China’s Innovation Model: An Alternative Strategy for Catch-up

Xielin LIU
School of Management of Graduate University, Chinese Academy of Science
liuxielin@hotmail.com
Outline of the presentation

- Approaches of catch-up
- China’s alternative catch-up model
- The case of ICT industry
- Challenge and policy implication
1. Approach of catching up

- There are two different approaches to explain the process of catching up or lag behind.
- The first one is country level approach, using data of patent, R&D and others to find general factors to explain the difference of catching up across countries, Furman and Hayes (2004) found that the factors behind the catching up or standing still are: the development of innovation enhancing policies and infrastructure, financial and human capital investment in innovation.
- The second is historical and evolutionary approach, such as works of Freeman (1987) for Japan, Hobody’s work for Asia’s economy. This approach can help us find more country specific factors for catching up.
2. China’s Catching up

❖ There many countries used “window of opportunity” to catch up, such as USA in late 1900s, Japan in 1960s-1980s, Korea and Finland recently, etc.

❖ China did not realize the transition from imitation to innovation in 1950-1970 in planned economy stage.

❖ But China has kept a two digit growth for twenty years and made a long stage of catching up. Now, its GDP is about Germany level, expecting to reach level in 2020, and USA level in 2035 or so.
Two approaches for Chinese case

- The catching up happened and there is the threat of China, such as next S&T superpower (Sigurdson, 2005), more R&D growth than GDP.

- The Chinese researchers: there is a big imbalance between GDP level and its innovation level. A country with a level of Germany in terms of GDP but only has an US registered patent of 500 a year, very low in the world. A country with lots of industry volume top in the world, such as steel, cement, chemicals, coal, …..but they has to rely heavily on exported technology, such as digital machine tools, IC, for its operation.
Chinese innovation capability is poor

Table 9 Chinese and Korean patent registrations in the U.S.

<table>
<thead>
<tr>
<th></th>
<th>Number of Patent</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rank</td>
<td></td>
<td>26</td>
<td>24</td>
<td>21</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rank</td>
<td></td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

3. A new framework for understanding catching up in China

- We like to see process of catching up in China in a specific industry, ICT industry.
- We assume that market size, market-oriented innovation, use of global knowledge, government support are very important factors for Chinese catching up and that suggest a new paradigm of catching up.
Factor one: market size

- The GDP per capital in China has reached a level 1700 US dollar (2005) and ICT industry is no.3 in the world.
- market dynamics. This kind of market change does not match multinational familiar rhythm. Fiber industry is one of the examples.
- graphical vastness makes lots of technology developed in advanced countries are not directly usable in China.
Outline of Chinese ICT industry

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2006</th>
<th>Average annual growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed phone users</td>
<td>145 million</td>
<td>371 million</td>
<td>21%, 1/4 of the world</td>
</tr>
<tr>
<td>Internet users</td>
<td>33.70 million</td>
<td>131 million</td>
<td>31%, 1/10 of the world</td>
</tr>
<tr>
<td>Wireless phone users</td>
<td>85.0 million</td>
<td>449 million</td>
<td>40%</td>
</tr>
<tr>
<td>Sales of ICT industry</td>
<td>607 billion</td>
<td>3800 billion</td>
<td>31%, Number 3 in the world</td>
</tr>
</tbody>
</table>

Advantage for innovation

- Innovation for low end market: Huawei, ZTE, Lenovo, etc, all take the unexploited rural market as their first customer for innovative products. ZTE introducing PHS in China.
- Innovation for market niche: in mobile handset, specific designed for farmer, student, lady. Lenovo’s computer for SME.
- Use market size as leverage for cooperation with multinationals. Such as Siemens with Datang in TD-SCDMA.
- Use market size to acquire foreign company with technology. Lenovo, TCL, BOE, etc.
Lenovo’s market oriented innovation

- familiarity with specific market characteristics and user requirements in China;
- a superior domestic distribution network and information management;
- advanced industrial design capabilities;
- strong brand names;
- reliance on China’s competitive cost structure; and
- access to well-educated and trainable knowledge workers.
A case of market-oriented innovation: Domestic firms gain market share from the hands of multinationals

Fig. 5 the market share of foreign and local brands in handset industry
Factor two: open innovation

- Why open innovation?
- Chinese company has limited capability in R&D compared those multinationals in China.
- Though Huawei and ZTE are the technology intensive companies in China, but their R&D size is still limited.

Ratio of R&D/sales in Large and medium sized companies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D/sales</td>
<td>0.49</td>
<td>0.46</td>
<td>0.53</td>
<td>0.60</td>
<td>0.71</td>
<td>0.76</td>
<td>0.83</td>
<td>0.75</td>
<td>0.71</td>
<td>0.76</td>
</tr>
</tbody>
</table>
How to do with open innovation

- Global R&D:
- Huawei has set up 5 research institutes abroad, in Silicon Valley and Dallas in the USA, Bangalore in India, and Russia. In Bangalore they have 800 software engineers, and most of them are local engineers.
- ZTE has set up their R&D labs in USA, France, India and Pakistan, some for getting latest technology, some for close to the market needs.
- Lenovo: USA, Japan and China as their R&D triangle.

- Strong linkages with university and research institutes
- Outsourcing their R&D to university and research institutes is their important way to cover their own weakness of R&D.
- In ZTE, their first innovation was done jointly with Beijing Telecommunication University.
<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total R&amp;D expenditure</td>
<td>35.4</td>
<td>44.2</td>
<td>56.0</td>
<td>72.1</td>
<td>95.4</td>
</tr>
<tr>
<td>Funds for university</td>
<td>5.5</td>
<td>7.2</td>
<td>9.0</td>
<td>11.2</td>
<td>24.9</td>
</tr>
<tr>
<td>Share of total business’ R&amp;D (%)</td>
<td>15.5</td>
<td>16.2</td>
<td>16.1</td>
<td>15.5</td>
<td>26.1</td>
</tr>
<tr>
<td>Funds for R&amp;D institutes</td>
<td>3.8</td>
<td>2.5</td>
<td>3.6</td>
<td>4.7</td>
<td>5.0</td>
</tr>
<tr>
<td>Share of total business’ R&amp;D (%)</td>
<td>10.7</td>
<td>5.6</td>
<td>6.4</td>
<td>6.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Total outsourcing for domestic univ. and R&amp;D inst.(%)</td>
<td>26.2</td>
<td>21.8</td>
<td>22.5</td>
<td>22.0</td>
<td>31.3</td>
</tr>
</tbody>
</table>

Global alliance

- Huawei also has formed joint laboratories with TI, Motorola, Intel, AGERE, ALTERA, SUN, Microsoft and NEC, as well as a joint venture with 3COM.
- ZTE in their GoTa development, setting up an alliance with North Telecom, China Capital Telecommunication and etc. For end products, they formed alliance with South High-tech and other companies. For value added service, they do that with more than 100 SP companies.
- China Mobile has set up a R&D alliance with A&T, Vodafone, Docomo, Softbank, to do research on 4G standard setting.
Factor three: government support

- Licensing policy: who has the right to manufacture, later on, loosed the control.
- Government R&D program: 863 and others.
- HJD-04, the mother innovation of Chinese telecommunication is the result of government S&T program.
- For supporting TD-SCDMA, government used lots powerful tools.
- Research Academy of Post and Telecommunication was given the task for 3G research, later on transformed to Datang.
- In May of 2000, TD-SCDMA (Time Division - Synchronous Code Division Multiple Access), proposed by Datang Telecom Technology and Industry Group on behalf of the Chinese government, was approved by the International Telecommunication Union (ITU) as one of the 3G mobile communications standards.
- In 2002, the government was determined to support the new technology. State Development and Reform Committee, MOST and MII jointly made a strong support for the industrialization of TD-SCDMA by setting up a TD-SCDMA Alliance and give it a birth passport of specific radio frequency.
- 2006, market help: asked SOE China mobile to spend money in 8 cities to establish the net and do pre-commercial operation.
- But the results are not so good as it still has many technical problem to solve.
Factor four: role of FDI

- Policy of FDI: market protection and market for technology. Joint venture is the main policy tool for acquire technology from outside. Require multinational to transfer technology as their precondition before WTO. This produced knowledge spillover for program switcher, GSM equipment, handset.

- Shanghai Bell in program switcher technology, Nokia in GSM, Siemens in TD-SCDMA, etc.
Fig. 1 Model of China’s catching-up

Open innovation

- Market size and knowledge
- FDI and spillover

Catching up

- Cost advantage
- Government support
Some indicators of Catching up in Telecommunication industry

<table>
<thead>
<tr>
<th>Key products</th>
<th>International Commercial time</th>
<th>Commercial time in China</th>
<th>Time gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog program switcher</td>
<td>1965, Bell</td>
<td>1986, Great Dragon</td>
<td>21 years</td>
</tr>
<tr>
<td>Digital switcher</td>
<td>1970, France</td>
<td>1989, ZTE</td>
<td>19 years</td>
</tr>
<tr>
<td>GSM base station</td>
<td>1991, Ericsson</td>
<td>Huawei, ZTE, Datang, 1997-99</td>
<td>7 years</td>
</tr>
<tr>
<td>CDMA base station</td>
<td>1995, Qualcomm</td>
<td>2001, ZTE</td>
<td>6 years</td>
</tr>
<tr>
<td>WCDMA base station</td>
<td>2001, Ericsson</td>
<td>2003, Huawei</td>
<td>2 years</td>
</tr>
</tbody>
</table>
4. Policy lessons from Chinese case

- For developing country, especially BRICS with huge market size, catching up in a global context is possible.
- No single factor can work. It is the result of systematic interaction of multiple factors, especially country specific factor.
- Open can give companies in developing country more opportunity to use global knowledge.
Challenge ahead

- Too many market oriented innovation, few radical innovation in China. This is the result of short term strategy of Chinese company and strong competition.
- Too much rely on open innovation may hollow out of core technology in China. we need sustainable innovation strategy like what Huawei and ZTE do.
- China need political reform to regulate the market competition. There is a ongoing trend of more close relationship of business with government stakeholder. This will kill innovation from bottom-up.
- Need institutional innovation to help innovative company to win out in the market, such as standard setting, IPR, role of social dimension.
- Another fundamental problem in China is education. We have to reform the education system and put creativity and curiosity on top of test score for our young generation.