

# 9

## Technological challenges

Firms that occupy a unique technological niche were the most successful amongst the sample firms. Even in the current economic slowdown, they do not feel much market pressure (see Box 9.1 for a description of MD in Shunde). This chapter describes the sample firms' pattern of technological innovations, analyzes problems in R&D and acquisition of technologies, and highlights the importance of the protection of intellectual property rights in fostering private firms' innovations.

### The pattern of technological innovations

Amongst the 323 firms providing usable answers, 93.5 per cent regarded new technologies and new products as very important for their development. There were only 21 firms (6 per cent of the 338 firms given the CEO survey) that clearly indicated that new technologies and new products were not important for them. In contrast to the large proportion of firms that regarded new technologies and new products as important, the frequency of new products was relatively low amongst the sample firms. In the last five years, 16 per cent of them had not introduced any new products in the year preceeding the interview, 51 per cent had 1 to 5 new products, 18 per cent had 6 to 10, and 15 per cent had more than 10. Therefore, on average, two-thirds had less than 6 new products a year.

Regional and size differences were prominent (Table 9.1). Wenzhou had the highest rate of product innovation, with 19 per cent of its firms having introduced more than 10 new products in the last five years, and 33 per cent 6 to 10 new products. Several other cities had about the same percentage for firms having introduced more than 10 new products, but the incidence of firms having 6 to 10 new products was much lower than in Wenzhou. One reason why Wenzhou had more new products might be that its industries were concentrated in small electronic parts, garments, and small consumer goods such as buttons where competition was more intensive, and where there were greater opportunities for less elaborate product differentiation.

Beijing fared worst again. This could be related to the overwhelming presence of small firms. This conclusion is evident in the difference in firm size. For the group of firms with less than 50 employees and the firm with 51 to 100 employees, the percentages of firms with no more than 5 new products in the last 5 years was 68 per cent and 79 per cent, respectively. For the two groups of larger firms, the percentages dropped to 56 per cent and 50 per cent, respectively. In particular, 33 per cent of the firms with more than 500 employees

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**Box 9.1 MD: Development by way of innovations**

MD, located in Beijiao township of Shunde, is a company specialising in making home appliances such as electric fans, air-conditioners, water heaters, rice cookers, etc. It had 11,020 employees, and a sales volume of 5 billion yuan in 1998. It is the world's largest supplier of electric fans and China's second largest supplier of air-conditioners. In terms of sales volume, it was the 193<sup>rd</sup> largest firm in China. The company was started by its current president and CEO, and 22 others in 1968 as a small cooperative factory making simple farm tools. In the early 1980s, it started making electric fans, mainly by imitating the then famous domestic brands such as Huasheng. At the end of the 1980s and early 1990s, its products were expanded to other small home appliances.

In May 1992, MD undertook a major institutional innovation by taking the lead in privatisation in Guangdong province. After privatisation, the company was first listed on the Hong Kong stock market as an 'H' share. It soon broke the entry barrier and was listed on the Shenzhen stock market as an A share in November 1993. Privatisation and the subsequent listing on the open market have helped MD to make a leap in its development. In 1992, its sales volume was only 380 million yuan; in 6 years, that figure reached 5 billion yuan in 1998. With the funds raised in the stock market and reinvestment of profits, it began to enter the air-conditioner market and soon became one of the biggest air-conditioner producers in China.

The motto of MD president is: 'It is better to give up a 1 million order than to give up a person whose expertise is useful to the company.' MD has a strong mix of human capital. Among the 11,020 employees, 110 have a masters or Phd degree, 2795 have a college degree, and 4352 have a high school or professional diploma. The high concentration of human capital enables MD to lead the market by way of rapid technological innovation. It has more than 200 patents and 15 products that are designated as national or provincial new products. In addition, more than 400 of its products have obtained quality certificates in China and several other countries. Its products are being sold in every continent. In addition, it has led the trend in innovative internal management. It is the first company in China that started MRP II, a firm management system that provides a total solution to a firm's daily planning and management.

The aim of MD is to reach a sales volume of 9 billion yuan by 2000. Judging by its growth record and admirable perspective, this aim will be realised.

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**Table 9.1** The distribution of new products by city and firm size (% of firms with number of new products)

	None	1–5	6–10	>10
By city				
Beijing	24.5	49.1	18.9	7.5
Shunde	31.3	43.8	12.5	12.5
Chengdu	17.4	45.7	19.6	17.4
Wenzhou	9.5	38.1	33.3	19.0
Mianyang	11.1	55.6	16.7	16.7
Deyang	–	73.5	11.8	14.7
By firm size				
<51	22.4	46.3	16.4	14.9
51–100	15.2	63.6	12.1	9.1
101–500	2.2	54.3	28.3	15.2
>500	11.1	38.9	16.7	33.3

**Source:** Firm survey.

had more than 10 new products whilst 22 per cent of the firms with no more than 50 employees had no new products. This size-related distribution of product innovation is also revealed in the number of patents applied or bought by the sample firms.

Amongst the 299 firms with usable entries, 38 per cent of them applied for or bought patents. Larger firms had done more of this than smaller firms had. For the four groups of firms, from the smallest to the largest, the percentages of firms that applied for, or bought, patents were respectively 29 per cent, 42 per cent, 50 per cent, and 59 per cent. In terms of regional differences, Beijing still fell behind the other cities with only 24 per cent of such firms. Deyang had the highest percentage at 60 per cent. Other cities were concentrated between 35 per cent and 45 per cent.

Amongst the 276 firms with a usable entry, 50 per cent had experience of using foreign technologies. Regional variations were small, with the lowest being 45 per cent (Beijing) and the highest 56 per cent (Chengdu). However, size variations were large. The percentages of the two groups of smallest firms were 40 per cent and 39 per cent, respectively, while those of the two groups of largest firms were 67 per cent and 71 per cent, respectively.

The CEO questionnaire also asked whether cooperation with universities and government research institutes was important to a firm. While 79 per cent of the firms regarded cooperation as important, it turned out that the cities with more affirmative answers were not Beijing or Chengdu where university

and government resources are most abundant, but small cities such as Mianyang and Deyang where affirmative responses reached 92 and 96 per cent respectively. Larger firms generally gave more positive answers than smaller firms, although the differences were not strong.

The size-related differences are consistent with the findings of other studies. For example, a study conducted by a group of researchers at Tsinghua University on 1,051 firms in the period 1991 to 1993 found that R&D expenditures of large, medium, and small firms were 0.8 per cent, 0.3 per cent and 0.4 per cent of total sales, respectively. The national average for the manufacturing sector was 0.5 per cent in the same period. A study by the Ministry of Sciences and Technologies in Yichang, Hubei Province in 1990 revealed a similar pattern, with the ratios for the three groups of firms being 2.1 per cent, 1.3 per cent, and 1.2 per cent, respectively.<sup>1</sup> In fact, the two quoted studies also revealed striking regional differences. In the next section, an analysis is provided of the underlying factors that have driven the size and regional differences in firms' reporting of technological innovations.

### **Factors affecting firms' technical capacities**

Many studies have identified a lack of human capital, finance and information, and technological piracy, as the most important factors that impede a firm's technical capacities in China (see Wang and Yao, 1998 for a synthesis of the studies). While this is also the conclusion of the current study, we have found different intensities of these factors and some specificity for private firms.

An obvious impediment to the sample firms' technical capacities is the lack of human capital. In this regard, large firms are in no better position than small firms, but the problems they face are different. Large firms need R&D specialists and well-trained workers to carry out sophisticated tasks. Yet, because of the impediments laid out in Chapter 8, for example 'university graduates' preference for other employers, private firms' under-utilisation of market establishments, high worker turnover rate, and local government policies, it is hard for a private firm to obtain and retain qualified employees.

Small firms need is not for not specialists, but for general engineers who, possibly with limited education, can identify and transplant existing technologies as well as conduct simple technical improvements. This is not because small firms do not want to engage in technological innovations. But taking other constraints into consideration, the adoption of established technologies is usually an optimal choice for them. However, there is a price for doing so. If a firm can learn one technology, other firms can do the same in the current environment of weak enforcement of intellectual property rights. This is one reason why most of the private firms in one locality produce the same product and enter into head-on competition with each other.

Without further technological progress, increasing competition will drive down the profit margin to the point where many firms will not survive. One strong opinion expressed by small entrepreneurs was that market competition was so intense that they were fighting for salaries instead of for profit. While intense competition is related to overall macroeconomic conditions in the country (Chapter 2), it is also a result of the lack of technological progress among small firms.

For large firms pumping out hundreds of new products a year and smaller firms with a unique technical niche, complaints about market competition were heard less frequently. This suggests that the best way for a small firm to get out of the trap of intense competition is to develop new products that others cannot easily imitate. The probability of this is severely limited by the lack of qualified personnel. If it is difficult for large private firms to recruit and to retain qualified personnel. It will be even more difficult for small private firms to do so.

The second impediment to a private firm's improvement of its technical capacities is its lack of adequate financial resources. As pointed out in Chapter 5, most private firms are operating under a tight liquidity constraint. Priority in use of limited financial resources has to be given to matters essential for short-term survival. Technical innovations are low on their priorities.

In addition, government lending and taxation policies, besides the effects discussed in previous chapters, also have specific adverse effects on private firms' technical investments. The central bank limited the number of loans with more than one-year terms that commercial banks can issue. State firms can circumvent this restriction by getting special loans reserved for technical innovations. But private firms do not have this privilege. Consequently, it becomes difficult for private firms to engage in an R&D project that takes more than one year to complete.

Furthermore, the current tax code does not allow firms to deduct capital investment from of the base of the VAT. Since VAT is the largest tax for firms, this restriction severely dampens a firm's incentive to make new investments. Repressive government policies and underdeveloped institutions in the financial arena discussed in Chapter 5 also have profound implications on a private firm's ability to engage in R&D activities. In particular, the lack of financial intermediaries, stock markets, investment banks, and venture capital to provide long-term capital is important. In this context, large firms have a strong advantage over small firms because the banks are willing to provide them with continuous unsecured credit.

The third impediment is the lack of access to useful information. The CEO survey revealed that 36 per cent of the firms regarded the lack of technical information as a major hindrance to their operation, and 21 per cent regarded the lack of training information as a major hindrance. Here we turn to discussing the last factor on our list, technological piracy.

## The protection of intellectual property rights

The legal protection of intellectual property rights offers a firm monopolistic gain associated with its innovations. Technological piracy suppresses technological innovation. Law enforcement is weak in China, exposing firms to rampant piracy. How do firms cope with the situation?

The first type of response is to speed up technological innovation. This shortens the product life cycle and leaves the imitators no time to catch up. It requires considerable human capital and financial resources to do this. Here, piracy actually speeds up technological innovation.

The second type of response is more passive. A firm does not apply for a patent to keep its new product secret. The firm assumes that the new product will occupy a fair share of the market before being pirated. If a firm patents its new product before production, it is likely that pirated products will be produced at the same time. This type of response is a direct result of weak law enforcement.

The third type of response is to self-policing of products. Firms commonly use their sales network for this task. Usually it works as local governments generally take a cooperative position. However, when a firm cannot get assistance from the government, it may resort to unlawful action such as sending people to destroy the pirate's factory (Chapter 4).

The fourth type of response is to use collective power to enforce the protection of technological innovations. In Chapter 10, the case of a button industry chamber of business in Wenzhou is discussed. The chamber of commerce, with support from the township government, provides protection for button products to members in return for fees. It has been working effectively although its extension of the enforcement to nonmembers raises legal concerns.

The final type of response is to avoid products that are easily imitated. This is common in high-tech industry. Products that easily become victims of piracy have low entry barriers. In this regard, software, especially that from a large body of end users is the most vulnerable. For this reason the software industry is still primitive in China. The best Chinese word processing software belongs to Microsoft. Large companies have financial, legal, and social resources to fight piracy through the legal system whereas small companies do not.

Domestic IT companies concentrate on specific niches where piracy is less of a problem. Examples occur in IT products that demand intensive human capital inputs. For example, the largest software company in China specialises in enterprise management information systems. Since systems are complicated, simple technical protection prevents piracy.

Generally, firms are reluctant to resort to lawsuits to stop piracy. In addition to weak law enforcement, firms also have other considerations. One is that the violators are everywhere, and taking them all to court is impossible. In the case

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**Box 9.2 Intellectual property rights and technical innovation**

HDL, a building material producer in Wenzhou City, was established in 1993 by 17 private investors (but 15 of them have since quit). Now it has a total capital of 20 million yuan with 7 million in bank loans. Due to the sharp competition, the profit margin is low. But the general manager believes that the company is doing well. He said small firms, private firms in particular, face two major problems.

One is the risk in research and development. The current legal system does not provide much protection to firms' patents and brands. To develop a new product, a firm only has an 8–10 per cent chance of success. Once it is successful, it will be soon be copied by other companies. Two new products developed by his company were copied by others with minor changes. With one of them, the copying company was sued in court, spending one and a half years and 200 thousand yuan in the legal process. But the final judgment allowed both companies, the inventor and the company that copied, to produce the same product. A technician of the company was also 'hunted up' by another company, together with the know-how of his company. The manager concluded that, 'you were waiting to die if you don't develop new products, and you were seeking to die if you do: you spent money for others.'

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of local competition, violators may reside just next door. Taking the case to the court will be regarded as with distaste by both sides. However, a large percentage of firms having applied for or bought patents show that they still have some confidence in the law. Even if they do not have 100 per cent confidence, the legal system is still their last resort.

Four main conclusions have emerged in this chapter. First, the distribution of new products is clearly linked to firm size, and large firms consistently surpass small firms in several aspects of technological innovation. Second, geographical differences in performance on innovation are linked to variation in typical firm size across localities. Third, the better performance of large firms is caused significantly by their advantageous positions in human capital and financial resources. Fourth, firms have developed several expedients to combat technological piracy in an environment of weak law enforcement, with varying effect.

**Note**

1. The two studies are cited from Wang and Yao (1998)