



# Technology Commercialization in Universities -Experiences from China

Dr. Lan Xue, Professor and Dean  
School of Public Policy and Management  
Tsinghua University

May 7, 2009

# Outline

---

- I. Background
- II. Overview
- III. Universities in China's innovation system
- IV. The first wave of reform
- V. The second wave of reform
- VI. The case of Tsinghua University
- VII. Lessons and future issues

# I. Background--Major transformations in 30 years

---

- Economic system:
  - Central planning=>market-based;
  - Sustained high growth (see graph)
- Industrial structure :
  - Agriculture + Manufacturing=> high-tech and service industries
- Society:
  - Rural=>Urban (urban population: 1982: 20.6% => 2005: 43%)
  - Closed=>Open (overseas travel 1998=8.43million => 2004=28.85 million)
- Governance
  - Personal charisma and authority=>broad participation and rule of law

## II. An Overview of Technology Commercialization in Chinese Universities--30 years of experiments

---

- Reforms and experiments in the innovation system and the university system
  - Reform of the national innovation system
    - Application orientation and enterprise-centered
  - Reform and higher education system
    - Expansion and financial constraints
- Technology commercialization experience: A full cycle of changes with wide range of institutional experiments
  - From traditional to entrepreneurial in the 1980-1990s
  - From the “radical entrepreneurial” to the “moderate entrepreneurial” in the 2000s
    - Licensing, spin-offs, technology alliances and etc.;
    - University-run enterprises
- Learning from the process and developing visions for the future.

# III. Universities in China's national innovation system

---

- 1949-early 1980s--Establishment of a centralized system based on the Russian model: Separation of functions and mission orientation;
  - human resources=>universities & technical colleges;
  - basic research=>Chinese Academy of Sciences (CAS);
  - applied research=>ministerial/provincial Research Institutes
  - development=>in house services in enterprises.
  
- Assessments
  - Great achievements in selected missions (e.g. in defense);
  - Weak linkage to economic development.

# IV. The first wave of reform: from traditional to radical entrepreneurial

---

- The innovation system reform in 1980s
  - Opening up in the coastal areas and FDI, and the growth of township enterprises=> Market demand for S&T;
  - Success in agricultural reform led to reforms in other areas;=>impetus for reform;
- The reform strategy
  - Creating Incentive regime for R&D organizations to serve for the economic development.

## The outcome: Changing pattern of R&D spending

<u>Year</u>	<u>1986 (%)</u>	<u>1997 (%)</u>	<u>2001 (%)</u>
<u>Organization</u>			
business	<b>35.3</b>	<b>42.9</b>	<b>60.4</b>
Research Institutes	<b>60.7</b>	<b>42.9</b>	<b>27.7</b>
Universities	<b>4.0</b>	<b>12.1</b>	<b>9.8</b>
Other	<b>0</b>	<b>2.1</b>	<b>2.1</b>

## The outcome: Characteristics of R&D Work in Chinese R&D Organizations (2001, %)

R&D work Organization	Basic research	Applied Research	Development
Business	0.25	6.6	93.1
Research Institutes	11.6	27.7	60.6
Universities	18.6	55.3	26.2

# Impacts of the reforms on universities

---

- Focus shifted from teaching to research
  - Funding opportunities through competitions
- Developed close ties with the industry because:
  - Opportunities due to weak industrial R&D capabilities;
  - Financial need due to funding shortage;
- Ways of engagement with industry:

- 
- Technology commercialization—the regular model:
    - Technology service (through contracts with Ind.)
      - Close to 80% of R&D spending by universities are non-basic;
    - University patenting
      - Close to 1/3 of domestic patents were granted to universities
    - University-based science parks:
      - about 40 parks nationwide;
  - Technology commercialization—the URE model
    - Difficulties to transfer technology to the industry;
    - Low entry barrier to Jump into the “sea” ;
    - Policy encouragement

# University-run enterprises: a special case

---

- University-run enterprises:
  - Companies totally owned by universities;
  - Shareholding companies in which universities have shares;
  - Companies started with university money but now have fuzzy ownership.
  - There were 5451 of UREs in 2000 in China.

# Growth of university-run enterprises

---

- Early 1980s-1990==initial development: university-run factory, technology service companies, and JV (1989=470 million yuan);
- 1991-2000==rapid growth: expansion and getting on the stock markets (see tables below)
- 2001-current==Reflection and adjustment: doubts about university-affiliated enterprises and new policy initiatives

# Growth of university-run enterprises (1997-2000, billion Y.)

---

<b>Year</b>	<b>Sales</b>	<b>Profit</b>	<b>Income to University</b>
<b>1997</b>	<b>29.55</b>	<b>2.72</b>	<b>1.58</b>
<b>1998</b>	<b>31.56(6.8)</b>	<b>2.59(-5.6)</b>	<b>1.50(-5.1)</b>
<b>1999</b>	<b>37.90(20.1)</b>	<b>3.05(18.0)</b>	<b>1.59(6.0)</b>
<b>2000</b>	<b>48.46(27.9)</b>	<b>4.56(49.5)</b>	

# Characteristics of university-run enterprises

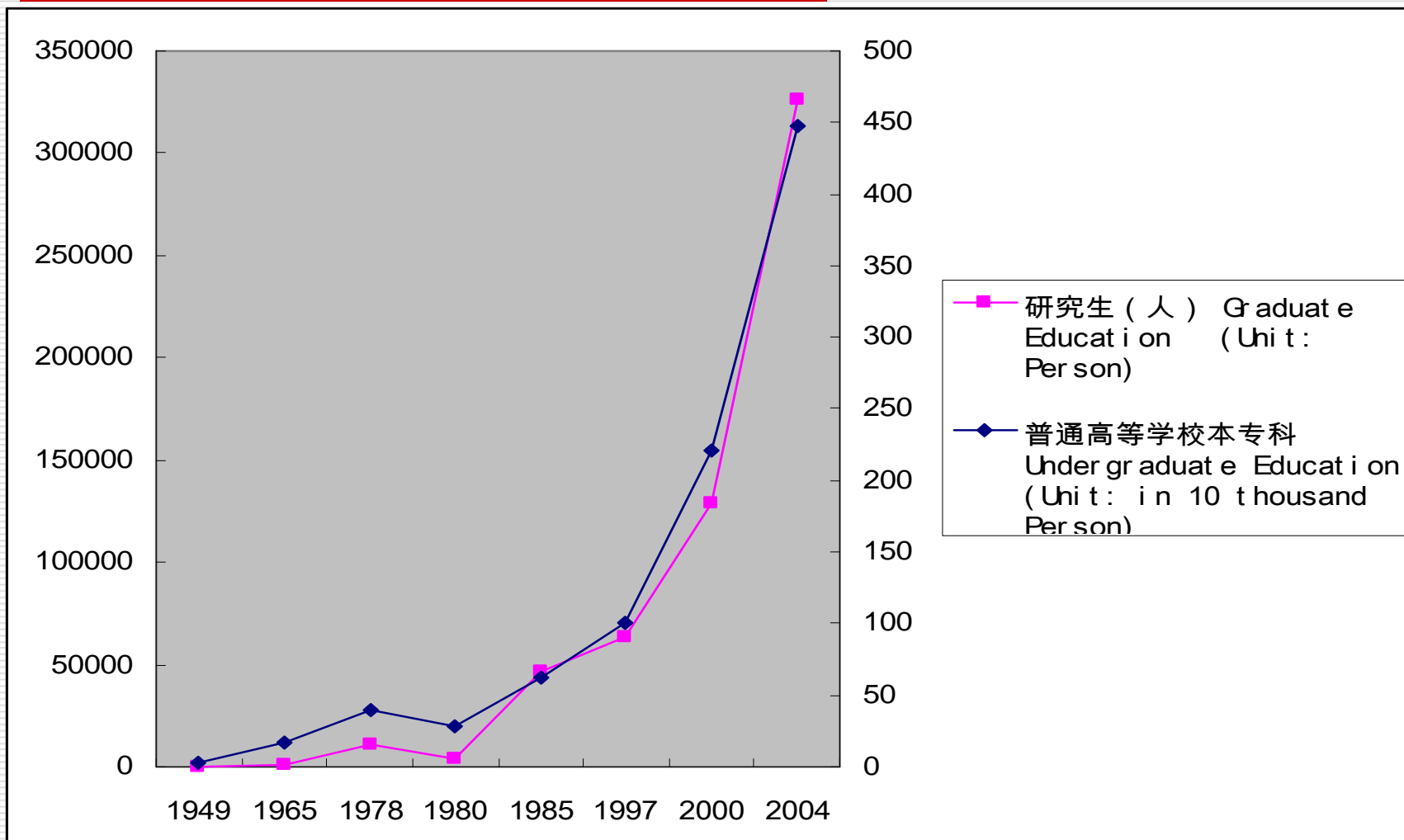
Enterprise Characteristics		# of enterprise	Total Income	Total Profit
Business Orientation	Production	1995	28.61	2.66
	Trade	849	4.35	0.24
	Others	2607	15.50	1.66
Ownership Structure	university	4793	32.18	2.51
	JV with D. partners	556	14.37	1.81
	JV with F. partners	102	1.90	0.24
Level of Management Control	University	4217	45.53	4.38
	School, Department	1234	2.93	0.18

## V. The second wave: radical to moderate?

---

- Reforms in higher education system:
  - Dramatic increase in university enrollment (see graph);
    - Gross enrollment rate
      - 1990=3.7%; 2001=10%; 2005=21%
    - Total enrollment
      - 1998=3.41 million; 2004=13.34 million

# Number of University Entrants by Level & Type



- 
- Consolidation of universities:
    - Merging specialized universities and institutes (637)  
=>comprehensive universities (270);
    - Delegations of administrative authorities:
      - Universities administrated by different central ministries:  
367=>120 ( 73 national universities by Ministry of Education);
      - The authority of issuing permit to start advanced professional college/associate college is decentralized to provincial government.
  - Market-based reform on university infrastructure development and service provision.

# Reforms in China's national innovation system

---

- China's S&T reform-2nd phase (since mid 90s)
  - CAS knowledge innovation program
    - Strategic planning process for CAS and for each institute in CAS;
    - Consolidation of research institutes (from a total of over 120 to about 80);
    - Establishment of innovation centers (lean and mean, with high pay and high pressure) within research institutes;
    - .....

- 
- Reforming Public Research Institutes - >pushing them into the market
    - 242 ministerial research institutes were transformed into business entities in 1999 government reform;
    - 134 ministerial research institutes followed the path;
    - Over 600 provincial research institutes also followed.
  - Strengthening universities' R&D capability
    - World class university (985)" project
      - Focused support for 2 (Tsinghua and Beida) +9 universities;
    - 2<sup>nd</sup> phase of 211program
      - Focused support for selected centers of excellence in about 100 universities.

---

## Industrial R&D

- Supporting the establishment of R&D centers in major SOEs
  - Close to 300 centers were certified by the central government;
  - Over 2000 centers were certified by provincial governments;
- Supporting small business innovation
  - SME innovation fund;
- Helping MNCs to establish R&D centers in China
  - Over 100 MNC R&D centers were established in Beijing, Shanghai, Guangzhou, Chengdu, etc.

## The outcome: Changing pattern of R&D spending

<u>Year</u>	<u>1986 (%)</u>	<u>1997 (%)</u>	<u>2001 (%)</u>	<u>2006(%)</u>
<u>Organization</u>				
business	<b>35.3</b>	<b>42.9</b>	<b>60.4</b>	<b>71.1</b>
Research Institutes	<b>60.7</b>	<b>42.9</b>	<b>27.7</b>	<b>18.9</b>
Universities	<b>4.0</b>	<b>12.1</b>	<b>9.8</b>	<b>9.2</b>
Other	<b>0</b>	<b>2.1</b>	<b>2.1</b>	<b>0.8</b>

Resource: Data are collected from the "China Technology Statistics Data" by MOST, 2007

## The outcome: Characteristics of R&D Work in Chinese R&D Organizations (2006, %)

R&D work Organization	Basic research	Applied Research	Development
Business	0.6	7.6	91.7
Research Institutes	12.0	34.6	53.5
Universities	25.8	49.6	24.6

Resource: Data are collected from the "China Technology Statistics Data" by MOST, 2007

## The Outcome: R&D fund and Productivity

	R&D Total (Billion yuan)	R&D from government (Billion yuan)	Publication	Patent Application	Patent Granted
University	<b>27.7 (9%)</b>	15.2	243,485 (60%)	<b>17,312 (21%)</b>	<b>6,189 (34%)</b>
Industry	<b>213.4 (71%)</b>	9.7	13,269 (3%)	<b>56,455 (69%)</b>	<b>9,433 (51%)</b>
Public Research Institute <sup>[1]</sup>	56.7 (19%)	48.1	42,354 (11%)	6,845 (8.5%)	2,553 (14%)
Others	2.5 (1%)	1.3	14,467 (4%)	873 (1.5%)	216 (1%)
<b>Total</b>	<b>300.3 (100%)</b>	<b>74.3</b>	<b>404,858<sup>[2]</sup></b>	<b>81,485 (100%)</b>	<b>18,400 (100%)</b>

Resource: Data are collected from the “China Technology Statistics Data” by MOST, 2007

# The impact of reforms on universities

---

- A gradual shift towards the traditional model of teaching and basic research
  - Intense debates about the university-run enterprises and the rising cases of mis-management of UREs
    - New policies to change from UREs to UOEs
  - Social concerns about teaching quality after expansion;
  - Increased funding to research universities
  - International benchmarking on publications (SCI etc) changes the internal quality criteria;

## VI. The case of Tsinghua University

---

- A leading national university founded in 1911;
  - Student population=35369 (14285+14090+6994);
  - 14 schools and 56 departments;
- Leadership in education:
  - A 2007 study on national leadership roles played by Chinese university graduates:
    - Tsinghua led by having educated the most (249)
- Leadership in research:
  - #1 in research budget, awards, and etc.

# The institutional arrangement for technology commercialization in Tsinghua University

---

- ❑ R&D Management Department (RDMD);
- ❑ University-industry Cooperation Committee (UICC);
- ❑ International technology transfer center (ITTC);
- ❑ Tsinghua Science Park Co (TusPark).;
- ❑ Tsinghua Holding Co.

# RDMD

---

- Founded in 1983. In addition to regular responsibility for sponsored research, the following was included:
  - To coordinate collaborations between Tsinghua University and regional governments;
  - To facilitate collaborations between Tsinghua and business partners;
- Technology transfer model:
  - Technology transfer contract
  - Research collaboration foundation
  - Regional research and development institute
    - Shenzhen, zhejiang, and hebei.
  - Joint research labs.

# UICC

---

- Founded in 1995 with 180 domestic and multinational industry members by 2006
- Goals:
  - Encourage research collaboration
  - Technology Transfer
- Collaboration model:
  - Member seminars and meetings
  - Joint research institutes
  - Investment on technology development

# ITTC

---

- ❑ A professional technology transfer center;
- ❑ Certificated by MOE and MOST in 2001
- ❑ Operate through a commercial entity: Coway International Tech Trans Co., Ltd. (2002);
- ❑ Commercializing not only Tsinghua's technology, also helping to facilitate the commercialization of technologies from other countries.

# TusPark

---

- The mission of Tsinghua University Science park (TusPark):
  - to facilitate technology commercialization, foster creative talents, and providing services to high-tech R&D.
- History of TusPark:
  - In 1993, Tsinghua University's proposal to start a science park in the heart of Zhongguancun area was approved by Beijing and construction began in 1994;
  - In 1998, the first phase of construction of 120,000 M2 was completed;
  - By 2000, the second phase of construction started. Registered firms in the Park reached 200;
  - By 2005, all the construction work of 690,000 M2 was finished and fully occupied.

---

## □ Management:

- managed by Tsinghua Science Park Co., Ltd., which is a joint venture between Tsinghua Holding and other high-tech companies;
- 3 major areas for over 100 different companies:
  - Main Area: mixed service companies and high-tech MNCs;
  - Innovation Park: high-tech incubators for start-ups;
  - Returned Students Pioneer park: for students returned from overseas;
- 10 division parks around China;
- It was the only level A university science park recognized in China by the Ministry of Science and Technology and Ministry of Education.

# Tsinghua Holdings: URE=>UOE

---

- 2001, State Council policy:
  - “Suggestions on standardizing university-owned enterprise management trial using Peking University and Tsinghua University as trial cases”
- 2003, Tsinghua Holdings. Co. Ltd. was established to manage the assets of Tsinghua University. The following steps were taken:
  - The total assets owned by Tsinghua University as of Dec. 31st, 2001 was valued as 2.71 billion Yuan;
  - Liquidation of all the operating assets of the university and transferred them all into the holding company;
  - University administrators gradually withdraw from their management positions in Tsinghua Holding Co Ltd;
  - For the 42 companies owned by Tsinghua University, they were either merged into Tsinghua Holding Co. Ltd, or being dismissed.

## VII. Lessons and future issues

---

- The roles of universities are defined not only by its internal logic but also by the external environments;
- There is a delicate balance between the academic and entrepreneurial model; the two are not mutually exclusive;
- Future issues:
  - What is the intrinsic comparative advantages of universities over other forms of organizations?
  - What should be the roles of universities in NIS in a developing country like China? Do they play different roles compared with their peers in developed countries?
  - What are proven practice/policies in supporting technology commercialization in universities?

Thank you!

