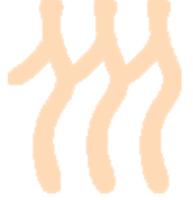




Measuring the performance of Knowledge Transfer from Universities to Industry in China

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Outline

- **What is knowledge transfer, and how can it be measured?**
- **Surveys of Knowledge Transfer Activities at Chinese Universities**
- **University–industry research cooperation in China: A bibliometric examination**

What is knowledge transfer

- Knowledge transfer takes place in channels of interaction between academic research and the commercial sphere. Knowledge transfer is an important part of the innovation ecosystem which has large economic and societal impacts.

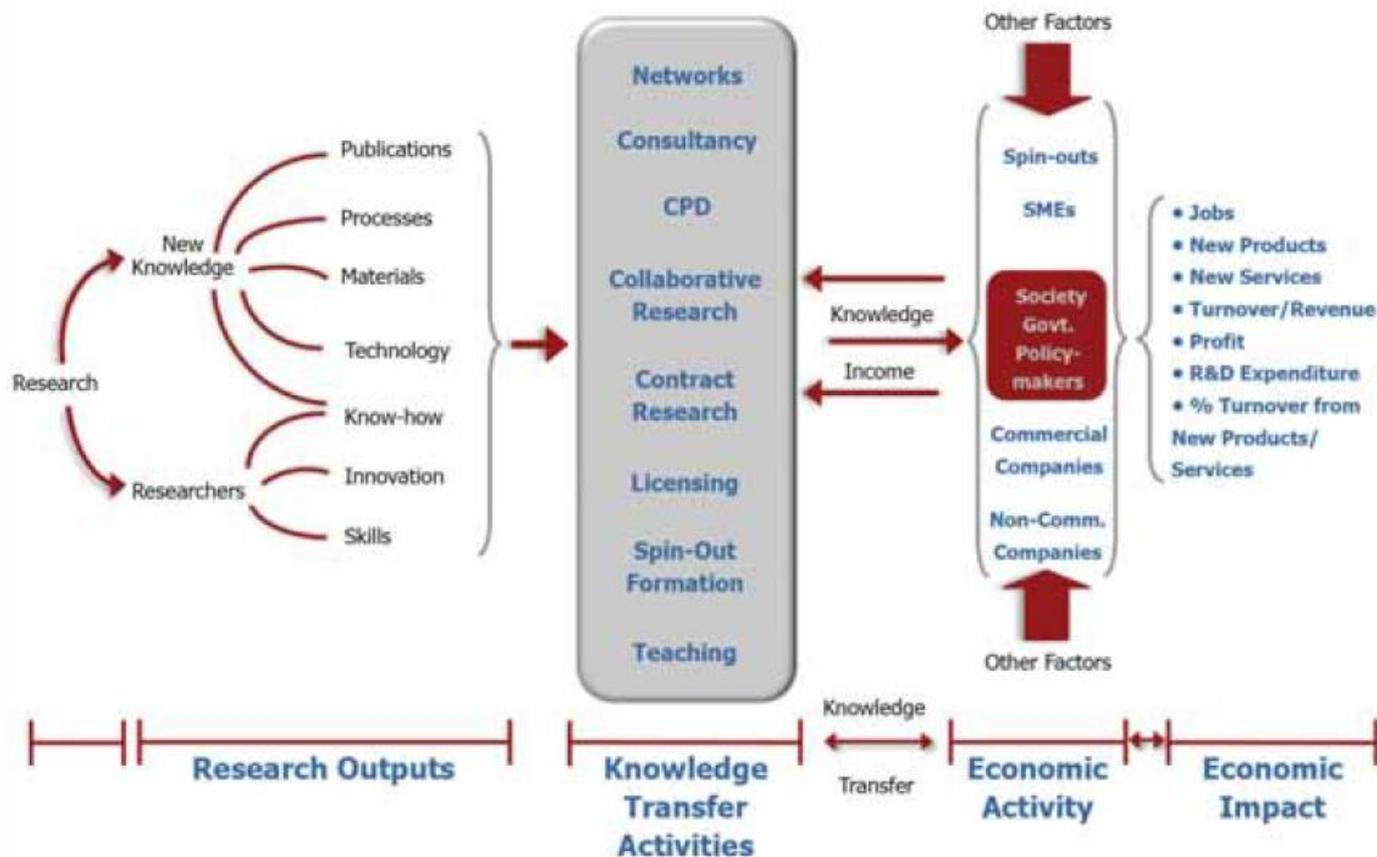


Figure 1: Model of Knowledge transfer within the innovation Ecosystem (source: Holli et al., 2008)

From technology transfer to knowledge transfer

- Different approaches to knowledge transfer measurement have been developed around the world, but most have built upon the US model below developed by the Association of University Technology Managers' (**AUTM**).
- However, it has recently been recognised that measurement of income from IP is an **incomplete and poor measure** of knowledge transfer performance. For this reason new approaches have been developed.

A typical classification of channels

- Networks (specifically social, for example, between academics and the business community)
- Continuing Professional Development (CPD)
- **Consultancy**
- **Collaborative Research**
- **Contract Research**
- **Licensing**
- **Spin-Outs**
- Teaching
- Other measures (publishing through scientific or popular media, movement of people (recruitment, temporary secondment, double positions in industry and PROs, student placement, etc.), and sharing of facilities.)

commissioned by UNICO in the UK
(Holi et al., 2008). 英国大学—企业
协会

A report by the Expert Group on Knowledge Transfer Metrics set up by the European Commission

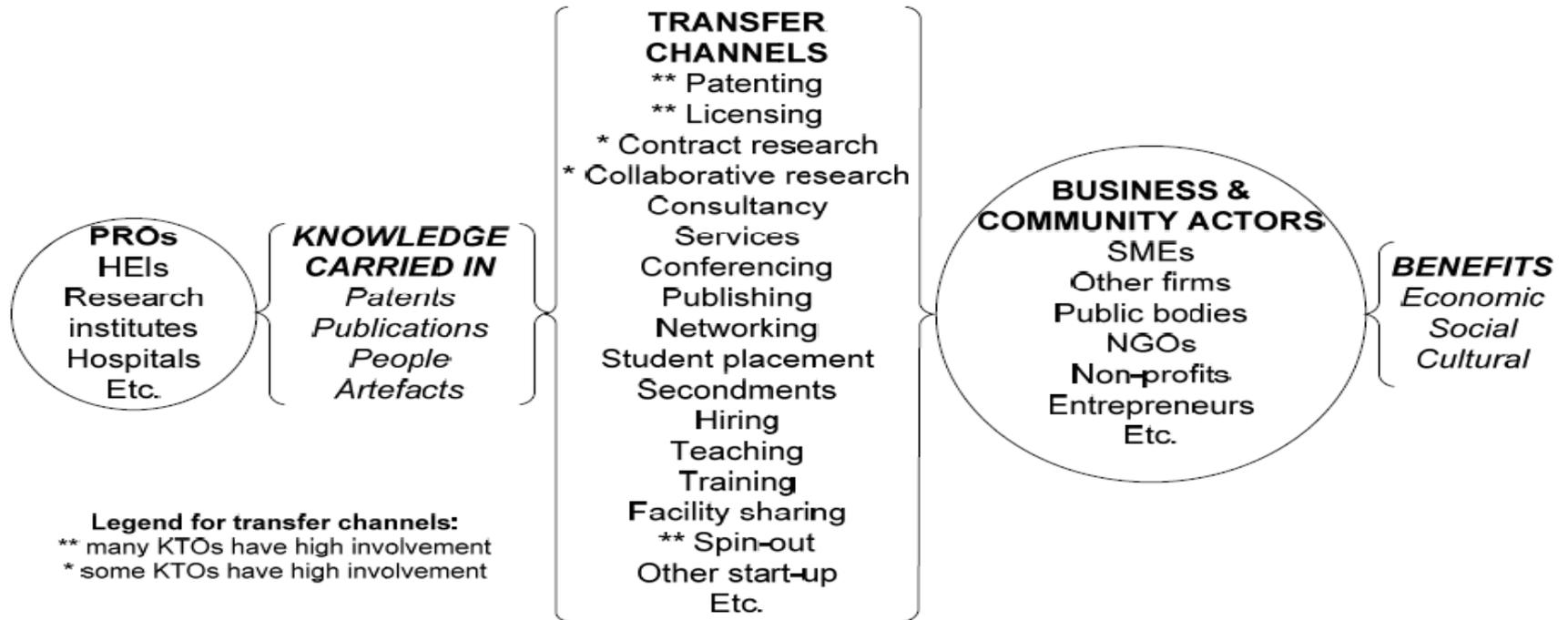
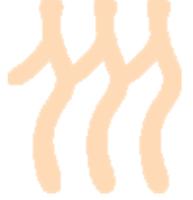


Figure 2: knowledge transfer from PRO (source: Report from the European Commission's Expert Group on Knowledge Transfer Metrics, 2009)

- informal channels and formal channels (involving a contract between the university and the firm), such as paid projects (collaborative research, contract research, consulting, etc.), licensing, and ventures (spin-offs).

Measuring knowledge transfer

- two commonly used alternatives. One is to estimate or negotiate the **value** of the knowledge transferred in its different forms. Another is to measure not the knowledge but the transfer: to **count the number** of manifestations of knowledge transfer as activities in various transfer channels.
- European Commission's Expert Group on Knowledge Transfer Metrics recommended core performance indicators for the PROs served by the KTO:
 - ① Research agreements with firms
 - ② Invention disclosures
 - ③ Patent applications
 - ④ Patent grants
 - ⑤ Licences executed
 - ⑥ License income earned
 - ⑦ Spin-offs established



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TTOs in China

- Only part of the research-intensive universities in China have specialised TTOs or KTOs.
- Most TTOs provide a range of services, including handling patenting and licensing, offering spin-off assistance, managing seed capital funds and incubator facilities **except contract research or applied research projects**, which is in the charge of Science & Technology Office.
- There is **no survey for university technology commercialization** in China, but we can get some useful information based on the annual Higher Education Science and technology Survey (HEST), which is mandatory and conducted by Ministry of Education. 《高等学校科技统计年报（理、工、农、医类）》

Patenting and Licensing survey

受让方类型	合同			当年实际收入	知识产权类型	申请		
	数	金额				数	数	数
	(项)	(千元)	(千元)			(项)	(项)	(项)
编号	L1	L2	L3	编号	L1	L2	L3	
合计	01				合计	08		
其中:专利出售	02				其中: 国外	09		
其他知识产权出售	03				发明专利	10		
国有企业	04				实用新型	11		
外资企业	05				外观设计	12		
民营企业	06				其他知识产权	13		
其他	07				其中: 集成电路布图设计登记数	14		
					植物新品种权授予数	15		
					国家或行业标准数	16		

- The measures of licensing include:
- Income generated from licences
- Number of licences
- Furthermore, it also includes a breakdown of licensing by sector (i.e. state-owned enterprise, foreign-owned enterprise, and private enterprise). Such a breakdown is important in order to provide a more in depth understanding of which universities are the most active in each sector, and how each sector contributes to licensing as a whole.

Research agreements with firms

- The survey includes detailed information of research project, but we **cannot distinguish** between consultancy, collaborative research and contract research.
- All funds from firms are integrated into a figure in the Higher Education Science and technology Statistical Yearbook.

spin-offs

- There are **no items related to the establishment of spin-offs** in the Higher Education Science and technology Survey.
- **University-run enterprises** survey(中国高等学校校办产业统计), which also conducted by MOE, collects some index about economic impact, but university-run enterprises are different from university spin-offs since they are mature firms and no technology or IP are transferred into the university-run enterprises now.
- We can find some information on incubation and tenants in national university science park from the **China Torch Statistical Yearbook**, which collected by ministry of Science & Technology.

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- In conclusion, the government has provided reasonably **good quality data on patenting and licensing**, but the data are much **less available** when it comes to spin-offs, consultancy, collaborative research, and contract research.
 - In the future, we should collect the impact of teaching and training, networking, mobility of people, open access to publications, and other channels.



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bibliographic record

- For lack of university-level, this information gap can be remedied, to a certain degree, by examining the institutional origins of joint research.
- The bibliographic record of each publication contains information on the **author addresses and their institutional affiliations**, which enables us to identify the institutional sector of co-authors and the geographical location of those research partners.
- UIC outputs provide a unique source of information for developing **aggregate-level** proxy measures of the magnitude and intensity of university–industry research cooperation.

- ‘The number of joint publications between private and public actors per population in the EU is roughly half that of the United States and one third lower than in Japan. It is, however, much higher in a number of Member States (Sweden, Denmark, Finland, the Netherlands).’
- This sentence, extracted from Executive Summary of the **European Commission’s Innovation Union Competitiveness Report 2011** (European Commission 2011: 6), is one of the first references in a policy report to **a new source of quantitative information on research linkages** between the business sector and public sector research organizations.
- co-publication data have their drawbacks and caveats (Tijssen et al., 2009)

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- Our case study of university–industry research cooperation patterns deals with the **84 largest research universities in China**.
 - The statistical data were derived from university–industry co-authored research publications (UICs) that were published during **the years 2012–2014** and jointly authored by university researchers and staff employed by business enterprises.

UIC intensity

- Tables 1 introduce summary bibliometric statistics of these universities. Our findings show an average UIC intensity of 4.6, i.e. UICs account for an average **4.6%** of their total publication output.
- An estimated **7% of all WoS-indexed** research publications can be classified as UICs, totaling some 60,000 publications per year worldwide (Tijssen et al., 2009).

Table 1. top 84 most frequently publishing research universities; summary statistics of publication output, 2012–2014

	平均值	标准差	最大值	最小值
大学论文总量	3738	3544	14992	0
校企合著数量	175	167	777	0
校企合作关系数量	188	181	834	0
校企合作强度百分比	4.60	3.93	27.48	0

most highly ranked universities

- Which universities have become major suppliers of industry-relevant knowledge and skills for research-intensive technology companies?
- As far as their output of UIC publications is concerned, one would expect **the world's largest research universities**, with the largest quantities of research publications, to **populate the top of the ranking**, which is what happens in Table 2.
- **Two industry-based university**, China University Of Petroleum and University of Science and Technology Beijing, are also in the list.

Table 2. Top 10 most highly ranked universities by UIC output, 2012–2014

排序	大学	地区	学校类型	办学特色	校企合著数量	校企合作关系数量	校企合作强度
1	清华大学	北京	理工	中国研究型	777	834	6.22
2	浙江大学	浙江	综合	中国研究型	623	654	4.16
3	上海交通大学	上海	理工	中国研究型	620	660	4.31
4	中国石油大学（北京）	北京	理工	行业特色研究型	491	634	27.48
5	北京科技大学	北京	理工	行业特色研究型	471	513	13.06
6	西安交通大学	陕西	理工	中国研究型	458	488	6.13
7	北京大学	北京	综合	中国研究型	426	451	3.65
8	哈尔滨工业大学	黑龙江	理工	中国研究型	425	448	5.53
9	北京航空航天大学	北京	理工	中国研究型	392	425	7.74
10	天津大学	天津	理工	中国研究型	374	410	6.21

organizational variables

- The results reveal a host of organizational variables that are likely to determine a university's UIC performance.
- Significant **positive coefficients (r=0.23)** are observed when correlating the UIC scores to the share of higher education sector R&D expenditure that is funded by the business sector.

Table 3. **Percentage** of higher education sector **R&D expenditure** funded by the business sector

	校企合著数量	校企合作关系数量	校企合作强度
是否属于理工类院校	0.411**	0.418**	0.604**
来自企业科研经费/全部科研经费	0.228*	0.238*	0.449**

	校企合著数量	校企合作关系数量	校企合作强度
全部科技经费投入	0.883**	0.861**	0.190
国际发表数/全部论文数	0.467**	0.451**	0.144

Thanks a lot!