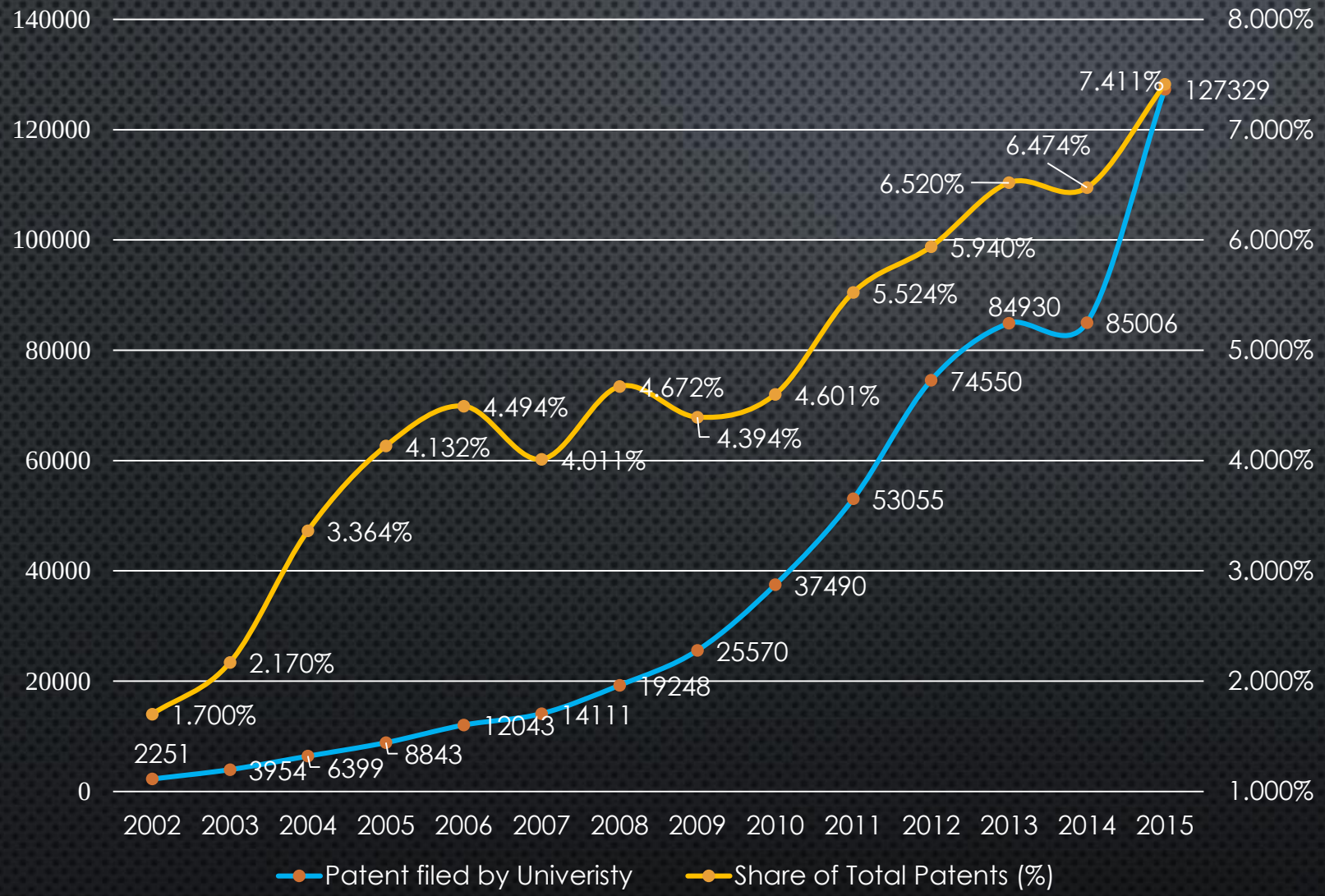
Knowledge creation and learning is critical to the competitive advantage of institutions. There is a strong claim that geographical proximity has a significant effect on information diffusion, implying that a great deal of interactions take place between agents that are geographically proximate and facilitate direct information exchange via face-to-face interaction and observability.

**Hypothesis 2 (Geographical proximity)** *Geographically proximate peer schools will exert a stronger influence on the focal university patenting and licensing activities than geographically distant peer schools.*

Knowledge creation and information diffusion goes along with uncertainty. Institutions function as "glue" for collective action because they reduce uncertainty and lower transaction costs. Shared rules are often regarded as a capability that supports learning and provide a basis for economic coordination: information is transmitted more easily with institutional proximity.

**Hypothesis 3 (Institutional proximity)** *Institutionally proximate peer schools will exert a stronger influence on the focal university patenting and licensing activities than institutionally distant peer schools.*

# CONTEXT: BOOMING UNIVERSITY PATENTING IN CHINA




Since the mid-2000s, to incentivize universities and professors, the Chinese government began to emphasize patents in performance evaluations for individual faculty and universities.

To remove any financial obstacles, filing costs for both universities and individual researchers are defrayed through government subsidies.

# UNIVERSITIES IN CHINA


**Table 1. Distribution of higher education by disciplines, 2015**

| | All 4 year university in China | | Our sample | |
|---|---|---|---|---|
| **Discipline** | **Number** | **Percent** | **Number** | **Percent** |
| Comprehensive | 336 | 26.90% | 135 | 26.95% |
| Engineering | 351 | 28.10% | 155 | 31.34% |
| Agricultural | 43 | 3.44% | 26 | 5.19% |
| Forestry | 7 | 0.56% | 4 | 0.80% |
| Medicine | 107 | 8.57% | 47 | 9.38% |
| Teacher training | 171 | 13.69% | 107 | 21.36% |
| Language | 25 | 2.00% | 2 | 0.40% |
| Finance and economics | 102 | 8.17% | 15 | 2.59% |
| Political science and law | 31 | 2.48% | 3 | 0.60% |
| Sports | 16 | 1.28% | 0 | 0.00% |
| Arts | 46 | 3.68% | 0 | 0.00% |
| Ethnic affairs | 14 | 1.12% | 7 | 1.40% |
| Total | 1249 | 100.00% | 501 | 100.00% |

# DEFINITION OF PEER UNIVERSITY

In this study we use two major factors to define peer university: student selection and university disciplinary classification.

Student selection: following Hoxby and Turner (AER, 2015), we define two universities as cross admitting schools if one university's average student admission score falls within 5 percentiles (on either side) of the other university. For example, if university A's average admission score is 10 and university B's average admission score is between 9.5 and 10.5, then universities A and B are cross admitting schools.

University disciplinary classification: Chinese universities are classified by the Ministry of Education in 12 different categories according to disciplinary orientation as in Table 1. Two universities are related in this sense either if one is comprehensive and the other is in any one of the twelve categories or if they both belong to the same category except comprehensive.

If two universities are cross admitting schools and belong to the same disciplinary category, then these two universities are considered peer universities.

# EMPIRICAL EVIDENCE: DATA SOURCES AND VARIABLES

**State Intellectual Property Office (SIPO):** SIPO was founded in 1985 and is responsible for the assignment and enforcement of patent rights in China. By matching the university name and patent assignee information from SIPO, we could identify the number of patents filed by each university from 2007 to 2015.

**Higher Education R&D Statistical Survey**: The surveys undertaken by the Ministry of Education contain the R&D information about 622 public universities in China.

**Dependent Variables:**

- ***Patent* :** the number of patents filed per R&D staff of the focal university ;
- ***Licensing :*** patent licensing revenue per R&D staff of the focal university.

**Independent Variables**

- ***Peer patent* :** the average number of patents filed per R&D staff per university across all peer universities.
- ***Peer license* :** the average licensing revenue per R&D staff per university across all peer universities.
- ***Peer institutional distance*:** the share of peer universities which belong to the same government agency as the focal university

# INDEPENDENT AND CONTROL VARIABLES

**Peer geographical distance:** the distance across all peer universities to the focal university.

We have calculated the distance between universities using latitude and longitude, converted from decimal degrees to radians. The spatial distance between non-peer schools to the focal university is 0. The following formula measures the distance between two universities, *i* and *j*:

$$D_{ij} = C\{\arccos[\sin(lat_i)\sin(lat_j) + \cos(lat_i)\cos(lat_j)\cos(long_i - long_j)]\}$$

where *C* is a constant based on the radius of the sphere that converts the result into linear units of measure. The lower the value of peer geographical distance the spatially closer peer schools are around the focal university.

**Control Variables:**

- ***Funding*** **:** research funding per R&D staff at the focal university;
- ***Size*** **:** number of total R&D staff at the focal university;
- ***Senior staff*** **:** share of senior R&D staff;
- ***Science park*** **:** dummy variable, equals 1 if university has a science park, 0 otherwise;
- ***Publication*** **:** academic publications per R&D staff.

# ECONOMETRIC MODEL

In order to estimate the peer school effect on the patenting and licensing behavior of a university, we introduce the dynamic panel data (DPD) model:

$$Patent_{i,t} = \beta_1 Patent_{i,t-1} + \beta_2 Peer\ Patent_{i,t} + \beta_3 Peer\ Patent_{i,t} \times Geographcial\ Distance_{i,t} \\ \beta_4 Peer\ Patent_{i,t} \times Institutional\ Distance_{i,t} + Controls_{i,t} + \mu_i + \varepsilon_{i,t}$$

$$E(\varepsilon_{i,t} | Patent_{i,t-1}, Peer\ Patent_{i,t}, Controls_{i,t}, \mu_i) = 0$$

$$Licensing_{i,t} = \alpha_1 Licensing_{i,t-1} + \alpha_2 Peer\ Licensing_{i,t} + \alpha_3 Peer\ Licensing_{i,t} \times Geographcial\ Distance_{i,t} \\ \alpha_4 Peer\ Licensing_{i,t} \times Institutional\ Distance_{i,t} + Controls_{i,t} + \nu_i + \delta_{i,t}$$

$$E(\delta_{i,t} | Licensing_{i,t-1}, Peer\ Licensing_{i,t}, Controls_{i,t}, \nu_i) = 0$$

A serious difficulty arises with the one-way fixed effects model in the context of a *dynamic panel data* (DPD) model. OLS and within-group estimation will be biased (Nickell, *Econometrica*, 1981). Difference GMM (Arellano and Bond, *Rev. Econ. Stud.*, 1991) and System GMM (Blundell and Bond, *J.Econometrics*, 1998) have been utilized in our analysis.

# RESULTS: PEER SCHOOL ON PATENTING

| VARIABLES | OLS | Fixed effect | Difference GMM | Difference GMM Two-step | System GMM | System GMM Two-step |
|---|---|---|---|---|---|---|
| Peer Patent | 0.486*** | 0.971*** | 1.226*** | 0.781*** | 0.692*** | 0.543*** |
| | (0.0735) | (0.130) | (0.248) | (0.131) | (0.263) | (0.0986) |
| Peer Patent◊Geographical Distance | -1.77e-07*** | -3.97e-07*** | -5.99e-07*** | -3.35e-07*** | -3.65e-07* | -2.33e-07*** |
| | (5.25e-08) | (1.01e-07) | (1.98e-07) | (9.47e-08) | (2.14e-07) | (6.96e-08) |
| Peer Patent◊Institutional Distance | -0.164 | 0.101 | 0.718* | 0.448* | 1.327*** | 0.220 |
| | (0.110) | (0.235) | (0.401) | (0.230) | (0.441) | (0.258) |
| Patent(t-1) | 0.753*** | 0.463*** | 0.285*** | 0.323*** | 0.568*** | 0.595*** |
| | (0.0118) | (0.0150) | (0.0329) | (0.0151) | (0.0158) | (0.00658) |
| Funding | 0.000215*** | 0.000193*** | 0.000143*** | 0.000109 | 0.000172*** | 0.000277*** |
| | (3.37e-05) | (3.78e-05) | (3.94e-05) | (7.94e-05) | (4.37e-05) | (8.01e-05) |
| Size | -3.11e-05* | -0.000413*** | -0.000480*** | -8.51e-05 | -0.000577*** | -0.000176 |
| | (1.88e-05) | (7.79e-05) | (9.96e-05) | (0.000125) | (0.000110) | (0.000117) |
| Senior Staff | 0.427*** | 0.259* | 0.194 | 0.353** | 0.202 | 0.560*** |
| | (0.0930) | (0.148) | (0.195) | (0.143) | (0.217) | (0.126) |
| Science Park | 0.0505 | -0.0740 | -0.440** | -0.0856 | -0.0887 | -0.0529 |
| | (0.0428) | (0.118) | (0.177) | (0.0910) | (0.191) | (0.0511) |
| Publication | 0.0347*** | 0.0262*** | 0.0161* | 0.00204 | 0.0242** | -0.0116 |
| | (0.00863) | (0.00912) | (0.00958) | (0.0161) | (0.0107) | (0.0220) |
| Constant | -0.327*** | 0.0132 | 0.217 | -0.161 | 0.186 | -0.317** |
| | (0.0760) | (0.133) | (0.175) | (0.153) | (0.194) | (0.138) |
| Observations | 4,000 | 4,000 | 3,500 | 3,500 | 4,000 | 4,000 |
| Number of University | 500 | 500 | 500 | 500 | 500 | 500 |

# RESULTS: PEER SCHOOL ON LICENSING

| VARIABLES | OLS | Fixed effect | Difference GMM | Difference GMM Two-step | System GMM | System GMM Two-step |
|---|---|---|---|---|---|---|
| Peer Licensing | 0.511** | -0.272 | -0.126 | -0.0960 | -0.143 | -0.107 |
| | (0.201) | (0.397) | (0.456) | (0.147) | (0.473) | (0.141) |
| Peer Licensing◊Geographical Distance | -2.38e-07 | 2.52e-07 | 1.66e-07 | 6.55e-08 | 1.26e-07 | 7.82e-08 |
| | (1.61e-07) | (3.11e-07) | (3.57e-07) | (1.08e-07) | (3.72e-07) | (1.10e-07) |
| Peer Licensing◊Institutional Distance | -0.00842 | -0.000863 | 0.00174 | 0.00711 | 0.00470 | 0.0136** |
| | (0.00519) | (0.0147) | (0.0169) | (0.00720) | (0.0171) | (0.00632) |
| Licensing (t-1) | 0.407*** | 0.122*** | 0.0890*** | 0.0991*** | 0.191*** | 0.199*** |
| | (0.0145) | (0.0166) | (0.0219) | (0.0103) | (0.0149) | (0.00840) |
| Funding | 0.00456*** | 0.00137 | 0.00135 | 0.00120 | 0.00200* | 0.00203* |
| | (0.000863) | (0.000962) | (0.00107) | (0.00110) | (0.00113) | (0.00109) |
| Size | 0.000320 | -0.00164 | -0.00483* | -0.00214 | -0.00500* | -0.00143 |
| | (0.000461) | (0.00195) | (0.00270) | (0.00197) | (0.00281) | (0.00175) |
| Senior Staff | 6.845*** | 12.09*** | 10.70** | 0.999 | 12.97** | 3.583* |
| | (2.383) | (3.739) | (5.265) | (2.433) | (5.508) | (1.958) |
| Science Park | 1.706 | 3.065 | 4.756 | 2.221 | 4.006 | 2.991** |
| | (1.133) | (2.982) | (4.780) | (1.419) | (4.847) | (1.250) |
| Publication | 0.0516 | 0.0291 | 0.0959 | 0.0366 | 0.121 | 0.0331 |
| | (0.0554) | (0.0689) | (0.104) | (0.0613) | (0.109) | (0.0746) |
| Constant | -4.452** | -4.084 | -1.941 | 2.688 | -4.040 | -0.831 |
| | (1.913) | (3.523) | (4.935) | (2.468) | (5.104) | (2.065) |
| Observations | 4,008 | 4,008 | 3,507 | 3,507 | 4,008 | 4,008 |
| Number of University | 501 | 501 | 501 | 501 | 501 | 501 |

# CONCLUSION

- Peer schools have a positive effect on university patenting behavior.
- Peer schools do not have a statistically significant effect on university licensing behavior.
- Geographical proximity has a strong influence on the focal university patenting behavior, but no statistically significant influence on licensing behavior.
- Institutional proximity has a strong influence on patenting behavior, but its effect on university licensing behavior is statistically insignificant.
- Research funding has a positive effect on both university patenting and licensing behavior.
- The share of senior R&D staff has a positive effect on both university patenting and licensing behavior.

# Thank you!

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