
Technological learning in six firms in Southern China: success and limits of an industrialisation model

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Abstract: This article examines the creation of industrial enterprises and the basic models of firm-level technological learning behaviour of the last 20 years in China. Six case studies of technological learning and links to external sources of know-how from the South of China in the Pearl River Delta are examined. It is shown that the learning process that has been experienced in these enterprises is similar to that of other fast growing East Asian economies. Until now enterprises have been acquiring technology through external linkages with foreign clients that become their main providers of technology. A detailed account of the enterprises allows a typology of the external technological learning. It is claimed that the growth of the South of China lies in this 'external' interactive technological learning, as in other East Asian economies.

Keywords: Asia; China; industrial development; technological learning; private enterprises; interactive learning; economic reform.

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1 Introduction: the 'secret' of China's recent economic growth

China has known an impressive 8% annual growth in recent years and its GDP has been multiplied by seven in the last 23 years. Still, the size of the country blurs the extraordinary diversity of situations. The recent growth began after the reform period, and relied on three waves of investment, creating a multiplicity of companies and a whole new emerging economy (Arvanitis *et al.*, 2003). Much of China's economic development is due to its industrial growth. The Chinese economy is still export-driven and relies heavily on foreign investment. But the growth process relies mainly on Chinese-owned and Chinese-managed companies (Gregory *et al.*, 2000). The private sector represented 1.8 million 'private enterprises' (*seyin qiye*) in 1998. State-owned enterprises represent more than 1.6 million (Guiheux, 2002,p.30), and today, state-owned enterprises can be 'privately managed' (*minying*).

Nowadays a lot of discussion is taking place on the reasons and sustainability of the growth process. Is this growth possible in other countries in Asia or elsewhere such as Latin America? How exceptional is this growth, that is, how much of it can be understood as being specific to the political conditions of China (a former communist country, a 'transition economy', a very large economy dominated by the state or any other qualification) and the specific 'advantages' of this country (low labour cost, easy and rapid administrative process for the registration of a new business, sizable markets)?

In this article, instead of looking at the macroeconomic conditions, we will investigate the learning process of Chinese companies and their relations to external sources of technology. Our cases are located in Guangdong province in the South of China (more than 36% of China's exports and 14% of China's production), a region which has been 'one step ahead' in the modernisation process of China, and still the largest receiver of foreign capital (Cheng, 2003). The 'miracle' of South China industrialisation is based on the creation of industrial private or privately managed enterprises, and mainly of small- and medium-sized enterprises. China has not been active in creating large enterprises, and state-owned firms did not transform into Korean-style *chaebols* (Huchet, 1999; Huchet and Richet, 2004). Guangdong's initial development relied on the combination of two types of enterprises: productive units employing unskilled, mainly immigrant labour force funded by foreign capital (mainly from Hong Kong and Taiwan); and, small industrial units created by local entrepreneurs (Chan, 2003). This combination of local and overseas Chinese enterprises created an impressive web of industrial companies, making of Guangdong and, more specifically, the Pearl River delta, a region that has achieved one of the fastest growth rates in the world.

Comparisons at the macroeconomic level were not able to detect the formidable entrepreneurial force behind growth. Comparing other Asian economies where salaries are lower than China will convince the readers that low salaries are not a suitable explanation. Other explanations like the cultural and geographic proximity of Hong Kong, the specific labour culture of China, the relatively high educational level of its population, the business-minded networks of friendship and *guanxi* (Hendrischke, 2004), may also have their part. However, if these were sufficient explanations, then Guangdong's development would have been easily foreseen. This was not the case: 25 years ago *nobody* thought Guangdong would become 'the factory of the world'. We believe that a good way to understand the South China miracle is to look at the technological learning of firms, rather than the entrepreneurial behaviour as a whole (Krug, 2004; Guiheux, 2002; 2003).

2 Technological learning of latecomer companies

Since the seminal work on technological learning in the developing world of Jorge Katz and Alice Amsden, a lot of the work has focused on South Korea and Taiwan on the theory of late industrialisation, the role of the state, and the creation of international value chains. A theory of the necessary steps to upgrade and attain a certain level of technological development has emerged (Kim, 1997; Hobday, 1995). Observing the Taiwanese electronics industry, Hobday (1997) predicted a continuous upgrading from simple suppliers, Original Equipment Manufacturer (OEM) to own brand manufacturers. Dutrénit (2000) draws attention to the importance of the transition process from building the minimum knowledge base to building strategic capabilities in latecomer firms.

Technological learning has been at the centre of these discussions, so much so that some authors propose to replace the concept of National System of Innovation by that of National System of Technological Learning (Mathews, 1999). Technological learning is seen as a structural feature that goes hand-in-hand with some special institutional arrangements (Kim, 1997). Learning and achievement in general have been seen as underlying features of Asian societies (Rowen, 1998). There has been an impressive

number of studies centred on issues like the national innovation system, institutions, and the overall environmental conditions of industrialisation (see, for instance, Lall, 1998; Chen and Sewell, 1996; Shin, 1996). Indeed, some studies such as Gereffi (1999) and Ernst and Kim (2002) have been sought to understand the subcontracting process in East Asian economies, and the creation of global chains of supply. In one such analysis of the Taiwanese electronics industry (Ernst, 2000,p.224) emphasise the diversity of linkages between subcontractors, foreign clients and providers of technology:

“International linkages include a variety of ties with sales, manufacturing, and engineering support affiliates of foreign firms; they also include different forms and trajectories of integration into global production networks of American and Japanese electronics firms. Taiwanese firms typically have relied on concurrent knowledge outsourcing: they have pursued different approaches in parallel, rather than concentrating exclusively on one particular linkage.”

Very much in line with this work, we stress that technological upgrading in China has followed a diversified pattern, and entrepreneurs have always kept a variety of technology sources, not so much because of some strategy, but rather out of an immediate and pragmatic need to be resolved: the access to technology. In the absence of previous experiences, local firms relied on their foreign clients, rather than some public knowledge provider, or other external sources of technical advice. This may not appear new to the Asian literature; it nonetheless is the actual industrialisation process in China: technological learning is taking place in a large variety of medium-sized companies, not so much through technology transfers from foreign firms that invest in China (inward FDI) or through some other providers such as universities, technical centres or consultants, but through their foreign clients.

3 Understanding technological learning in firms

The fieldwork for this study is based on a variety of firms. They represent different types of the emerging production system in South China. Technological learning is a cumulative process over time, very specific to each firm, and collective in the sense that it involves more than one person inside the company (Arvanitis and Villavicencio, 1998; Figueiredo, 2002). Economists have used the notions of ‘production capabilities’ and ‘technological capabilities’ in order to differentiate two resulting paths of technological learning, particularly in the developing countries (Bell and Pavitt, 1995). These terms encapsulate the notion of ‘absorptive capacity’ introduced by Cohen and Levinthal (1990), in that an enterprise needs to develop sufficient capabilities that permit absorbing of the new technologies. Nevertheless, it should be reminded that Cohen and Levinthal only discussed the case of rather large and sophisticated economies, and gave a particular importance to R&D. As the literature showed, learning cannot be reduced to R&D, even if it is an essential component. Moreover, R&D is not linked to production or the market in a linear and simple way (Rosenberg *et al.*, 1992). The existence of an R&D unit is not limited to some large R&D facility with specific research projects; R&D’s functions can be much wider, supporting the whole productive process, particularly in small and medium enterprises where it is frequently undercounted (see Arvanitis and Vonortas, 2000; Acs and Audretsch, 1991; Kleinknecht and Reijnen, 1991). R&D, in fact, affects the strategic capability and thus we try in the interviews to understand what is called an R&D unit in each company.

An empirical description of technological learning would identify two types of activities: those that permit the enhancement of products and processes inside the enterprise (internal learning), and activities with the same purpose but in relation to clients, suppliers, and external sources of knowledge (external or interactive learning) (Pirela *et al.*, 1993; Arvanitis, 2000). Internal learning includes activities such as: seeking technological information on alternative technological routes, adaptation of technology, development of better and new products and adaptation and design of processes. Product and process innovations, strictly speaking, are part of this learning experience as well as R&D, design, engineering, maintenance, and quality management. External or interactive learning activities can take a very wide variety of forms. Table 1 summarises those external relations that are related to a foreign provider of technology, and their impact on the creation of technological capabilities.

Table 1 Effects of different forms of international technology transfers on technological learning (external learning)

<i>Technology transfers modes</i>	<i>Effects on technological learning</i>
Sales of equipment with technical documentation for installation	The interaction is a market relation. The supplier offers little support, and there is no learning by interaction. This relation is not favourable for tacit knowledge.
Technology transfer contract, with the license of the technology, technical assistance, engineering, production assessment, management contract, all inclusive contracts	The relation is a hierarchical relation, based on the structure of the market. Depending on the nature of the contract, the suppliers can be active and learning by interaction can happen. Many contracts prohibit explicitly certain types of learning procedures (no copying, no adaptation permitted, no enhancements). Tacit knowledge can be acquired depending on the degree of interaction with engineers on the floor.
Contract with a client (less formal, long-term relation with client)	The relation is market-based and unstable. No formal technology transfer but the suppliers of technology are final clients, transmitting quality specifications and productive procedures. Usually, engineer or technical personnel installs and checks quality procedures. Favourable for tacit learning.
Subcontracting, co-production, OEM or ODM	Hierarchical relation between users and providers, even if some element of market is included. The longer the relation is, overtime, the more active are suppliers (they transmit larger parts of their know-how). Specific mechanisms in order to grow the value chain are devised (for example learning by monitoring, design proposals, quality checks) where user firm can upgrade by interacting on a more permanent basis with their suppliers. Non-exclusive contracts are a bonus for the user company. Favourable for tacit knowledge.
Foreign direct investment: all kinds of joint ventures, contractual common enterprise	Hierarchical relation between providers and users of technology. Providers will be more active depending on the degree of their investment. The larger their financial investment, the more intense is their effort. Internalised relation similar to that between a subsidiary and headquarters. Technological learning is a process controlled by the headquarters. If the mother firm is willing, the affiliates will learn a lot. Usually the local firm gives access to market and gets technology in exchange. Could be very favourable for tacit learning.
Strategic alliances, R&D alliances, technological cooperations (rare in developing countries)	The relations are an organised market. Providers and users share competencies and have complementary abilities. Both parts are active. Tacit knowledge is acquired from both sides.

Note: Based on Tidd *et al.* (1997), Richet and Huchet (2000) and author's own field-work.

Companies that upgrade from productive capabilities to technological capabilities combine internal and interactive learning and, as their experience evolves, they enter a more complex organisational learning. This latter 'soft' skill has mostly interested the business management literature mainly on joint ventures. The substantial management literature on joint ventures or foreign companies in China is focused on management issues (Peng and Luo, 2000), investment decisions (Shi, 2001) and, in some cases, on technology transfers (Wang *et al.*, 2001; Martinsons and Tseng, 1999; Walsh, 2003). The same issues are less commonly studied in Chinese-owned companies (with some exceptions like: White and Liu, 1998; Zhao, 2000; Xie, 2003; Xie and Wu, 2003).¹

4 Sample selection and methods

We briefly describe here the experience of six different firms in South China. They were selected through a process of 46 interviews. The selection is based on our qualitative appreciation of the 'typical' character of the cases representing what we have called 'the emerging industrial sector' of South China: a large sport shoemaker Taiwanese joint venture (hereafter named TL) inserted in a global value chain, a medium-sized packaging joint venture with an industrialised country partner (CB), a small private Chinese enterprise oriented toward export (CZ), a small private Chinese company oriented mainly toward the national market (HY), a slightly larger collective-owned company in a traditional sector (WG), and a middle-sized collective company in electro-domestics (JL). Their histories and strategic orientations illustrate the wide range of strategies that we found on the ground. Large firms and high-tech firms were not included. Indeed, this type of firms deserves a specific treatment (Arvanitis, 2004). The interview guide sought to capture the history of the company, the linkages with providers of technology and clients, the insertion into the local policy and economy, internal management of manpower and quality, and the general strategy of the firm. Each interview lasted around one-and-a-half hours. Some interviews were followed by a factory tour. Interviews were also made in eight innovation centres among 38 companies in Guangdong on the management of innovation, management issues of the centres and relations between companies in industrial clusters (reported in Arvanitis and Qiu, 2004).

5 Findings on six empirical cases

Key evidence related to the researched firms is described in Table 2.

Table 2 Six examples of relations of Chinese enterprises with foreign clients

	<i>TL (Nanthai)</i>	<i>WG (Shuikou)</i>	<i>HY (Shuikou)</i>	<i>CZ (Shuikou)</i>	<i>CB (Zhongshan)</i>	<i>JL (Jiangmen)</i>
Products	Sporting shoes	Faucets	Faucets	Faucets	Packaging	Washing machines
Range of products	Small (large variety of design details)	Large	Large	Large	Small	Large
Ownership	JV Taiwan	Collective	Private	Private	JV France	Collective
Main client/main market	Foreign transnational (OEM)	Foreign clients and buyers (partial OEM). National wholesalers	Wholesalers, national and foreign, and foreign producers	Export 90% to foreign wholesalers	National industrial clients, large transnational client in China	National wholesalers and retailers
Needs of clients	Client's specifications + proposals of variants to the client	Client's specifications + own models	Client's specifications + own models	Client's specifications + own models	Client's specifications + own models	Client specifications + own models
Size (employees)	Approximately 3000. Company owns 15 other factories.	Approximately 200	Approximately 400	Approximately 200–250	Approximately 1000	Approximately 2000
Presence of client	Control bureau inside factory	Technical inspections by client	Technical inspections by client	Technical inspections by client	Internal adaptations	Technical inspections by clients
Regularity of contacts with foreign clients	Permanently on-site, OEM arrangement	By orders + regular inspections	By orders + regular inspections	By orders (regular clients) + regular inspections	Regular clients	Regular clients, company seeks to provide OEM
Type of production	Large mass production	Medium-sized production	Medium-sized mass production	Medium-sized production	Large mass production	Large mass production
Type of productive process	Batch, semi manual	Batch, semi manual + automatised metal plating	Batch, semi manual	Batch, semi manual	Continuous process, automatised	Continuous process, semi manual
Initial investment	Medium	Medium	Low	Low	Low + High	Medium

Table 2 Six examples of relations of Chinese enterprises with foreign clients (continued)

	<i>TL (Nanhai)</i>	<i>WG (Shuikou)</i>	<i>HY (Shuikou)</i>	<i>CZ (Shuikou)</i>	<i>CB (Zhongshan)</i>	<i>JL (Jiangmen)</i>
Difficulty of accessing the foreign market	Easy	Medium	Difficult	Difficult	Easy	Medium
Exclusivity of production for one client	No, but exclusive models	No	No	No	Yes (one product)	Yes, some products
Subcontractors	Few	Few	Few	Few	Few	Many
Origin of inputs	Imported	National	National	National	National and imported	Imported/some national
Origin of owner/manager	Taiwan	Local, ex-worker of a local factory	Local, ex-worker of the collective factory	Local, ex-worker of the collective factory	Expatriate managers + Chinese manager	Local, engineer
Industrial cluster	Yes	Yes	Yes	Yes	No	No
Authorities support	Strong	Medium	Low	Low	Medium	Strong
ISO 9000	Yes	No	No	Yes	Yes	Yes
R&D	Yes, design and test	No	No	No	No formal unit of R&D, technology development team	Yes, strong R&D and collaborative links with universities

5.1 *TL: a Taiwanese shoe producer in China*

TL is a typical company created by ‘overseas Chinese’ from Taiwan. It was established in Nanhai, an industrial city near Guangzhou, where the shoe industry has been supported by local government. TL is a shoe-producing company quite strong in Taiwan, which has some 15 factories in Mainland China, all based on the production of sports shoes exclusively for foreign clients. TL, which employs about 3000 workers, produces sports shoes for Italian and North American brands. No foreign client has exclusive production in this factory. The factory is fit for the international market; it can produce for any large brand of sports shoes in the world. Containers are loaded inside the factory and shipped to the port of Nanhai.

TL has OEM arrangements with its principal clients and very stable contracts over time. The clients have permanent representatives located inside the factory for quality checks and production procedures supervision. The firm has a testing and experimental so-called ‘R&D unit’, which proposes new models to clients, mostly variations of previous models. In fact, the multinational brands rely more and more on these OEM providers for low-end changes in design. The cost of design is normally low because designers have low wages. The factory has a good competence in testing quality, an essential feature in this trade. Feasibility of the new designs is part of the package for technological learning.

The local firm publicises its regular contacts with the international brand. In every office the ‘ethical rules’ of the multinational are shown, particularly as to how labour and human resources are managed by the multinational group. The factory seems to work as a subsidiary of a multinational company. This is, however, a false picture: management of labour and local resources is not controlled by the foreign partner. Clients only check for quality and timing.

This factory is a typical example of the ‘triangle manufacturing’ depicted by Gereffi (1999,p.60) in the apparel and textile industry where:

“The US buyers place their orders with the (Taiwan or Hong Kong) manufacturers they have sourced from in the past, who in turn shift some or all of the requested production to affiliated offshore factories in low-wage countries (e.g., China, Indonesia or Vietnam).”

5.2 *CB: successful JV of a multinational with a city authority*

We can contrast the case of FDI made by the Taiwanese-owned company with this French multinational. CB is one of the largest packaging producers in the world. The multinational set up a joint venture with a company owned by a local government, the only legal form for foreign investment at that time.

On entering the market, they also were looking for immediate profitability, which arose from fully exploiting the market of the already existing company with which it formed the JV, and a strong and growing local market. A totally new investment was done to serve exclusively a US multinational, leader of cosmetics, soaps and detergents, by installing high-end equipment, using exclusive design for the moulds, and maintaining close relationships with the equipment producers. This new production line coexisted with two older lines, serving different markets.

The existing Chinese company, says the French director, needed little reorganisation. Technological reordering and financial cleanup were the two priorities of the new management. The company is small with around 280 workers and has always been earning money. The JV has benefited from the management experience of the French owners, but on the whole, production management and personnel have been in the hands of the Chinese managers with long-time experience. Some technical personnel in highly technical areas (moulds) have benefited from long stays in factories located in France.

Competition with Chinese companies is quite strong. To be a famous French brand is not sufficient to get new clients. The only stable market is the US transnational client. The French company has offered many times to buy the Chinese partnership, but the city authorities don't want to lose a company that is earning money.

5.3 WG: a collective enterprise in the faucets and plumbing sector

WG is a *collective enterprise*, that is, a company that formally belongs partly to a collective body (the municipality). Most collective enterprises have been at the forefront of the Chinese industrialisation, later becoming famous brands (like *Haier*, or *LeNovo*). The particular ownership status does not seem to deter their dynamism.

Before the reform, WG was once the only company in the city of Shuikou. It was dedicated to producing simple faucets made from cast iron. With the reform policy during the 1980s the company was challenged: some of its workers, who had been working there for more than 20 years, created private enterprises. Faucets and plumbing in general is a good business when there is a construction boom, as is still the case in China. Soon many more companies were created by former workers of WG, which is called the 'mother of all companies' in Shuikou, but it still remains the largest company in town. Among other things, it is the only one that has a metal-plating facility, a highly polluting activity that is nonetheless an obligatory passage point in producing faucets. Collectively owned, in fact, does not mean 'state-owned' and the company is managed very much in the same way as in other companies in Shuikou. The technology is not so much better in WG than that in other companies. Additionally, the company produces along the standards that are offered by the foreign clients; for the local market, the company provides models for merchants.

5.4 HY and CZ: two private SMEs in the faucets and plumbing business

HY and CZ are both private companies created by former workers of WG in the township of Shuikou. HY is a young company (eight-years-old) with 300 workers, all immigrants from other regions of China, like all workers in the other factories around. HY is quite well ordered, and managed as a family business, *i.e.*, the woman looking at the accounts, her husband managing the production and public relations. It is considered one of the best companies in the city, although the owner does not seem willing to share any friendship toward the authorities; 'public authorities means taxes', we were told. HY has been a better and stronger learner than many other companies we visited in the area. Nonetheless, the whole productive process is mainly manual. What makes the difference here is a stronger quality control, a better division of production tasks and a more efficient layout of the factory.

The company has benefited from one big contract with a Spanish client. After two years, the client proposed a joint venture, but the Chinese entrepreneur refused. Following pressure from local authorities, a joint venture has been set up, but the foreign client is a minor shareholder (only 20%), a rare situation since most JVs are set up in a manner that benefits more openly the foreign partner.

This entrepreneur never wished to lose the diversity of clients and has no exclusive contracts with any client. Visits of technical foreign personnel are quite frequent, but the quality control is not local. The case of CZ, created nine years ago, in this town of Shuikou, is quite different because this company is producing exclusively for the export market, mainly to the German market. CZ, with 200 to 250 employees, is a 'real' ISO 9000 company. It has invested strongly in the ISO process and the owner and general manager have used the ISO system as a lever to maintain high quality. This company has been introducing many new products and making considerable adaptations to the production processes. The owner has visited professional fairs in Germany and has brought with him faucets which have been 'reversed-engineered'. Technicians coming from client-enterprises have also inspected the company. In Europe, its production is considered of middle-range quality. In order to produce higher quality, investments would be too important.

5.5 *JL: local state-owned enterprise with strategic alliance in the washing machines*

JL is a local government-owned enterprise, a collective enterprise, producing washing machines since 1979. It started with a production of 200 machines per year and now it produces above one million. Today, it produces among the highest quality washing machines in China (sales of two billion Yuans per year, around 250 million USD, and has exported last year for eight million USD). Today, it is the fifth producer in China, the third exporter of washing machines. Recently it entered a JV with Mitsubishi for the production of air-conditioners, and is considering a partnership with General Electric in the washing machines business.

The production of washing machines exemplifies the evolution of the Chinese market. The sector has been dominated rapidly by companies that today either disappeared or have lost their rank. A famous case is *Weili*, a collective company based in Zhongshan well known as the main producer in China. Today Weili produces less than 20 000 cheap and obsolete units per year.

Managers of JL explain their success by the fact that they were a relatively small company that did not attract the envy and greed of provincial authorities. Apart from this political aspect, a constant strategy based on technological learning is perhaps a better explanation. JL has developed good processes, high quality products, created an R&D unit, and kept a continuous training for its personnel. Workers here are mainly local people, not immigrants from other regions, and are rather well paid. It looks actively to create a production unit outside China: Brazil will probably be its next destination. JL is also an OEM for many large firms in China like Konka and TCL. These well-known brands produce other types of equipment like televisions, computers, and telephones. Washing machines under their brands are produced by JL.

The company has developed competencies in product design, training of human resources, process capabilities. It has benefited from the help of the city office of science and technology for developing partnerships with a local engineering school, and developing its R&D unit. It focused on Computer-Aided Design (CAD), a priority in Guangdong and also installed a GIS for sales management. Research focused on a highly automated system of electronic commands of the washing machines. It also designs specific moulds for its equipment. A cooperation with Tsinghua University, Department of Engineering in Beijing (among the most famous universities in China) was established, and with the Normal School of Beijing, the Industrial University of Harbin, and the Polytechnic School of South of China in Guangzhou. Some of these collaborations were supported by the National Programme for Science and Technology. Its investment in R&D has always been quite high: 4.1% in 1998 and 5.9% of its sales in 2001.

Their strategy is to constantly produce new washing machines: new products represent 30% of their sales. "We want to export and be famous because of the quality of our products and our technological innovation", says the general manager. JL also has a patent policy, a portfolio of 20 patents (of which seven are technical patents) and an intellectual property office, a rather unusual feature. Some patents have been extended abroad. The company also learned how to manage efficiently its network of suppliers. For example, the motors are produced outside the company and have attained a 90% rate of acceptance.

Recently the company created an affiliate JV with Mitsubishi for the production of air-conditioners. "For Mitsubishi, the air-conditioning is a small division; for us it means a lot. They have among the best technology and we will learn a lot from their management. Our own development will benefit from this unit". This JV is entirely Japanese-managed. The objective is to see how the Japanese manages their company.

JL also entered in a partnership with General Electric (GE). Although the company does not show this as being of paramount importance, it is in fact a decisive step. JL was a supplier of GE for washing machines sold in Latin American. The technical level of the machines attracted the attention of GE. Now, entirely automatic machines are produced as an OEM arrangement with GE. The aim of JL is to have a strategic alliance with GE.

6 Analysis of cases in a learning perspective

We chose these six case-studies in order to highlight the relations of the companies with their foreign clients, because they are typical of the industrial world of Guangdong (Guangdong Office of Science and Technology, 2002). Table 3 summarises four models of learning that we could identify through these cases. The main sources of knowledge, except the joint venture, come from the support the client gives to the company as it inspects productive processes, gives the blueprints and pushes the company for higher quality. The client is, thus, the main provider of technology.

1 OEM model

The OEM model made Taiwan famous and is well fit for a globalised industry, where the international brand puts the orders while the factory deals with the local advantages. Taiwan producers, already used to these OEM arrangements, understood the full advantage they could get from coming to Mainland China. Somehow differently, Hong Kong capitalists also came to Mainland China seeking low costs, transforming Hong Kong into an industrial desert. Local Chinese enterprises cannot access foreign clients with the same facility.

2 Contracted provider

The second model is very well illustrated by the Shuikou industrial cluster. It is particularly interesting because it concerns mature industrial sectors populated by SMEs, which are the main force of China's industrial growth, and will probably still be for many years (Lemoine and Unal-Kesenci, 2004). The local companies are aching for foreign clients. "Our clients are our teachers", said one manager. All the best quality producers are linked one way or another to international clients who give them new blueprints and propose improvements in quality. Companies become contracted providers for foreign clients because they have to. They also know that the local market will be unable to sustain today's large quantity of producers and sooner or later only the best ones will survive a more competitive market (see the domestic consumer electronics sector in Cao, 2004).

3 The Joint Venture (JV) model

JVs were once thought to be the panacea of technology transfers. China has provided legislative effort in order to promote FDI and JVs. Foreigners are usually uncomfortable with the figure of the JV and most foreign companies now want to become wholly owned foreign enterprises, since the law is authorising this new possibility. In most JVs, the partnership is a forced one, not a chosen one, and whatever the benefits, it is always seen with suspicion. Inside the JV there is an important input of technological know-how, as would be the case for the subsidiary of a transnational firm. But all decisions *in fine* depend on the internal structure and strategy of the transnational or foreign partner.

4 The mixed model

This appears to be the ideal model, as exemplified by the case of JL. Other large companies in China, mainly collective companies, like Haier, TCL, Konka, Legend (now LeNovo) or Fenghua follow a similar model; these companies are not so numerous in China. Under this model, the company has a learning strategy based on technological development and high standards in production; it also develops collaborative R&D with outside sources of knowledge. At the same time, these companies also seek to become, at least partially, OEM providers. This allows for lower cost in entering the foreign markets, and permits to get a grip on the technology as well as marketing in foreign countries. As an outcome, they also try to set up facilities in foreign countries, a growing tendency for Chinese enterprises.

Table 3 A brief typology of models of interactive learning

<i>Model of interactive learning</i>	<i>Main characteristics</i>
OEM model	Dominated by FDI, the company is inserted in the chain value. Stable relation, regular and long-term commitment to client. Strong productive learning, design capabilities. But no original design, no capacity to innovate strongly in models since the brand is the one which decides. Example: TL (Nanhai), Taiwanese shoe-maker
Contracted provider	Unstable relation to client. Strong local competition. Can be private or collective enterprise Emphasis on quality control and productive processes Example: enterprises in Shuikou WG, HY, CZ
JV, subsidiary or affiliate	Mainly internal learning. Transnational circuit Very stable relation. Example: CB
Large local producer with OEM and provider under contract	A mix of stable and unstable relations External learning, emphasis on quality control and productive processes as well as on innovative products. Example: JL

7 Conclusion

Companies in South China are quick learners in a usual catching-up strategy. They engage actively in looking abroad for sources of technology and seek actively to cooperate with foreign clients in order to have access to better technology. Their foreign cooperation is driven by this need for productive technology rather than a need to export. They seek these contacts through varied forms and channels, always maintaining the variety of foreign clients and arrangements. This 'copy and fabrication' strategy opens possibilities for larger production scale, better knowledge, and wider markets. The association with a foreign client is thus strategic to practically all companies that want to go up the value chain, to approach the technological frontier and to access the more lucrative markets.

In Asia, the discussion centred on how companies upgrade from productive to technological capabilities. The South Korean experience shows the switch from basic productive capability to a more complex technological capability is linked, but not exclusively, to the introduction of R&D, to some organisational sophistication, and to the integration of technology and markets in the strategy of the firm (Kim, 2000). The models of learning that the Chinese enterprises are experiencing can trace their origins to this East Asian catching-up model (see for example the work of Hobday, 1997). In fact, what our research found is that learning in Chinese enterprises has not created a new paradigm for the learning literature. On the contrary, the learning experience of the Chinese enterprises is an ordinary process and the industrialisation of the South of China should be regarded as a normal catch-up case, even a follower of the Asian model. Even firms advancing more rapidly toward an innovation frontier are in this pragmatic, down-to-earth catching-up model, upgrading cumulatively productive and control knowledge. These firms introduce new models as long as their foreign clients provide them new blueprints. Firms that seem to enter in a transitional stage in upgrading from a basic productive learning to a more sophisticated technology learning maintain the same

diversified types of contacts with their clients, aggregating more sources of knowledge and trying to keep a multiplicity of external sources. These firms follow a mixed model of interactive learning, maintaining a variety of sources of technology, keeping a large portfolio of clients and products, accepting to be both OEM providers for some products and an autonomous brand for others, depending on the market.

From an economic point of view, what is surprising is how such an ordinary technological learning based on a catching-up strategy at the firm level could lead to such an extraordinary fast industrialisation at the macro level, which is sometimes called 'China Miracle' (Lin *et al.*, 2000). The answer might rely on the size of this common-type learning. When an ordinary learning behaviour spreads through thousands of all kinds of enterprises in an economy like the Chinese, the result would be like the consequences of a typical Chinese social movement, *i.e.*, a mass outcome or a 'miracle'. China, since the beginning of 1980s, has been carrying out a massive technological learning movement throughout its industrial firms based on the initiative of its new emerging companies. This process is far from finished and will reveal more surprises, a fertile ground for socio-economic analysis.

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Note

- 1 This article will not deal with the role of local governments in China, nor the foundation of the national innovation system, but see Arvanitis (2004), Sigurdson (2002), Xu (2004), Suttmeier and Cao (1999), Liu and White (2001), Huang *et al.* (2004), Gu (1999; 2001).