The Third Mission Stalled?
Universities in China’s Technological Progress

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- Higher education and innovation in China
- University-industry linkages (UILs)
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Limited role of universities in emerging economies

- Universities largely focus on human capital training and university-based research is limited
- Lagging technology
- Dependence on imported technology
- Lack of markets for expensive cutting-edge products
- Institutional deficiencies:
  - fragmentation of institution
  - lack of channels for commercialization
  - weak IPR regime, etc.
Is China any different?

- Early success of university spin-off, 1980s-1990s
- Large and rapidly growing technological market
- Increasingly capable local tech-firms
- Major investment in R&D in universities
- Activist state in commercialization and UILs
- Universities are yet to become key driver of national R&D
  - 16% of national R&D personnel (2006)
  - 9% of national R&D expenditure
  - 34% of domestic patents granted
China’s national innovation system

Central government

- Local governments
  - Public research institutes
- Industry & private sector
  - CAS & CASS
- Ministries
  - Corporate R&D
- Ministry of Education
  - Universities & colleges
University sector’s share

Percent

0.0 5.0 10.0 15.0 20.0


- R&D personnel
- R&D expenditure
University sector’s share in granted domestic patents

Percent

0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0


- All patents
- Inventions
- Utility models
- Designs
Types of UIL

- Conventional technology transfer (resembling UILs in the West)
  - patent licensing or sales
  - consulting
  - joint or contract R&D
  - technical services

- University-affiliated enterprises (almost uniquely Chinese)
  - wholly university-owned and operated
  - controlling equity position by university
  - participating equity position by university
More positive trends of UIL

- Diffusion of university research occurs primarily through contracts for technology services, patent licensing and sales, and university-affiliated enterprises.
- Largest beneficiary of technology contracts are state enterprises.
- More flexible and commercial oriented institutional arrangement has emerged – affiliated spinoffs, a favored form early on, are gradually declining in both numbers and economic contribution.
Technology transfer contracts between universities and enterprises
The less positive...

- Uneven development by regions and universities
- Universities R&D concentrate on redevelopment of existing technology
- Enterprises rarely seek university assistance in technology
  - All of these in the context of rapid technological change, growing market, growing R&D investment and favorable policy environment and state attention
- Overall, a somewhat troubling picture
Low levels of enterprise engagement

<table>
<thead>
<tr>
<th>Size</th>
<th>Product innovation</th>
<th>Process innovation</th>
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</thead>
<tbody>
<tr>
<td>Large enterprises</td>
<td>3.9</td>
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<tr>
<td>Medium-sized enterprises</td>
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<td>Small enterprises</td>
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<td>2.4</td>
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<td>Large and medium-sized enterprises</td>
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<td>State-owned enterprises</td>
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<td>Collective enterprises</td>
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<td>4.4</td>
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<td>Other domestic enterprises</td>
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<td>4.3</td>
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<td>Enterprises with HK/Macau/Taiwan investment</td>
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<td>2.0</td>
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<tr>
<td>Other foreign-invested enterprises</td>
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<td>1.6</td>
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<td>High-tech enterprises</td>
<td>4.7</td>
<td>4.1</td>
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<td>Eastern region</td>
<td>3.4</td>
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<tr>
<td>Central region</td>
<td>4.8</td>
<td>3.9</td>
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<tr>
<td>Western region</td>
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<td>Small enterprises</td>
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<tr>
<td>Eastern region</td>
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<td>2.6</td>
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<tr>
<td>Central region</td>
<td>2.9</td>
<td>1.9</td>
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<tr>
<td>Western region</td>
<td>2.6</td>
<td>1.6</td>
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</table>
What underscores UILs?

- R&D input is positively related to UILs, patent and publication at the provincial level
- # of R&D personnel and clustering of universities in the province have marginal positive impact
- For technological transfer contracts, GDP, personnel and university clusters all have positive impact
- Local enterprises and levels of economic development have only minor or negative impact
- But these factors only explain a small part of the variance. Other characteristics are not captured:
  - entrepreneurial bent of the university
  - tradition of individual institutions
What underscores academic R&D?

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Technology transfer</th>
<th>Patents</th>
<th>Journal publications</th>
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<td></td>
<td>Standardized B</td>
<td>Sig.</td>
<td>Standardized B</td>
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<td>Constant</td>
<td>452.401</td>
<td>-2.879</td>
<td>127.036</td>
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<tr>
<td>Per university R&amp;D revenue (1,000 RMB)</td>
<td>.926</td>
<td>***</td>
<td>.708</td>
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<td>Per university R&amp;D FTE (person year)</td>
<td>-.249</td>
<td>.187</td>
<td>.191</td>
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<td>Number of 4-year universities</td>
<td>.145</td>
<td>.003</td>
<td>.155</td>
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<td>Eastern region</td>
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<td>.094</td>
<td>.066</td>
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<td>Central region</td>
<td>-.167</td>
<td>-.058</td>
<td>.006</td>
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<tr>
<td>N</td>
<td>62</td>
<td>62</td>
<td>62</td>
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<tr>
<td>Adjusted R$^2$</td>
<td>0.551</td>
<td>***</td>
<td>0.849</td>
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</table>
Channels ofUILs

- Jointly building lab: 9.0% (51), 11.5% (65)
- Training of specialized personnel: 13.6% (77)
- Comprehensive collaboration: 19.4% (110)
- Lab or equipment support: 19.4% (110)
- Sharing information: 27.0% (153)
- Technology contracts: 27.0% (153)
Implications

- Overall development of UILs suggests flawed calibration of university mission and enterprises needs
- Problems have become acute as the sources of technology diversified
- Indigenous companies are cultivating their own internal technological capacity
- Slow pace of reform at the university level in autonomy, governance, and incentive structure
- Universities and industry remain out of sync