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From imitators to inventors: China's changing innovation landscape

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China's sprawling manufacturing capability has earned the country the moniker "Factory of the World", and consumers in developed and developing markets alike, have gotten all too used to cheap products that China's factories roll off their lines at an increasing volume.

However, along with the ability to churn out products of all kinds at probably the most competitive prices in the world, is a shady reputation: that the people profiting from this manufacturing muscle are not shy about copying existing products, and selling them at a lower price. In short, critics will snide that China is happier copying rather than inventing.

Now, according to China's State Intellectual Property Office (SIPO) comprehensive patent data analysed by Singapore Management University's Assistant Professor Kenneth G. Huang (http://www.business.smu.edu.sg/faculty/management/kennethhuang.asp), patent filing within China, having gotten off a slow start back in 1986, has surged over the past decade, implying that there is a growing emphasis on innovation and emphasis on intellectual property rights. Huang's findings were also recently published in the journal, *Science.*

Between 1986 – when SIPO was formed – and 2006, the cut-off date of the data gathered by Huang when his research began more than two years ago, the number of patents granted grew by an average of 13% per year in this two-decade period, where more than two million applications were filed, and some 1.1 million granted.

"Patents play a central role in empirical research on innovation, despite their limitations as measures of the introductions of new products, processes, and services. They identify the inventors, assignees (patent holders), location, date and innovative characteristics of every filed invention over long periods of time," said Huang, whose research interests include strategic management of technology innovation, intellectual property, science policy and technology strategy.

In the same mould

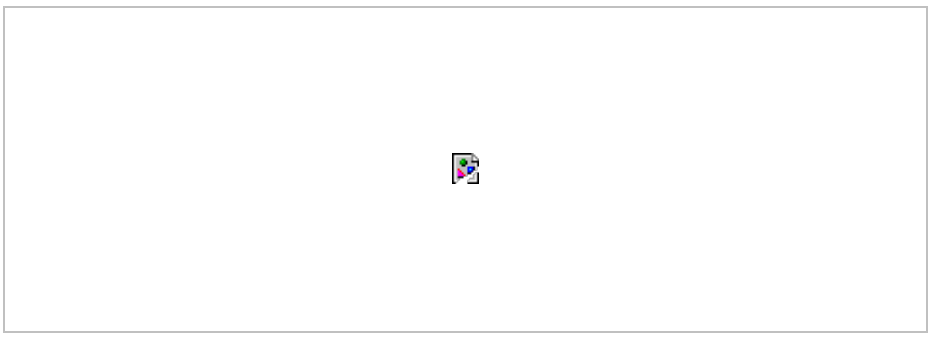
Huang's analysis has thrown up several other interesting data points in this survey of China's innovation landscape. For critics who still prefer the view that China is happier copying that inventing, Huang points out that the United States, as recent as 50 to 100 years ago, was also an economy largely in the same mould. "First you imitate, next you gain some indigenous capability, then you start doing some innovation yourself," said Huang in an interview. Furthermore, the success rate of patent applications in China is around 55% or more, in line with the 50% success rate awarded by the United States Patent Office (USPTO) in recent years, which removes suggestions that the spike in patents assigned is due to lower standards in an effort to catch up.

Just to be sure: national patent offices, like SIPO and USPTO, do not merely award patents to their own citizens and companies. Foreign businesses can also file and be awarded patents. The same goes for universities, hospitals, and other research institutes or organisations.

Based on the SIPO data collated by Huang, the number of patents awarded to Chinese entities constituted 58% of the total patents in the 12 major science and technology classes: medical sciences; micro-structural technology; nanotechnology; organic chemistry; organic macromolecular compounds; biochemistry, microbiology and genetics; optics; computing; information storage; electric elements and semiconductor; electronics, and last but not least, electric communication. The number of patents awarded to them grew by an average of 33% a year between 1986 and 2006; outpacing the 13% overall growth for patents granted across all classes and ownership sectors. In contrast, in the same period, USPTO awarded 55% of the patents filed to American entities, with an annual growth rate of 7%. These figures suggest that innovation and invention is gathering more momentum in one place than the other.

To be sure, the process of patent filing and protection in China was a late comer to the party. Prior to 1985, there was no legal framework protecting intellectual copyright in China. However, the importance of such protection was soon recognised. A big push came during the 1990s, when China's own multinational corporations – the likes of Lenovo, Haier and Huawei -- wanted and started asking for more protection, as they have, by then, built up some research and development (R&D) capabilities.

Thus, no eyebrows should raise with data showing that private enterprises have emerged as the largest assignees by a wide berth of the patents granted, with 19,198 assigned to them in 2006 alone for the 12 major science and technology classes, notably in medical sciences, semiconductors, communications and computing. Coming in second were the 9,324 assigned to individuals for the same 12 categories.



Private enterprises overtaking individuals

Interestingly, individuals used to be the largest assignees sector of patents. In 1986, individuals were granted 119 patents whereas private enterprises had a mere 17. As late as 2001, individuals were awarded 5,966 compared to private enterprises' 5,520. However, the following year, private enterprises overtook individuals with 7,984 versus 5,969.

Still, with 9,324 patents in the 12 classes (and some 70,000 in total from all patent classes) granted to individuals in 2006, it is a clear signal that in some village, somewhere, someone is not merely pre-occupied with sowing and harvesting. "(Thomas) Edison would find company in China," said Huang, referring to the founder of General Electric and prolific inventor of the light bulb.

So, what accounted for the widening gap and surge of private enterprise patents after 2001? Individual inventors are up against increasingly sophisticated technologies and higher R&D costs that only corporations can afford. Also, 2001 was the year that China joined the World Trade Organization, which made some regulations more favourable for certain patent applicants. Some companies, therefore, could have withheld from applying prior to 2001, he suggested, pointing out that this would make interesting future research.

Moreover, a big boost in the patent numbers came in the form of the growing presence of multinational corporations setting up shops in China. Many of them – like the South Korean and Japanese electronics manufacturers, the Samsungs and the Mitsubishis – brought along their own technology and patented them in China, under their local subsidiaries. This could have positive spill-over effects to enhance innovative capability of indigenous Chinese firms down the road.

Also, the overall climate and government policies have been favourable towards R&D, lauding sophisticated technology, and thus fuelling the growth of patents granted. Local Chinese firms eager to move up the value chain have also taken heed of what foreign competitors are doing. "Clarifications of IP laws favouring patent protection and better alignment with international standards, as well as increased domestic investment in research and development, also may also have played roles," said Huang, who expects private enterprises to continue widening their lead over other patent assignee sectors.

Changing attitudes within universities

While the leading patent assignees are private companies as well as individuals, universities – a hotbed of inventions and innovation in many countries – are a distant number three in terms of patents granted. According to the SIPO data, in 2006, the number of patents, (across the same 12 major classes) assigned to Chinese universities, was only 2,049 -- significantly lower than the 19,198 and 9,324 assigned to private enterprises and individuals respectively.

However, from Huang's perspective, despite the relatively lower absolute numbers, there is already a pick-up in the growth of patents from universities. Back in 2001, there were only 298 patents. "They are not yet contributing a lot, but there is a fundamental change in mindset," he said. The relatively late start can be attributed to mentality, academic culture and norms rather than capability. "In the past, as a professor in a Chinese university, you don't usually patent, you contribute your research and innovation efforts to advance fundamental understanding in science; but increasingly, this is more accepted," he added. Universities are increasingly viewed as an important source of innovation which serves as a catalyst to commercialisation and to fuel technological growth and the economy.

Nevertheless, Chinese universities, collectively, are still very much behind their Western counterparts. The usual suspects, like Massachusetts Institute of Technology (MIT), where Huang completed his doctorate in technology management and policy, has taken advantage of the extensive ecosystem conducive for invention, innovation and commercialisation in Boston and the state of Massachusetts. This includes the availability of talents, venture capital and supporting institutions. Not to say Chinese universities are not doing much, for there are a few leading ones that are strong in this aspect. They include Tsinghua University, Beijing University, Fudan University and Shanghai Jiaotong University.

One constraint, however, is that many universities do not always enjoy the luxury of sufficient funding and resources. To be sure, the central government wants to raise the international standing of its top institutions and the universities will play an increasingly important role. However, with insufficient funding, and with few exceptions, they are not able to attract the best people. "It will be interesting to observe if the Chinese universities can catch up to their U.S. counterparts, but this would be challenging in the short term," said Huang.

The issue of resources can be somewhat addressed with universities tying up with private enterprises. This is something that many researchers in Western countries are already doing. "It is inevitable (that) we will be seeing more." However, "we have to be a bit cautious when universities take money from private corporations. Their research agenda and objectives have to be very clear," said Huang, who was, himself, a recipient of a doctoral fellowship from pharmaceutical giant, Merck.

Tipping point yet?

If there is a sector of the Chinese economy that worries the least over resources, it has to be that of the numerous state-owned enterprises (SOEs), legacies of the country's command economic system. This is especially so for the national level giant entities – the likes of Sinopec, Sinosteel, State Grid Corporation. They (still) control vast swathes (or outright monopolies) in strategic areas like telecommunications and energy. While firms and organisations in the chemical and biomedical sciences, computing, communications and semiconductor industries would naturally have more patents awarded in the 12 major science and technology classes, a mere five patents were awarded in these 12 classes to the state-owned enterprises in 1986. By 2006, only 895 were awarded to SOEs, not even 5% of that awarded to private enterprises.

Are SOEs a group of lumbering giants more concerned with toeing the Party line and unfazed over how new technologies will impact their bottom lines? Not entirely true. According to Huang, it is not accurate to suggest that the SOEs do not really care about applying for patents. It is a very industry-specific issue. China Mobile, the world's largest mobile operator, for example, is active. Meanwhile, others like Sinopec, are not necessarily so – at least in the 12 major classes looked into by Huang.

"The SOEs play a major role, but, where they are active in, may be interpreted more as a signal from the government, as an indication of where its focus is," said Huang. But, in the same vein that private enterprises are now contributing a growing share of China's economy, it is almost only natural that private enterprises, and not SOEs, should be at the forefront of patents and innovation. "I expect and I hope to see more private enterprise and start-ups to fuel the next stage of growth, beyond the SOEs," said Huang.

With data from SIPO clearly showing that it is an increasingly busy office, is it time to hail the world's second largest economy as also the leader in innovation? Dare anyone still call Chinese companies better copiers than inventors?

Well, not entirely right. There is still some way to go. "We have not seen the tipping point yet. The way they operate, they still do a fair bit of copying and imitation. However, I think this is a very good start," said Huang.

After all, as most casual students of Chinese history will point out, this is a country that invented paper making, gunpowder, the compass, and printing technology.