INTERNATIONAL TECHNOLOGY TRANSFER TO CHINA

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SUMMARY

Technology transfer to China from developed countries has been developing at a rapid pace since a market oriented economic reform policy was introduced in the early nineties. Previous research activities in this area largely concentrated on the process of technology transfer and the behaviour of concerned organisations, and the case study method was normally adopted by researchers. There seems to be a lack of qualitative research on the macro trends of technology transfer to China.

The objective of this research is to produce the trends of technology transfer to China in key industrial sectors, in which further analysis based on their relations with government's policies is also carried out. The project also looks at other interesting issues, notably the comparisons among most developed countries. In order to achieve these goals, a database of major contracts signed between China and other countries in the last five years is constructed for the analysis, and a theoretical model is established to form the basic structure of the process of technology transfer. A linkage between the results derived from the database and environmental factors in the model, which mainly include political events and economic policies, is therefore established.

Year, country, industrial sectors, type of agreement, and regions were selected as the key variables for the data analysis. The results demonstrate the inter-relations among these variables. In addition, key industrial sectors such as the telecommunications, aerospace, and automotive sectors are examined in detail to show that certain policies specially designed by the Chinese government have a strong influence on the level of transferred technology. The results indicate that the level of technology has become more significantly important than other factors in the transfer process, and the Chinese government's policies have achieved their original goals of attracting more advanced technology to specific industrial sectors.

Key words: Major Trends, Key Industrial Sectors, Reliable Database, Environmental Factors, Theoretical Model

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LIST OF CONTENTS

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION TO INTERNATIONAL TECHNOLOGY TRANSFER

There is a wide range of research activities related to international technology transfer from developed countries to developing countries. The majority of these research activities are conducted in case studies and are focused on the organisational behaviour of the corporations concerned in the those cases. This project, however, mainly involves quantitative analysis, which is based on a database consisting of major contracts published by China-Britain Trade Review and China Business Review. The results of the analysis will then give us a clearer indication as to what factors have more influence on technology transfer to China. The results will also show how the correlation between political and economic policy shifts and the level of technology transferred can be justified. The first task is to establish a theoretical framework of technology transfer. The objective of this chapter is therefore to review the work of some previous researchers and to build a simple model of international technology transfer, which can be used in our discussions in later chapters.

1.1 Technology and Technology Transfer

The term "technology" is a rich but often ambiguous concept . Many researchers have given or adopted different definitions for it. In his review of definitions of "technology", Blakeney (1989) said, "At its broadest, technology has been defined as 'the skills, knowledge and procedures for making, using and doing useful things'

(Merrill 1968), or as 'the means and capacity to perform a particularly activity' (Gruber and Marquis, 1969). In its commercial context technology is taken to embrace the 'knowledge of how to make use of factors of production to produce goods or services for which there is an economic demand' (Brown,1979)." Contractor (1990) also pointed out that though technology is mostly confined to engineering or production, it may include proprietary marketing or administrative techniques. Thus a clear classification is needed to distinguish different types of technology. Having studied previous research results, I find there are two common ways to classify technology. I shall call them as "vertical classification" and "horizontal classification".

The vertical way is to classify technology based on its levels ---- "conventional technology" or "high technology" . According to Blakeney, conventional technology is used to refer to the technology in the shoe , textile, paper and cement industries etc, and "high technology industries are characterised by very large 'research and development expenditure, a large element of complex patented or non-patented proprietary technology, rapid and continuing technological change, high capital requirements, a stake in maximising the profits or quasi-rents on this high technology and product differentiation' Chudson (1971) ". However, certain technology which is considered to be conventional in developed countries may well be regarded as high technology in some developing countries. Another problem due to such classification is that it needs to be modified from time to time, since high technology will possibly become conventional as time passes by, especially in the current business environment where information technology is being rapidly developed.

"Horizontal classification" is used to distinguish hard technology and soft technology. Hard technology is embodied in a tangible form, such as machinery and plant. Soft technology is intangible and involves items such as managerial and technical skills, organisational structures and development. So soft technology is simply human skills or practices, not "things" to be transplanted (Morgan 1990). The horizontal classification is difficult to understand because it is not as commonly used as vertical classification in our daily business life. A major element in "soft technology" is organisational technology, which consists of organisational structures and processes that do not involve physical technology, or involve them only peripherally (Westney 1990). However, I am not going to include management skills as a type of technology in this project. Therefore, throughout this project the term "technology " will refer to "hard technology", unless otherwise specified.

We have now defined the meaning of technology and its two classification methods. But what do we mean by technology transfer? There are two approaches that need to be distinguished. Technology transfer can be viewed as a communication process from R&D to industrial practices and it normally occurs within one organisation. The whole transfer process can be cast in three levels which differentiate the goals involved in the transfer : Technology Development, Technology Acceptance, and Technology Application (Williams and Gibson 1990). This process is sometimes called "vertical transfer", which is completely different from the "vertical classification" we have defined. The other approach is to view the transfer process as taking place from one organisation to another (again, it is sometimes called "horizontal transfer", which is a

different concept from the "horizontal classification" we have defined). When such a process involves crossing national boundaries, an international technology transfer occurs. Though the two approaches can sometimes be inter-related, our prime concern in this project is the latter one. In his work of building an overlying model of the entire transfer process, Robinson (1990) defined the meaning of international technology transfer as follows:

The development by people in one country of the capacity on the part of nationals of another country to use, adopt, replicate, modify, or further expand the knowledge and skills associated either with a different manner of consumption or product use, or a different method of manufacture or production of either a product or service, than that previously known.

He also pointed out that "technology can only be replicated elsewhere through some sort of communication process", " it is more accurate to view technology transfer as a relationship, rather than an act (Contractor, 1980)", and " one might say that it is a relationship built by a communication process". Hence a major part of the study of technology transfer is about analysing the communication process between technology suppliers and technology recipients. Generally speaking, a technology supplier is an organisation from a developed country, and a technology recipient is another organisation from a developing country. Having said that, we do not however exclude technology transfers between developed countries or those from developing countries to developed countries, since technology transfer is becoming more multidirectional

(Safafi-nejad,1990). Though there is a vast range of non-commercial transfers of technology (Blakeney 1989), we confine ourselves to commercial organisations in this project.

The communication process of technology transfer takes place through certain intermediaries. Different researchers have adopted different approaches towards studying these intermediaries. Helgard Wienert and John Slater (1986), treated these intermediaries as different types of co-operations and thus the focus was on the analysing the agreement forms. Another way, which was demonstrated by Robinson, emphasise the linkages between suppliers and recipients, and the transfer methods adopted through such linkages. A certain type of technology is therefore, transferred through an organisational link by using a transfer mechanism.

1.2 Transfer Mechanisms and Organisational Links

Some commonly used organisational links are joint ventures, subsidiaries, branches, agents and partnerships etc. Transfer mechanisms include sale of equipment, license, training and turnkey contract etc. Different transfer mechanisms are used for different types of technology. For example, when a British manufacturing company forms a joint venture in China with a local partner, its technology is usually transferred to China through a combination of sale of equipment, licensing and training. In this case, the organisational link, i.e. the joint venture, is the centre point of the technology transfer. Hence a joint venture is sometimes regarded by some researchers (Sagafi-nejad 1990) as a single transfer method. When sale of equipment occurs, it is the technology embodied

in the equipment that has been transferred. Simple licensing is regarded as the traditional form of technology transfer from Western developed countries to Eastern communist countries, but it is not sufficiently effective because it does not need any commitment on the part of the supplier (Skowronski, 1987). Since one of the major elements involved in technology is human skills, training is usually considered to be a necessary part of the transfer process, especially when the supplier is a multinational enterprise which holds a stake in the recipient company such as joint ventures and wholly foreign owned ventures. As Kim (1990) stated in his research of multinational technology transfer, " hiring local citizens and training them how to use the respective firms' methods and products have become increasingly important tasks for multinational firms".

As we just mentioned, technology may be transferred through organisational links such as joint ventures and wholly foreign owned ventures. The differences between different organisational links give companies the option of whether to transfer its technology internally or externally. Robinson defines an external transfer to be "one in which the recipient has no long-standing, formal relationship with the transferring firm", whereas an internal transfer "is one taking place between two closely related entities". For example, a multinational enterprise may transfer its technology internally through its subsidiaries abroad. Robinson draws a conclusion that the decision of whether to transfer technology internally or externally depends on two parameters ---- the maturity of the supplying firm and the maturity of the transferred technology. The maturity of a firm is its experience in international markets. The maturity of a technology relates to where a technology lies in its life cycle, which is divided into 11 phases: discovery,

research, development, commercial, market introduction, modification, standardisation, universalisation, competitive intensification, replacement, and disappearance. Robinson concludes that a firm is inclined to have a higher propensity to transfer technology externally during its earlier years of international involvement, since it has few associate firms abroad. But it is more inclined to seek internal transfers as it has more connections abroad. As the firm gains still further experience internationally, it tends in fact to transfer technology externally in order to maximise returns on the technology, which is normally a mature technology. If it is a less mature technology that is still under development and modification, the firm tends to transfer it internally.

1.3 Groups of Factors Influencing Technology Transfer

We could view organisational links and transfer mechanisms as channels between technology suppliers and recipients. The quality of a channel can determine whether a transfer will be successful. However, a successful transfer does not entirely rely on the linkages between the supplying and receiving parties. There are other factors that are inter-related to these channels but are also equally important. Sagafi-nejad (1990) grouped all the variables related to technology transfer into four clusters : technology, transfer, organisational and environmental. The transfer variables reflect the linkages through which a transfer takes place, i.e. the organisational links and transfer mechanisms that we just mentioned. The following discussion therefore concentrates on the other three factors.

1.3.1 Technology Factors

Sagafi-nejad suggested that a typology of technologies would be needed to understand the process of technology transfer. He also defined the technology variables as "those that help differentiate technologies from one another, be it along industry lines, complexity, life cycle, R&D intensity, or another attribute". We have already shown that the maturity of a particular technology has an effect on the transfer mode that the two transfer parties will adopt. There are other variables related to technology that also have effects on the transfer process. Robinson used " technological dimensions" to classify all the variables related to technology. He suggested that there are 15 technological dimensions that need to be considered: maturity, dynamism, relative importance, environmental specificity, factor substitutability, scale specificity, availability, complexity, centrality, production continuity, susceptibility to reverse engineering, process/product, firm specificity, primacy and completeness. The detailed explanations for these characteristics are given by Robinson in his work. Though all of these variables are considered to be related to technology variables, some of them may also be classified into organisational or environmental variables such as environmental specificity and firm specificity. Hence "Chinese walls" exist between the four groups of concerned factors. This phenomenon also justifies the fact that all the four groups are inter-related.

1.3.2 Organisational Factors

The organisational factors specify how a particular transfer may be influenced by the organisational structures of both supplying and receiving firms, or by the links between

the two parties. We mentioned earlier the role of organisational links, such as a joint venture or a wholly foreign owned venture, in the transfer process. In later chapters, such links related to Chinese business, and joint ventures in particular, will be discussed in detail. One of the core issues in organisational factors is the transfer of the structure of the organisation itself, because a certain type of organisational structure such as an unique management style, as it was said earlier, can be regarded as "soft technology" . However, for the sake of simplicity, such kinds of technology are not included in this project. Another key issue raised from the organisational structure is the contribution to international technology transfer from multinational enterprises. Because of their experience in international markets, and their well established networks of subsidiaries or associated firms, multinational enterprises have certain advantages in cross border technology transfer other firms with smaller operational scales. And they particularly dominate the technology trade in patents, licensing and technical know-how (Safarian and Bertin 1986). The importance of organisational structure in the transfer process is also reflected by the variations of patent agreements among different organisations. An organisation has its own attitude towards the issue of intellectual property, depending on its industrial sector and national origin, which effectively determines the structure of the organisation. For example, Sagafi-nejad noted that Japanese firms tend to rely more heavily on patenting than their US and Western European counterparts. Due to China's poor record in protection for international intellectual property, exceptional care is needed in dealing with Chinese firms.

1.3.3 Environmental Factors

A particular patent agreement also depends on the intellectual property and patent laws in the technology receiving country. We can consider the regulations and laws as the variables which influencing the transfer process in the legal environment. Sagafi-nejad grouped societal (environmental) variables into five clusters: economic, cultural, political, administrative-legal, and infrastructural. This is a macro view to see which environmental factors are considered to influence the effectiveness of the transfer process. Economic variables are the indicators of the host country's economic performance, such as GNP growth, market size and labour force etc. Cultural variables are to do with people's attitudes in the host country towards new technology, foreign investment, and foreign management styles. The political system is possibly the most important and sensitive issue. For instance, it is fair to say that the fact that new technology has been flowing into former Eastern European countries for the past four years is a direct consequence of the political changes in those regions. In the case of China, however, it was the open-door policy that first attracted foreign investment and technology. Other environmental factors such as major policy shifts in some industrial sectors have also played a part. We will look at this issue more closely in the later chapters. Administrative-legal variables define the legal environment in which businesses operate. The collapse of an agreement on technology transfer can be caused by some inadequate intellectual property laws in the host country, or lengthy bureaucratic administrative processes, or both. Infrastructural variables refer to the levels of the institutions in host countries that conduct scientific and technological development and training. As R&D and training institutions in the host country improve, more advanced technology will be transferred. The differences among

developing countries in these five major technology related environments are enormous. Thus, each country should be dealt with separately.

1.4 The Final Model

Having reviewed the major concepts in the technology transfer literature, we now can build a final model based on our discussions (See page 20) based on our discussions in 1.2 and 1.3.

The model on page 20 illustrates the flow of technology and the four groups of factors influencing the transfer process. The arrows connecting the four groups indicate the ways information flow between these four groups. The examples for each group of factors are also illustrated in the model, of which transfer mechanism and organisational links have the most direct impact on the transfer process.

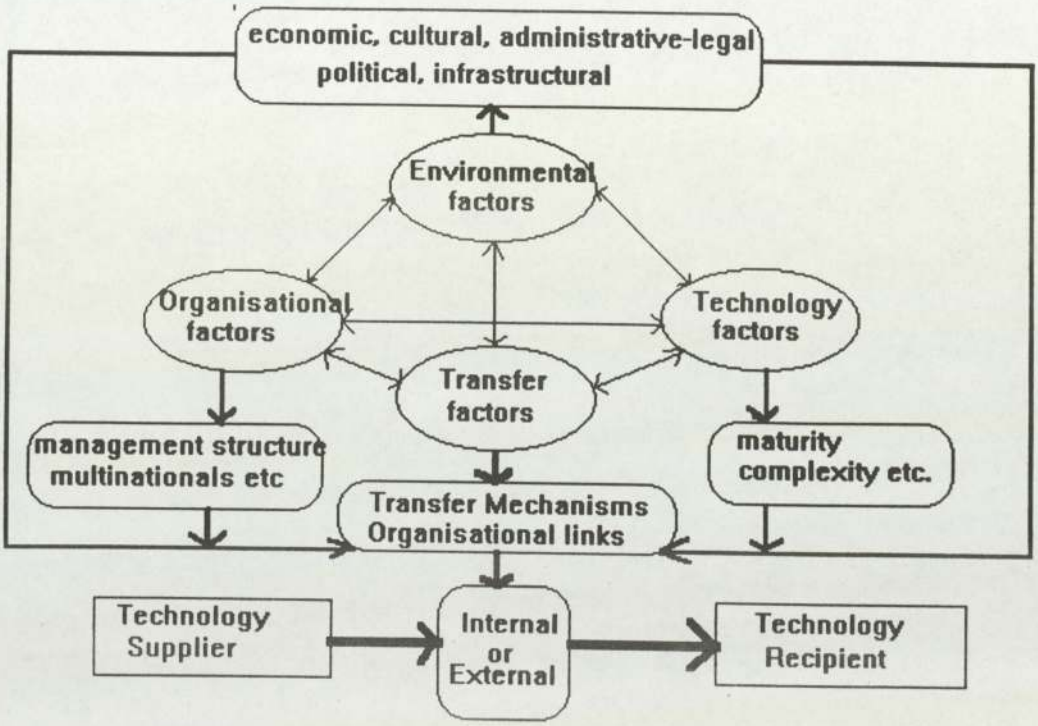


Diagram 1. Simple Model of International Technology Transfer

CHAPTER TWO

INTRODUCTION TO TECHNOLOGY TRANSFER TO CHINA

In order to analyse the trends in technology transfer to China during the early 1990s, it is necessary to introduce some related background knowledge. The background introduction in this chapter has two aspects. Firstly, general information related to technology transfer in four areas will be reviewed: the history of technology transfer since 1949, the economic background in the 80s and early 90s, the trends in technology transfer in the 80s, and some of the major factors influencing technology transfer in joint ventures. Secondly, major macro policy changes which had direct impact on technology transfer will also be introduced later in this chapter. Since the early 1980s, the Chinese economy has made two U turns, caused by two major political events. Our analysis in the next chapter will show clearly how these two events affected trends in technology transfer.

2.1 The History (1949 --- 1979)

After decades of social unrest and civil war, there were virtually no significant technological or industrial bases left in the mainland, when the People's Republic of China was established in 1949. China turned to other industrialised Communist blocks for technological assistance.

The technology introduced from the Soviet Union and Eastern European countries in the 1950s was mainly in heavy industrial sectors, and as a result, by the late 1950s, the foundation of China's industrialisation was established. Because both the Soviet and the Chinese economies were highly centralised, all projects involving technology transfer were of the form of inter-governmental agreements. Technology transfer was therefore very strongly politically oriented. Such orientation proved to be fatal when the relationship between China and the Soviet Union broke down in the late 1950s and eary 1960s. All Soviet experts were withdrawn from China and technology transfer was completely suspended. During the years of the Culture Revolution, China's economy was in severe decline. While some of China's neighbours were enjoying consistent booming economies in the 1960s and early 1970s, the transfer of technology to China was almost non-existent, with the exception of a small amount of Western technology imported for scientific research. In the mid 1970s, when the Culture Revolution gradually subsided, and after the celebrated visit by President Nixon, China began to import a small amount of technology from Western countries in the chemical, steel, and power industries. But it failed to assimilate the imported technology, and there was no rapid improvement in the economy.

2.2 Background to China's Economy (1980-1994)

Generally speaking, China's economy has been growing positively since it first introduced its open door policy in 1979, three years after Mao's death. It marked the end of thirty years of virtual isolation from the West. The importance of the opening of China to the rest of the world can hardly be underestimated. It was widely compared to

the discovery of a new continent. In this section, three aspects of the growing economy, both positive and negative ones, will be briefly introduced: economic growth, the impact on science and technology research, and rising social problems. In addition, we are going to examine foreign direct investments, which is the most influential factor in the economic success, and its relation to technology transfer to China in the 1980s. In the later section of this chapter, some government policy shifts will also be looked at closely. A more detailed examination of technology transfer in various industrial sectors in relation to political and economical changes from 1989 to 1994 will be in covered in chapter five.

2.2.1 Economic Growth, Technology & Science Development and Social Problems

According to a report in the Financial Times (Wolf and Walker 1994), China's economy has been growing at such a pace that real gross domestic product expanded by 270 per cent between 1978 and 1993, which means a compound annual rate of 9 per cent a year. Economic growth in 1992 and 1993 was believed to be at least 13 per cent. 1994 was the year in which the government wanted to slow the growth down to a much healthier 8-9 per cent, yet it ended at 11 per cent. Those figures reflect overall growth, which means that they include both state-owned and the private sectors. The growth rate in private sector is believed to have been at a much faster pace, as much as 50 per cent in some enterprises for 1992 alone (Walsh, 1993).

The impact of the open door policy on scientific and technology research in China has been tremendous. Scientists have started to make their mark internationally, despite

chronic shortages of funds and equipment. They have been catching up to their Western counterparts on a broad front, and in several key fields may be pulling ahead, such as lasers and optics, biotechnology, superconductors, and carbon isotopes (Elmer-Dewitt, 1993). However, on the whole, China is still well behind well developed countries as far as science and technology are concerned.

On the other hand, after years of over heated economic growth, China has been infected with some painful diseases. The rate of inflation was very high in the early 1990s, as much as 27 per cent in some coastal cities, but there have been some good signs since the end of 1994. Corruption seems to be unstoppable, and it has scared away some potential investors. As more foreigners have learned how to do business in China, however, corruption has gradually been accepted in the business world. The gap between the newly rich and the poor is widening tremendously, and millions of peasants have been moving to coastal areas looking for jobs. State-owned industries have begun to make workers redundant by hundreds of thousands, and the unemployment figures have been rising sharply in recent years. The mixture of great economic achievement, seemingly incurable social diseases, and uncertainty about the future leadership, has made the future of China's economy mysterious and to certain extent, almost unpredictable.

2.2.2 Foreign Direct Investment and Joint Ventures

The driving force behind overall economic success is the massive foreign direct investment. In the early 1980s, China struggled to modernise itself by abandoning

collective farms, engaging cautiously in foreign trade, and most importantly, inviting outside investments into experimental enclaves called Special Economic Zones (SEZ). The most notable SEZ was Shenzhen, which was a tiny fishing village in the late 1970s and expanded to a commercial city with three million residents within a decade. The success of SEZ encouraged the government to open 14 other coastal cities, which include Shanghai, Guangzhou and Tianjin. In addition, Pudong, the underdeveloped part of Shanghai, was put on the top of the agenda for attracting foreign investments. Because of the great importance of foreign direct investment to China's economy, it is necessary to examine it in details here, and in particular, its relation to technology transfer.

Foreign direct investment in China can be classified under five headings: Joint Venture, Wholly Foreign-Owned Venture, Joint Development, Compensation Trade, and Processing and Assembling.

There are two basic forms of joint venture in China ----- equity and contractual, and they are commonly adopted in manufacturing and service businesses (Dingle, 1990). Generally speaking, a manufacturing joint venture is in the form of an equity venture, with capital inputs required from the foreign partner for, among other things, providing or updating equipment. A service joint venture, in which the expertise of the foreign partner in management or technical know-how is usually regarded as the main contribution, is often contractual. Thus, the foreign partner in an contractual venture is not a shareholder but shares profits or liabilities under the terms of the contract. But some joint ventures are a the mixture of these two forms. For instance, the construction

and ownership of a hotel may well be an equity venture, whereas the management is an contractual venture. As was mentioned in the last chapter, a joint venture is a very important organisational link through which technology transfer takes place. However, it does not mean that the relation between the number of joint ventures and the amount of technology transfer is linear. If "soft technology" and "low technology" are excluded as they are in this project, we may find that lots of quite popular joint ventures in southern China involve little or no technology transfer, such as in the tourism business and some labour-intensive manufacturing ventures.

China was the first Communist country to allow 100 percent-held affiliates of foreign companies (Plasschaert, 1993) . Since wholly foreign-owned ventures were rare in the 1980s, there was hardly any research related to this area. Although there was no Chinese partner in such ventures, technology transfer could still take place through the training of local employees. As Western countries gradually learned to understand the way of doing business in China, they would not have to rely on Chinese partners as is the case with some joint ventures. It was therefore expected that there would be more ventures of this kind in the 1990s. Our later results in chapter four will show it is indeed the case.

Plasschaert also pointed out that joint development was commonly used in the natural resources area, particularly in offshore oil exploration and production. Such forms of international collaboration were limited, and almost no detailed investigation of technology transfer has been conducted.

Like joint ventures, the development of processing and assembling industries was also quite popular in the 80s, especially in the southern part of China. Direct sales of technology or equipment sometimes occurs through this kind of investment. The materials, machinery, or technical know-how were contributed by foreign partners, though they did not share any enterprise risks.

The final form of foreign investment is compensation trade. It is classified as foreign investment because to a certain extent, it involves importation of technology. Once quite popular with Russia and other Eastern European countries, the compensation trade is basically a barter trade, with foreign partners being remunerated by goods produced out of the common venture or from other sources. I suspect that this kind of trade will not continue in private sector, since the quality of imported technology from Eastern European countries is thought to be not competitive enough to match the requirements of the booming domestic market. For the sake of simplicity, this kind of technology transfer will be ignored in my further discussion.

The precise total amount of foreign investment in China in the past 15 years is unclear. The Financial Times put the total amount of pledged investment between 1979 and September 1994 at $275bn (Walker, 1994 [1]) . Li (1992) estimated that US$45bn had been invested by the end of 1991, and that a further US$56bn were invested in 1992 alone (Bennett and He ,1993). The sharp rise in 1992 was a direct response to Deng Xiaoping's famous visit to southern China early that year, when he pointed out the need for a more accelerating pace of reform. We will see from later discussion that Deng's visit was one of the two political events that had a direct impact on technology transfer.

His visit also demonstrated the weak side of China's economy. It is heavily dependent on the politics. The other event that inevitably influenced foreign investment was the tragedy of Tiananmen Square. Most investors decided to stay in China after Tiananmen, but few risked the commitment of new funds (Seo, 1993). New loans to China by Western countries were restricted and delayed. But when the Chinese government repeatedly emphasised that there should be no linkage between politics and business, and the open door policy would remain same, investment came back on course, and it has been increasing exponentially for the past four years. Perhaps a more convincing reason for the return of foreign direct investment is the recession in western countries during that period. We will look more closely at this issue later in this chapter, as well as in chapter five which covers some industrially based studies.

2.3 Review of the Trends in Technology Transfer (1980s)

The trends in technology transfer to China in the 1980s were analysed by Kent (1990). The database she used was set up by using information published by the China-Britain Trade Group (CBTG). The information included all the published contracts signed from July 1980 to April 1989. In her database, she did not include any of what she considered to be technologically irrelevant contracts such as joint ventures in tourism. Several major trends in technology transfer were analysed in her work ----- the annual total number contracts, the number of contracts signed by different Western countries, the contracts in different industrial sectors and their relations to different countries, and the types of agreements used. Kent focused fairly heavily on the foreign countries' involvement in technology transfer. As her results are reviewed in this section, I will

also concentrate on this aspect, and in addition, I will investigate the involvement of Hong Kong in technology transfer, an area which might affect the accuracy of Kent's results, but not examined by her.

2.3.1 Annual Total, Foreign Countries and Industrial Sectors

Kent found that the annual total number of contracts increased steadily until 1986, when the government started to reduce the rate of growth in industrial output and foreign trade, and as a result, the figure dropped dramatically. The number of contracts bounced back in 1988, but in 1989 it went down because of the Tiananmen Square event.

Over the decade, the percentage of contracts won by the UK had dropped, whereas US companies gradually gained a higher proportion of the contracts. Kent suggested that the decline in the percentage of contracts won by UK companies and the rise in that of US companies were due to political factors. She noted that the traditional anti-Japanese feelings among the Chinese had affected Japanese companies' performance, though they still dominated most industries along with the US. She also compared the performance between European countries. The presence of UK companies in China was the strongest. West Germany came closely behind, followed by France and Italy. However, West Germany always looked like it was going to overtake the UK. The reason, as Kent explained, was because of the downturn in the British economy with respect to that of West Germany which was relatively healthy. As I found out later in my research, there seems to be another more direct reason for this phenomenon. The Chinese have become more aware of the level of technology imported as more foreign companies try to get

into the Chinese market, and there has always been a slight gap between German and British technology. When the level of technology, which forms an important part of technology factors in our model, is taken into account, the British companies may lose some competetive edge to their German counterparts.

When different technology sectors were compared, Kent found that electronics had maintained a fairly stable percentage of the total number of contracts since 1984, and had increased its share over the decade. The other dominant sector was Power/Energy, with Chemicals and Telecommunications emerging at the end of decade. I believe this conclusion reflects a complete change in Chinese technology transfer policy from the 1950s to the 1980s. Both heavy and light industry were emphasised in the 80s whereas the latter was completely ignored during the 1950s. Kent also found out over the decade, that the country which dominated the market in each year was at the same time the country which dominated the major technology sector and that in the three years, 1984, 1985, and 1986, the country was the US and the technology was in the electronics sector . This result can also be used, as I found out, to support one of the previous conclusions that the Japanese companies' performance might be effected by some factors other than their economic or technology level such as the traditional rivalry between China and Japan, since both the US and Japan are regarded as the leaders in the electronics sector.

2.3.2 Confusion Over Hong Kong Companies

One of Kent's results shows that the percentage of contracts involving Hong Kong rose during the decade to reach a high of 8.9% in 1989. She did not raise any question about the reliability of this figure. However, I found there was an interesting problem which needs to be addressed here. It is true that most foreign investments were from Hong Kong in the 1980s and it is also believed that up to 1984, over three-quarters of the joint ventures in China were from there (Beamish and Spiess, 1993). And in the late 1980s, Hong Kong's share in foreign investment was reduced, as more countries came to China. But Kent's figure showed that the highest percentage of contracts involving Hong Kong was only 8.9 per cent, and it did not occur in the early 1980s but in 1989. At first glance, it appears that there was an contradiction, which means Kent's results might not be reliable. However, I think that there are reasons which can be used to justify her results. Firstly, although most joint ventures were set up by some companies from Hong Kong in the early 1980s, most of them were labour-intensive, low-tech, or even non-tech manufacturing or hotel business in southern China (Sit, 1986). Thus, many joint ventures of this kind were excluded by Kent in her research. Secondly, the proportion of contracts from Hong Kong involving low-tech manufacturing was gradually reduced over the years, while the proportion of contracts involving direct technology transfer was increased. Therefore, Hong Kong's involvement in technology transfer increased despite the fact that its shares of foreign direct investment decreased over the decade.

Another seemingly astonishing result found by Kent was that the type of agreement used most frequently was not joint ventures, but sale of equipment/technology, despite the fact that the number of joint ventures increased steadily, and the sale of equipment/technology decreased every year. Again, I think it can be explained using an

argument simliar to the one above. Because of their little involvement in technology transfer many of the joint ventures established by companies from Hong Kong, were not counted in the database that Kent analysed. Actually, the fact that the number of joint ventures was increasing steadily over the decade, is in line with another result showing that Hong Kong's involvement in technology transfer was increasing steadily. For this resason, it seems that Hong Kong's participation in technology transfer varied linearly with the number of joint ventures involving technology transfer. It is also necessary to point out that technology transfers which took place through joint ventures were themselves in the form of licensing or sale of equipment, as opposed to the direct sales of equipment or technology through other organisational links such as agents.

In her work, Kent did not describe Hong Kong's position in detail. But since Hong Kong has been the gateway to China, at least in terms of trading, I think it is worth discussing Hong Kong's acting the role of 'middle-man' in technology transfer to China. According to a Commerzbank report (1994) , German investments through holding companies domiciled in Hong Kong are regarded as investments from Hong Kong. Another similar report in the Financial Times (Walker and Tyson, 1994) indicated that some Taiwanese companies channelled their investments through subsidiaries in Hong Kong. Thus, technology could well be transferred from Germany or Taiwan to China via Hong Kong. Because of the lack of direct information about Chinese business in the 1980s, there were far more companies using their Hong Kong subsidiaries to invest in China, especially from Britain, whose companies had closer links to Hong Kong than other countries. Another complicated issue is that of the so called "fake foreign devils". It is explained as follows: A "foreign company" was from Hong Kong, but its parent

company was actually a mainland Chinese company. It invested back in China to form a joint venture with a local partner (sometimes the local partner was just its own parent company), so that it would enjoy the various advantages of joint ventures such as reduced tax rates. And also, from a marketing point of view, a company with the name "joint venture" attached would almost certainly do better than a state-owned company, because it has been widely recognised in China that joint venture products are of better quality. If technology transfer took place in such "joint ventures", the origin of the technology would be classified as from Hong Kong. But in fact, the "Hong Kong company" could simply buy the technology from anywhere in Western Europe or North America. The more worrying sign is that, as 1997 approaches, more and more mainland Chinese companies are establishing their subsidiaries in Hong Kong, and as a consequence, more and more "fake foreign devils" will invest back in China. Thus, it will be more difficult to detect the origins of imported technology. Therefore, for the reasons of "middle man" and "fake foreign devils", I believe Kent's figure indicating Hong Kong's involvement in direct technology transfer are an overestimate. This also applies to the results we have in chapter four.

In addition, even if a company does not use its subsidiary in Hong Kong, it can still be difficult to tell where a particular technology comes from. For example, when Charoen Pokphand (also known as the Chai Tai Group) , a conglomerate from Thailand, set up a motorbike joint venture in Shanghai, the technology was licensed not from Thailand, but from Honda in Japan (The Economist, 1994 [1]). We have shown that an increase in the number of joint ventures in China does not necessarily imply that more technology is transferred to China. Since joint venture is the most popular form of foreign direct

investment in China, my conclusion is that the relationship between foreign direct investment and technology transfer in not linear, at least as far as China is concerned. The examples above of Charoen Pokphand and the Hong Kong problems also prove that more investment from a foreign country does not necessarily mean that more technology originates from that country.

We must bear in mind that the only data available are the information from signed contracts in the 1980s. However, for various reasons, some signed contracts fell through, which meant that the technology transfer did not take place at all. But the concerns of inaccurate conclusions drawn from such database should not be exaggerated. Contracts signed, but not implemented, could happen to any foreign partner in any technology sector. Hence from a statistical point of view, all of Kent's results except those absolute values such as the total number of agreements, are as reliable as those obtained using another database with only implemented contracts included.

2.4 Review of Major Factors Influencing Technology Transfer in Joint Ventures (1980s)

A number of scholars have investigated various factors related to joint ventures in China, and some of the factors studied have a direct impact on technology transfer. The discussion of some major factors influencing technology transfer in joint ventures in this section is based on works by Bennett and He, Campbell (1989), Behrman, Fischer and Simon (1993) , Shapiro (1990), and a report in CBTR on a survey conducted by the R&D unit at Manchester Business School (1993). As far as technology in joint ventures

is concerned, there are three factors whose influence occurs most frequently ----- the level of new technology , the technical training supported by foreign partners, and the ability to implement transferred technology. It is noticable that the structure of a joint venture may determine the efficiency of technology transfer. So the joint venture itself is an organisational factor, which was mentioned in the model of technology transfer in chapter one. Thus technical training and the ability to implement technology can both be considered to be organisational factors, whereas the level of technology is a technology factor.

2.4.1 Level of Technology

As Shapiro puts it, the role of joint ventures is more valuable for technology transfer, management know-how, and access to international markets than for initial capital contribution. The Chinese firms usually want the most advanced technology, and the scope of the technology is much wider than western firms expect. However, the two main reasons why foreign firms are unwilling to transfer most up-to-date technology, as Shapiro explains, are the fear of potential future competition and the lack of patents protection in China. A commonly adopted compromise choice, as Bennett and He found out, is to select a technology which is not the most advanced in the world, but is much superior to the local one. The chosen technology should also be adaptable to the local infrastructure such as transport, power supplies and telecommunications. There was far more foreign investment in the early 1990s than in the whole decade of 1980s, and the domestic competition is becoming more like competition between rival foreign companies. The infrastructure is also improving daily in major investment areas. For

these two reasons, it could be expected that the foreign companies would change to a new strategy of using the most advanced technology in their future projects. In fact, the latest research by McKinsey & Co. shows that the most successful multinationals in China tend to sell current-generation technology because there is a real danger of older technology being surpassed by other foreign competitors (Shaw and Meier, 1994). Some of them like Volkswagen even transfer management skills and R&D from abroad (The Economist, 1994 [2]). In the later chapters, our analysis will show that the technology level has indeed been a major concern during the process of technology transfer.

2.4.2 Technical Training

Technical training is an integral part of technology transfer. Almost all foreign companies have trained their Chinese personnel abroad, or locally or both. The methods used in training differ from company to company, but two are widely used --- short-term intensive training and long-term 'on the job' training. Previous research reveals different opinions about the two methods. An early investigation based on a Sino-US glass making joint venture suggests that the latter method is more important to a successful joint venture than the former one. But Bennett and He investigated a number of Sino-Foreign joint ventures, most of which were based on high technology undertakings, and they reject such a hypothesis and argue that the two methods could be alternative, or even parallel, choices for a joint venture. Companies have also started to offer trainings overseas in order to attract the best candidates. In addition, Chinese firms sometimes have difficulties in selecting suitable trainees, arranging training , and conducting the training programmes due to their insufficient management abilities.

However, a more western-style procedure for graduates recruitment by foreign firms in China is now taking place. Foreign companies can now recruit graduates directly from the universities, and implent their own training programmes.

2.4.3 Ability to Implement Technology

Behrman, Fischer and Simon pointed out that, because there were few R&D institutes attached to various industries, the diffusion of technology proved to be difficult. They also concluded that there was often a lack of understanding of the basic manufacturing techniques, limited competence of engineers and technicians, maintenance problems, and acquisition of equipment that requires too high a degree of sophistication. However, both the survey conducted by Manchester Business School and some case studies of joint ventures such as Shanghai Foxboro (Jackson, 1993) showed that the ability of the Chinese to evaluate new technology is impressive. It seems that under appropriate supervision, the Chinese learn very quickly, though few of them have a wide range of expertise. Engineers were not able to work in commercial fields, whereas trade officials had no knowledge of technology. Generally speaking, it was the management, rather than the technology that was regarded by foreign companies as far from satisfactory. As I found out later, the Chinese are willing to learn the most advanced technology, and well educated technicians in big cities are capable of doing so. However, old habits die hard as far as management is concerned, managers are not used to radical changes employed in new joint ventures. That is also the reason why some foreigners prefer wholly foreign owned ventures. As China opens up more, both the Chinese and their

foreign partners have learned how to work together. Such problems have therefore been of less concern over the last few years.

2.5 Policy Changes

In order to examine the relationship between economic and political policy changes and technology transfer, some major policy changes from 1989 to 1994 need to be presented here. China has been changing at such a rapid pace that some important political or economic changes take place on a weekly basis. The complicated political hierarchy means a U turn policy can be announced with notice. For example, the health of China's paramount leader Deng Xiaoping may well determine the whole reform policy. In the last decade or so, technology transfer to China, and China's economy as a whole, has been influenced by some specific government programmes and political events. The review of some key programmes and events are presented in the next section. Once a series of important policy shifts have been established, our results derived from the data analysis can be linked to them. And trends of technology transfer in various industrial sectors can also be compared with the political and economic background. The results will be shown in the next two chapters.

2.5.1 Economic Development Programmes (1980s)

Like the former Soviet Union, China's economic development has been , at least in theory, under the guidelines of a series of five year plans since 1953. The emphasis on technology issues in the plans has been gradually shifted from Soviet style heavy

industrial sectors to more dynamic export oriented sectors. In the late eighties, China embarked on a coastal development strategy in order to promote an outward looking economy along China's vast coastal areas. In addition to these five year plans, China launched some specific programmes to target certain industrial or geographical areas. Two mostly noticeable programmes in the eighties were the Torch Programme and the Sparks Programme.

During the eighties, China gradually realised that one of the trends in global economic development had been the shift of labour intensive technology from developed countries to developing countries. Due to lack of communication, transportation, energy, and raw materials etc., China could not concentrate on high technology based industries as some other developed countries did. The Torch Programme, which was launched in 1988, was a strategy born under such circumstances. The key objective of the programme, as described in the Guide to China's Science and Technology Policy (vol. 3, 1990), was to "mobilise China's scientists and engineers to develop commercialised high technology products, promote high technology enterprises, both domestic and international market oriented, and gradually form an industry based on new and emerging technologies". The Torch Programme was also claimed to be "not just a technological or economic project in the usual sense, but will play a pilot role in blazing a new path for China's economic restructuring". The programme was initially intended to concentrate on the following priority areas: micro-electronics and computer, information and communications, biotechnology, new materials, mechatronics, lasers, new energies and energy conservation. It also mentioned the importance of promoting Sino-foreign joint ventures and wholly foreign owned ventures in such areas. In the case of foreign joint

ventures, technology inputs would be regarded as an investment in exchange for shares. The specification of the Torch Programme reflected the ambition China had to compete against other industrialised countries in the high technology sectors. It did have certain successes in some areas such as lasers and biotechnology as we mentioned earlier in this chapter. In China, the whole infrastructure that supports the programme, including transportation and telecommunication, were very poor. The Tiananmen Square event, whose impact on the whole foreign direct investment and technology transfer will be discussed later, also slowed the programme. Whether the implementation up to the present of the Torch Programme is therefore very much under debate. Some of the results derived from the data analysis, which can be seen in the next chapter, have shown that China has put much of its effort into improving the infrastructure such as telecommunications, transportation and the chemical industry.

Since the Torch Programme was aimed to build up a high technology based industry, it was naturally in line with the coastal development strategy which the government had adopted. The Sparks Programme, which was first implemented in 1985, was to "invigorate village and township enterprises and promote rural economic development through the application of science and technology" (Guide to China's Science and Technology Policy, vol. 1, 1986). Unlike the Torch Programme, in which the technology flow was from overseas or R&D centres to industry, the Sparks Programme promoted the technological integration between coastal areas and rural areas. "The programme depends on the introduction of advanced appropriate technologies and rational management into the rural and township enterprises for the promotion of its economic objectives" (1990). The Sparks programme was introduced earlier than the

Torch Programme, and the technology requirements were relatively lower and more available in China, which meant foreign involvement was significantly less . Hence the programme has enjoyed a relatively higher success. One point missing from the Sparks programme, was the lack of a clear indication of which parts of rural areas in China was to be given the priority. The areas near rich provinces or cities such as Guangdong, Shanghai and Beijing, had benefited the most.

The Torch Programme and the Sparks programme raise two important points regarding technology transfer to China. Different industrial sectors are given different priorities by the Chinese government depending on certain economic development phases. But has the government's specially designed policy towards a certain industrial area or product attracted more foreign direct investment and more advanced technology? Has the regional distribution of imported technology within China improved in the past six years? Our data analysis in chapter four will give us some answers.

2.5.2 The Political and Economic Policy Changes (1989 --- 1994)

The macro development of the Chinese economy and the changes in politics from 1989 to 1994, were clearly affected by two events. What happened in Tiananmen Square caused a huge setback both politically and economically. A trip to southern China by Deng Xiaoping in 1992, when he pointed out the need for a faster market oriented economy, was another turning point from where China's economy has taken a giant step

forward. It will be shown later that economically, what China gained from the latter event is far more than what it lost from the former one.

In terms of technology transfer, the role of most Chinese companies changed completely after 1992. It was China who asked for foreign investment and technology before 1992. Though China was still hungry for technology , we will see in chapter five why it is that, in almost all the key industrial sectors, it was the foreign companies that tried to knock on China's door after 1992. Psychologically, China suddenly became a choosy "buyer" from being formerly a desperate "seller".

One of the central issues after Tiananmen Square was how much of the economic reform adopted in the eighties should be abandoned in favour of a tighter, centralised control. The whole debate started in 1988 when inflation surged to 18.5 % from 8% in the previous year, which was also one of the main reasons for the protests in Tiananmen Square in spring 1989. In September 1988, the government launched an austerity programme, an important part of which was a credit squeeze. The initial idea of this programme was to cool down the economy, but it targeted the wrong sectors. The inefficient state controlled industries were least hurt, but smaller export oriented and profitable enterprises suffered most. Since the regulations for Sino-foreign joint ventures required that certain percentages of the final products for exports must be made using local components, the joint ventures found it very difficult to be granted credit to buy local made parts. The worst came when foreign loans were suspended after the

Tiananmen event. An estimated $10 billion in loans were suspended. This would have been the main financial sources for big infrastructure projects that would improve efficiency in all the other sectors. As a result of this, the trade deficit reached a value estimated between $9bn and $10bn. Some positive signs appeared in 1990 when the government decided that they might have to ease the austerity programme in order to boost the economy. And in addition, investment in southern China started to increase. The slow economic progress was largely boosted by returned foreign loans, improved foreign relations, and a drastic change in Chinese financial policy.

When virtually all foreign loans were suspended after June 1989, China stressed tighter political controls but insisted that the open door policy remained open. The US policy towards China was more engagement rather than more isolation. While the US was engaged in more political talks, Japan was more interested in economic relations. Japan was the first country to resume $5.5bn loans to China, firstly through Hong Kong in December 1989, six months after the Tiananmen Square event. The World Bank and the Asian Development Bank also started to resume loans to the private sector in 1990. Taiwan and South Korea, formally still enemies, started to trade directly with China. The European Community also lifted its sanctions against China in October, 1990. China's foreign relations continued to improve in 1991, when the US renewed Most Favoured Nation status to China just as it did in 1990, and both the Japanese and British prime ministers visited China as gestures of thawed relations.

Another important factor that improved China's economy was the devaluation of its currency the Yuan by 21% at the end of 1989. It was a common method used in other countries to improve exports, but in China, it marked the beginning of the unprecedented financial reforms that have effectively changed the whole economic structure since 1992.

From a political point of view, Deng's visit to Shenzhen and Zhuhai, the special economic zones in southern China in January 1992, was a great triumph for reformers. Though officially retired, Deng was still universally viewed as the most powerful figure in China. During his visit, he called for pushing economic reform forward but did not mention any possible political reforms. He also promised that southern China would become another "dragon" economy in 20 years. The signal was a clear indication of the ending of the three year retrenchment. In practice, foreign business activity in China got a strong boost and political tensions with other countries were eased considerably. More significantly, the visit by Deng set out the basic principle for the coming 14th Communist Party Congress, which would then decide the next five year plan.

The 14th Communist Party Congress held in October 1992, was an official announcement for embracing the market economy, which in practice had started roughly a year earlier. Jiang Zemin, the party secretary, called for "exploring new ways and dare to experiment in changing from the old economic structure to the new". The Congress announced the need for moving towards a "socialist market economy with Chinese

characteristics", which was in essence an adoption of western economic methods with no changes in political structure. The party also recognised that private enterprise held the key to China's modernisation, but more importantly, it recognised the need for reform in the state industrial sectors. In order to achieve the goal of making the vast loss-making state controlled enterprises more competitive, some radical policies in the financial sector were introduced. Two stock exchange markets in Shanghai and Shenzhen were set up so that some state companies would be able to raise funds through the markets.

Another boost for the economy was the establishment of a young , technocratic government. The majority of them were widely considered to be reformers from more developed coastal areas, and especially from Shanghai. Certain regions might then get preferential treatments from the central government. In addition, the Congress continued the policy from the 1980s that certain areas in China should be made richer first. The unbalanced economy in China, as a result, would mean that the regions would grow economically further apart.

The positive message from the Congress was perhaps over warmly welcomed by the business community, both domestically and internationally. Foreign investment poured into China and by the end of 1992, it was double that of the previous year. By the end of 1993, China had recorded a 13% growth, and its share of world trade had doubled in a decade. Exports had been increasing, and it enjoyed a trade surplus of $6bn by the end

of 1994, a big contrast from a deficit in 1991. There was however a price to pay for such a rapid growth. As it was said earlier in the chapter, inflation had been surging ahead, unemployment was going up as result of reforms in state companies, and the widening gap between the coastal areas and inland caused massive migration of peasants to the rich cities, searching for jobs. The central government pledged a tight money supply policy, trying to cool down the overheated economy, but has generally failed to bring the growth under a much healthier 7-8% a year. One of the prime reasons was that the private sector was able to raise funds overseas, because there was an enormous interest among foreigners in investing in China. Hence the tight money supply control had a less significant impact on the economy than the similar austerity programme of 1988.

In terms of international relations, however, there were constant rows with the US and the UK. Sino-US relations have been a matter of two steps forward followed by one step back. The two most frequently encountered issues were those of intellectual property and human rights. The issue of democratic reform over Hong Kong was the key obstacle in the Sino-UK relationship. Despite all these unpleasant rows, both the US and the UK have adopted the policy of salesmanship as far as business was concerned, though companies from the two countries might have adopted different strategies in selecting places for investment. The impact on such preferences for certain regions will be discussed in the next chapter. The idea of "politics should not interfere with business" was encouraged by two major facts. Firstly, China has the largest population in the world and it also has the fastest growing economy in the world. Its potentially

endless market has therefore got the most attention from foreign companies. Secondly, industrialised countries embarked on a recession in the early 1990s, and this coincided with the booming market in China. Large corporations had to rethink their global strategies. China was still a very risky market, but it was a question of "now or never" for most multinationals. The experiences of some companies such as Unilever and Volkswagen (See later in chapter five) had convinced most multinationals that the earlier they got into China, the better. It is this kind of "salesmanship" attitude that has given China a huge advantage over negotiations. And it in turn has made China able to access most advanced technologies much easier than in the 1980s. Later discussions on some selected industrial sectors will assess this problem in more detail. It also helped China to gain its political objectives. One of the reasons that the US renewed China's most favoured nation status in 1994 despite its early threat of refusal because of China's human rights record, is that the major US corporations such as Boeing and GE had been lobbying hard so that they wouldn't lose any orders to European and Japanese companies. On the other hand, European governments had been encouraging the US government to stand up "morally", but they themselves would not take any action against China!

CHAPTER THREE

METHODOLOGY FOR
ASSESSING TECHNOLOGY TRANSFER TO CHINA

In chapter one, a theoretical model of international technology transfer was constructed. A detailed investigation is needed for a thorough assessment for the four groups of factors that influence the process of technology transfer. The four groups of factors, namely environmental factors, technology factors, organisational factors and transfer factors, can be assessed using different methods. Previous research work has concentrated on examining three of the four groups that are directly related to organisations involved in the transfer deals : technology factors, organisational factors, and transfer factors. The method commonly used for assessing these three groups is the case study method. By investigating two or more organisations involved in a technology transfer negotiation, most factors that influence technology transfer within these groups can be evaluated. The possible solutions for any problem arising from all these investigated factors can be applied to other organisations facing similar problems. Our review of factors influencing technology transfer in joint ventures in the last chapter, was also based on previous case studies.

Environmental factors, which depend on economic, political, cultural, legal and infrastructure situations, are considered to be indirectly related to any organisations involved in technology transfer matters. Thus the case study method is not appropriate

in examining those factors. They nevertheless form a macro structure that governs other factors.

The objective of this project is to produce an overall picture of international technology transfer to China from 1989 to 1994. In order to obtain an overall picture, sufficient data are needed so that the trend in every aspect of technology transfer can be analysed. Thus the first task is to collect a reliable database. Once a database is established, the following questions at the heart of international technology transfer to China can be answered, based on the results derived from the analysis of the database: What type of agreement has been most popular in China ? Which Western countries have been more heavily involved in technology transfer to China ? In which industrial sectors has technology transfer commonly taken place? Has technology transfer been constrained to geographic regions in China? Has the increase of technology transfer to China been in line with the increase of foreign direct investment? And how do we judge the importance of Hong Kong with regard to bringing new technology to China? In addition to finding out the answers to these questions, we also want to know the possible reasons behind these answers. In essence, it is the group of environmental factors of technology transfer which are to be examined. Since other case studies for the assessment of organisational, technology and transfer factors are to do with individual organisations and would be hardly linked to the overall trends of technology transfer to China, they will not to be examined in detail in this project.

3.1 The Method of Using a Database

As I reviewed in chapter two, Kent analysed the trends of technology transfer to China in the 1980s, so the analysis of the database in this project is therefore, a continuation of her work, with a view to making a comparison between the two results.

The original database has been set up, as Kent did, using information in "China-Britain Trade Review", a monthly journal published by the China-Britain Trade Group. The data appear in the section entitled " Business Synopsis : Recent Contracts and Agreements". I also discovered that some other journals also had lists of contracts and agreements. The most noticeable one is called "China Business Review", published every two months by the US-China Business Council. The journal clearly states that all the contracts are extracted from other publications in the US . With very careful examination, I found that some of the contents of the data were different. Certain contracts listed in the "China-Britain Trade Review" are absent in the "China Business Review", or vice versa. In order to achieve the highest accuracy of the outcomes, I decided to merge the two data sets as one final database. The final results would be derived from the analysis of the merged database. Using this method, we can virtually eliminate the suspicion that either the British or the American data collectors are "biased". The rest of this chapter is a discussion on how the merged database was created.

3.1.1 The Structure of the UK Data Set

The information given in the British publication was set out under the following headings:

Sector, Country, Foreign Partner, Chinese Partner, Date, Project, Type of Agreement.

Sector indicates in which industrial sector a business contract or agreement is signed, and *Country* refers to where the foreign partner comes from. *Foreign Partner* and *Chinese Partner* are the companies involved in the contract, whereas *Date* is simply the month in which the contract is signed. *Project* gives a brief description of the nature of the business involved , and *Type of Agreement* indicates whether the agreement is a joint venture, or sale of equipment, or a loan etc.

While creating a database for the analysis using the above information, I added another five headings:

In Europe?, Region, Year, Amount, Technology Transfer?

Because the economic integration is becoming more evident in certain parts of the world, and in Europe particularly, I think it will be interesting to compare trends of technology transfer to China from different European countries. And the new heading *In Europe?* is introduced for this purpose. Similarly, *Region* is also used because China is a huge country with an extremely unbalanced economy in different regions , and it will be necessary to see how such a phenomenon results in new technology being distributed unevenly. In order to know when technology is transferred, the month in which the contract is signed, which is headed by *Date* in the original information, is not a good indication for the reason that the implementation of a contract normally takes a lengthy time. And it is particularly true in a bureaucratic country like China. Though *Year* is not an absolutely correct indication , it is nevertheless the best we could use. *Amount* refers to the total amount of investment in the project. However, because of the lack of financial information provided in the original published data set, the use of this heading

is very limited. The most important and certainly most tedious task in constructing the required database is to detect if a contract appeared in the publication involves transfer of technology. *Technology Transfer?* is a Boolean variable which has only two answers : Yes or No. The answer for each contract is determined individually based on the criteria discussed later.

3.1.2 The Structure of the US Data Set

Unlike the UK data set, the US data set does not include so many headings. Each contract is classified into a sector group, and the description of the contract normally indicates the foreign country, date, type of agreement, and the province in China where the contract was signed.

Because of the unstructured nature of the US data set, I thought that the construction of the merged database would therefore be much easier if the "heading" system of the UK data set was adopted. One of the major tasks to form a merged database was to convert the US data set to the same structure as the UK data set. Once a merged data set was established, the next step was to delete all those contracts that did not involve any kind of technology transfer.

3.1.3 Criteria Used to Select Contracts Involving Technology Transfer

The objective of this project is to analyse technology transfer from other countries to China. So any flow of technology from China to overseas is not considered. Some

contracts in both publications are related to the overseas investments by Chinese companies, mainly in Africa , South America and South East Asia. Those contracts are eliminated from the database. However, I found there was very little literature on overseas investments by Chinese enterprises, which is a new phenomenon repeatedly reported in the news. I think it will be an interesting topic for future research.

There are some contracts with Eastern European countries and Russia under the agreement of barter trade. The projects involved mostly include finished products from China and natural resources from the foreign partners, from which no technology is provided. Such kind of agreement is therefore also excluded from the database.

There is a considerable number of financially related contracts such as bank loans, financial aids, and gifts etc., which I don't think, though necessary, have a direct impact on technology transfer. For bank loan contract, I was able to trace back to another contract in the publication that has a linkage with it. For example, an interest free bank loan contract in the financial sector from the Swedish government often leads to another contract in the telecommunications sector, in which the foreign partner is very likely to be Ericsson. Because the two contracts refer to the same project, the bank loan contract is omitted from the database.

One interesting type of agreement is the sale of equipment, products, and materials etc. Because the description about a contract is limited in the publication, I have to adopt the idea of using common sense. In some cases, "sale of technology" is a name used for the contract agreement, and therefore must be included in the database. However, any

purchases of raw materials, agricultural products, and natural resources are not considered. The most tricky type is the sale of product or of equipment. If some technology is embodied in the equipment or product, such as a complete computer system, or a processing machine line, then those contracts belong to the database. There is one exception however regarding some finished products, particularly in the cases of Boeing and Airbus aircraft. Though technology is embodied in such products, it had already been sold to China in the eighties and therefore cannot be regarded as another technology transfer.

In the first chapter, I discussed the horizontal classification used for technology. This is particularly important in my criteria. This project is only concerned with "hard technology", i.e. any technology which is tangible. Thus "soft technology" is not included in the database. On examination, I noticed that there was an increasingly large number of contracts related to "soft technology". In those cases, the foreign partners provide management structure, marketing skills or some consultancy services. Although those contracts are excluded from this project, I would be interested in seeing more research in analysing transfer shifts from "hard technology" to "soft technology" in China.

There is a small number of contracts in which technical training is explicitly described. Because training is considered to be one of the most important transfer mechanisms in the transfer process, other contracts are included in the database. However, if only management training is provided by the foreign partner, no technology transfer is considered to take place.

There is also a number of contracts to do with oil and gas explorations in China. All these projects are limited to the Chinese coast line or to the North West part of China. Oil and gas is a very important industrial sector behind all the economic developments, but technology transfer is not very explicit in pure exploration as in other manufacturing industries. As also described in chapter one, no previous technology transfer was conducted in this area. Therefore, oil and gas explorations are not included in the database.

Finally, it is necessary to notice the importance of the fact that foreign direct investment and technology transfer are not interchangeable as explained in chapter two. And such importance is also reflected in my data collection. A large number of contracts in the publication are to do with road, airport, and factory construction. Unless there is a clear indication that technology or equipment needed is included in the contract (as in the case of bank loans, there is normally a separate contract in the publications related to it), any contract of such kind is not considered. Another type of contract which is not included is property development, which has almost nothing to do with technology transfer. The interesting question is whether more technology has been transferred to China in the nineties, if an assumption that the large number of contracts of either construction or property development, particularly in 1992 and 1993, was a significant source of foreign direct investment, is taken into account.

3.1.4 Some Problems With the Two Data Sets

Three major problems with the two published data sets were encountered during the construction of the database : inconsistency , repetition, and lack of financial information.

Consistency in the classification of industrial sectors is the prime concern. For instance, some contracts are classified as being in the Electronics sector, whereas almost identical contracts are classified in the Light Industry sector. Some classifications used in the US publication are so different from the ones used in the UK publication. For example, almost all the contracts under one sector called "Consumer Goods" in the US publication are included in "Light Industry" and "Electronics" in the UK publication. In addition, I was forced to group some relevant sectors such as Aviation, Aerospace, Automotive, and Railway as one sector called Transportation rather than four independent ones, which I would like to examine individually. The reason behind this is that there is no distinction among these four sectors in the US publication. Though every caution was taken, it has been extremely difficult to reclassify some contracts.

Inconsistency also occurs in the classifications for Foreign Country, Chinese Partner, and Type of Agreement. When a UK company uses its Hong Kong subsidiary to set up business in China, there is confusion about which country name should be used. "Hong Kong", "UK", and "UK/Hong Kong" have all appeared in the original data set. In this case, "UK" is used in my database. A lot effort has been put into detecting the original country where technology is transferred from, but it is sometimes still impossible to tell, due to lack of information. The names of some Chinese partners change from time to time in the data set. The holding company's name or the branch

name, or even no name is used for one company. Fortunately, we are not interested in examining some individual company from this data set. There are various types of agreement listed in the original data set, but some similar contracts sometimes are described using different types of agreement. For example, a joint venture project in a factory construction, according to the data, can be seen as either a joint venture agreement or a construction agreement. The method I use is to concentrate on some key types of agreement such as joint ventures, co-operation, and licensing etc., and the rest are classified as "others".

Some contracts are published twice or even three times over a certain period in either publication, let alone the contracts appear in both publications. Because such mistakes have a great effect on our statistical results, all repeated contracts have been eliminated. And because of the inconsistency in classifications mentioned earlier, it has been proved to be a very time consuming task.

However, the most valuable information yet missing from the data set is the foreign equity contributions to each contract. Less than half of the published contracts include the total amount of investment. I have to say that, with great regret, it is impossible to investigate any shifts in technology transfer in terms of financial contribution.

3.1.5 Rearranging the Merged Database

As mentioned earlier, each record in the database consists of several variables such as *Sector, Country, Foreign Partner, Chinese Partner, Region, Date, Type of Agreement*

etc. We are particularly interested in four variables : *Sector, Country, Region* and Type of Agreement. The ranges of these four variables given by the original database, however, are too wide for the purpose of this project. For instance, the variable Sector covers 27 industrial sectors.

One of the purposes of the data analysis is to find out the trends of technology transfer in different industrial sectors. However, there are certain key sectors in which technology transfer often occurs. In order to achieve a clearer vision of the key sectors involved, it is necessary to reduce the number of industrial sectors in the process of data analysis without affecting the results. A preliminary analysis was therefore conducted, and the following industrial sectors were chosen for the later analyses: Agriculture, Chemicals, Electronics, Food, Light Industry, Machinery, Medicine, Metals and Minerals, Power, Telecommunications, Textiles and Transportation. All other areas such as Environment, Shipping, and Publishing etc. are clustered as a group underlined as "Others". During further detailed data analysis, as we will see in the next chapter, five industrial sectors were found to be of most important : Chemicals, Electronics, Light Industry, Telecommunications, and Transportation.

The variable Country also covers far more entities than necessary. There are a total of 37 countries involved in the original merged database. The number of contracts signed by companies from different countries is however, very unbalanced. The number of contracts involving US companies, for example, is over 600, whereas there is only one contract signed by a Jordanian company. As in the case in Sector, we are only interested in certain "key" countries or geographic areas. Four countries are of greatest

interest to us in this project : UK, US, Japan and Germany. Hong Kong is classified into two fields, which refer to technology from "Hong Kong" and "via Hong Kong" respectively. Australia, Canada, France, and Italy also remain as they were in the new classification. All Scandinavian countries are grouped into a single entity as "Scandinavia". The remaining Western countries such as Austria, Netherlands, Belgium, Spain and Switzerland, are grouped as "Other Western European Countries". Another important group of countries consists of the so called "South Eastern Asian Dragon Economies", namely Singapore, Taiwan, South Korea, and Thailand. Hong Kong is of course a single entity in this project. There is a significant number of contracts signed by more than one company from different countries. If this is the case, the entity under the variable Country becomes " International".

In the original merged database, the geographic regions within China to which technology is transferred, are listed as provinces. Using the conventional method adopted in China, I reclassified the regions into wider areas. The new classification breaks China into 10 areas : Shanghai, Beijing, Tianjin, South , East, North, North East, North West, Central, and South West. The biggest advantage of using such a classification rather than using the names of the provinces is that, the trends in technology transfer in relation to geographic regions within China can be illustrated relatively easier and can be easily understood by non-Chinese as well as Chinese.

As in the cases of Sector and Country, we want to reduce the number of entities in the Type of Agreement so that we can concentrate on some of the most important types of agreements used in the technology transfer process. Joint Venture, Cooperation,

Licensing, and Wholly Foreign Owned Venture are the most frequently and explicitly listed in the original database. In the reclassification process, I kept these types of agreement as they were. There was, nevertheless, some confusion over other types of agreement, particularly in the various sales agreements. There were agreements referred as " Sale of equipment", "Sale of technology", and "Sale of plants" etc. I adopted the following method to classify those types of agreement into two groups. If the description of a record clearly indicates there is a technology transfer in the contract, then the type of agreement is classified as direct "Technology Transfer". If technology is embodied in equipment, and then it is simply classified as "Sale of", based on the criteria for identifying technology transfer discussed earlier.

3.2 The Method of Monitoring Industrial Sectors

The uniqueness of the political structure and the fast pace of economic development in China indicate that policy changes in industrial sectors have to be traced regularly. There are so many daily publications available in the UK that report from China frequently. The most comprehensive reports, as I found out, are from the Financial Times. That publication reports virtually every day from China on its economic, political, financial and trade developments. It also regularly conducts surveys on different industrial sectors in China. Hence, the tracing of policy changes and economic development is based on the information primarily reported in the Financial Times, with other daily and weekly publications as supporting sources.

The policy changes can be used to assist the analysis of the database, so that a link between policy shifts and technology transfer in China can be established. A series of major policy shifts were reviewed in the last chapter. Such linkage provides an abstract picture of the relation between technology transfer and policy changes. A more concrete usage of the examination of policy changes is to help industrial sector based studies, which have become increasingly important in policy making in China. Specific policies have been announced for some key industrial areas, notably the aerospace, automotive, and telecommunications sectors, and the discussion in chapter five gives a clearer indication how political events and/or changes of financial systems have effected the developments of these sectors, and consequently technology transfer to these areas.

The selection of industrial sectors to be examined is based on the results derived from the data analysis, and some reports from publications in the last six years, mainly from the Financial Times , and The Economist. My own working experience in early 1993 and some field work in late 1995, both in Shanghai, have also helped.

CHAPTER FOUR

ANALYSIS OF THE DATABASE

Having established the merged database, we can now analyse the database in a structured way so that trends of technology transfer to China in terms of industrial sectors, regions, foreign countries etc can be derived. Some limitations of the database, however, must be pointed out here so that our later results can be reflected more accurately.

The number of contracts in the database is well over 2000, after all the irrelevant contracts have been discarded using the criteria discussed in chapter three. These contracts, however, only represent major contracts signed in the past five years. The US publication explicitly states that all contracts have been published elsewhere. During the construction of the database, I also noticed that the total amount of investment involved has been steadily increasing. As said earlier, not all the contracts included their financial information, it is therefore impossible to examine what the financial limit is for a contract to be included in either publication. Hence we can only assume that our analysis is based on major contracts only. We must also bear in mind that the so called "major contracts" vary from year to year. Generally speaking, contracts signed after 1992 are much bigger than the ones signed before 1992.

The analysis of the merged database from two publications in the UK and US is focused on the trends of technology transfer to China from 1989 to 1994. Four factors --

industrial sectors, foreign participation, types of agreement, and regional distributions within China -- are of particular interest to us, as well as their inter-relations.

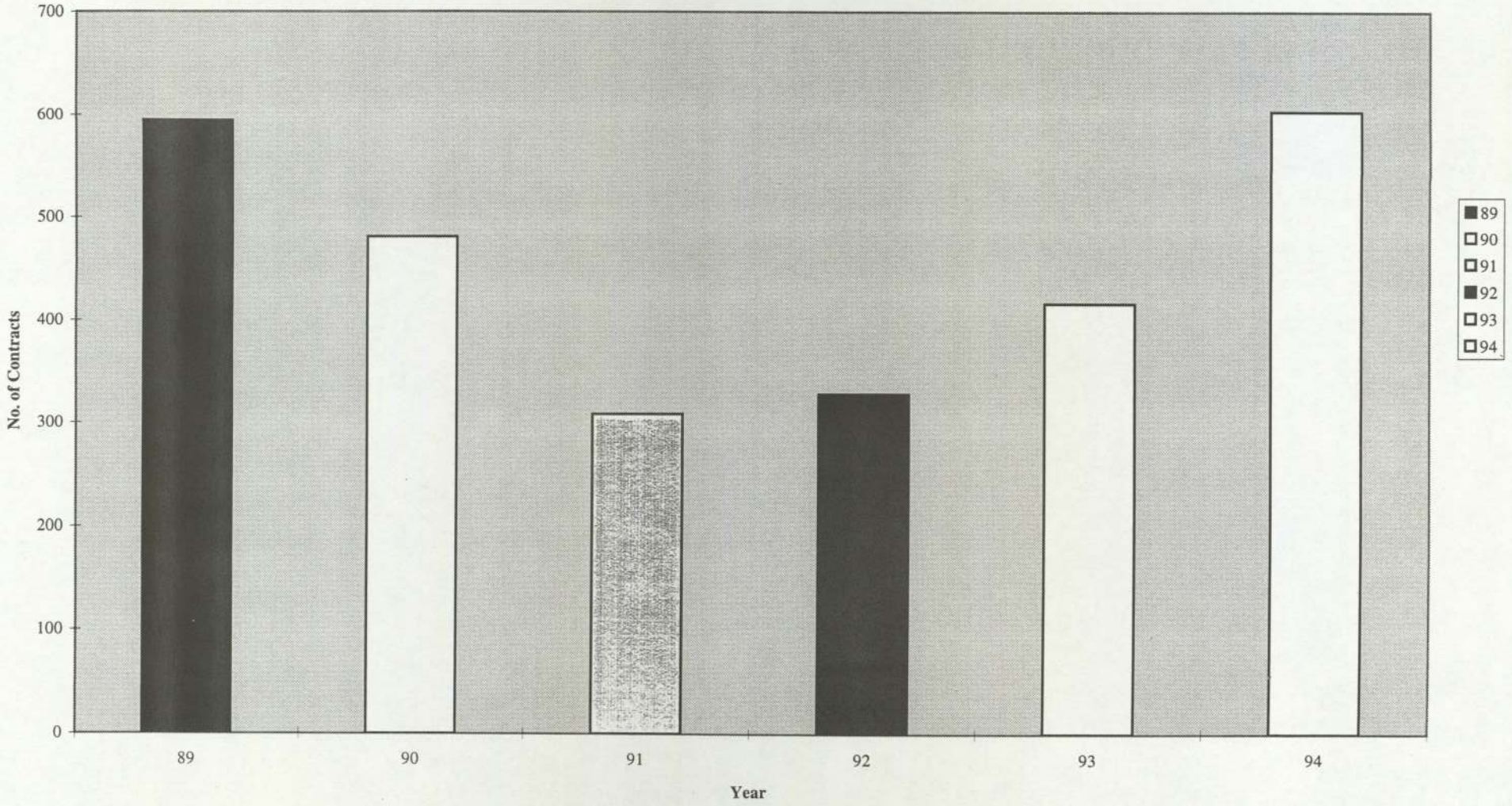
4.1 Annual Total

The trend of the total number of contracts involving technology transfer is presented in Figure 1. As we can see, the number of contracts decreased significantly after 1989, hitting the lowest point in 1991. It recovered in 1992 and increased steadily to 1994. At a first glance, the trend, especially from 1989 to 1992, is not in line with the political changes or reported foreign direct investment during the period.

The first surprise is that the number of contracts signed in 1989, when the Tiananmen Square events happened, is almost equal to the number signed in 1994. And in 1991 and 1992, when China started its economic recovery, an increase in the number of contracts from 1991 would be expected rather than a decrease as shown in Figure 1. There are however several possible reasons for such unexpected phenomena.

The graph shows the trend of the number of contracts signed. Because of the lack of financial information in the original data, the values of contracts can not be presented. Although the number of contracts was virtually the same in both 1989 and 1994, there might have been a big difference in terms of the financial input. Since the beginning of the economic boom in early 1992, foreign investments and projects have been getting bigger and bigger. During the course of the data collection, I noticed that the amount of capital for contracts has gone up tremendously since 1992. Projects over one billion US

FIGURE 1 Annual Total



dollars were not exceptional, whereas anything below the one million dollar mark was hardly mentioned in the database. The contracts before 1992, and especially before 1990, were comparatively much smaller projects. My perception is that there were so many contracts signed after 1992 that only those with relatively bigger projects were published. Another piece of evidence in support of this perception is furnished by the fact that the Tiananmen events of 1989 caused most foreign loans to be suspended, especially those from the World Bank and the Asian Development Bank, both of which were the sponsors of huge industrial projects in China. The loans gradually resumed after 1990. Though not perfect, the number of contracts is the only indicator available for us to use. Any possible misunderstanding due to the lack of financial information, which was the case for German companies, will be explained during the interpretation of the results.

Another important factor is the length of time for a project to be realised, from the start of negotiations to the actual signing of the contract. It is very common to take more than a year to set up a joint venture in China. The negotiation style of the Chinese partners, the lengthy bureaucratic process, and the inadequate infrastructure all cause delays for a final deal. Foreign firms that started negotiations with their Chinese partners in 1987 or 1988 or even earlier, could end up signing the contracts in 1989. So the actual signings were not affected by the Tiananmen Square event. Only implementation of these contracts could be delayed, but it is not reflected in our data. If this is indeed the case, the graph makes sense. Thus we claim that contracts signed in 1989 were not affected, but in 1990 or even 1991 there was a decrease because foreign firms lost interest in investing in China in 1989. Similarly, Deng's visit to the South in 1992 had an effect on

the results in 1993 and 1994. Hence the overall trend of the number of contracts from 1989 to 1994, which can be broken into two sections, one decreasing after 1989 and the other increasing after 1992 , clearly shows how the two major political events in 1989 and 1992 have affected technology transfer to China.

4.2 Country of Foreign Partner

The percentages of contracts signed by foreign countries from 1989 to 1994 are displayed in Figure 2. It can be seen that over the years, technology transfer was dominated by the US and Japan, sharing respectively 24% and 17% of the total number of contracts. Hong Kong had 12% of the shares if technology transfer through the territory was included. If not, the territory only accounted for 9% of the total shares. The UK and Germany had 6% each , which was a relatively higher proportion than any other individual country.

The dominance by the US and Japan is not unexpected, since they are the two biggest economies in the world, and also have some of the most advanced technology. The 9% figure for Hong Kong, the biggest trading partner of China and one of the biggest sources of foreign direct investment (Hong Kong's investment has always been higher than Japan), seems to be too low. As happened in the 1980s, a vast amount of investment from Hong Kong has gone into hotel and road construction, low tech labour intensive manufacturing and, more increasingly in the early 1990s property development. Most hotel and road construction projects, as well as property development, require large amount of financial input but little technology input, so they

are not included in the database and hence are not reflected in the graph. We could say that though Hong Kong is of most importance to China in terms of trade and investment, its involvement in technology transfer is limited when compared to the US or Japan.

The western European countries as a whole share around 33% of the total number of contracts, including those signed by international consortiums with European participation, and those having technology transferred through Hong Kong (Figure 2.1). Though this figure exceeds those for the US and Japan, each European country on its own is totally outclassed by each of these two countries. Since it is the third most powerful economy in the world and boosts some of the most advanced technology, a narrower gap between Germany and Japan or the US might be expected. But again these figures form a quantitative representation only. German companies that act as foreign partners in the database are mainly well established, big international corporations such as Siemens, VW and BASF. The deals they are involved in are often lucrative, multibillion dollar projects. So, quantitatively, Germany might not be as active as some other countries, but it was successful in terms of quality. The successful story of Volkswagen, which will be presented in the next chapter, is a key example. On the other hand, British companies of all sizes are involved. The historically closer connection between Britain and China, as well as the role of Hong Kong, may be responsible for this phenomenon. Small or medium sized German companies, on the contrary, have a tradition of trading with, and investing in, other emerging markets with easier understandable cultures such as Eastern European countries.

FIGURE 2 Percentages of Contracts Signed by Foreign Countries

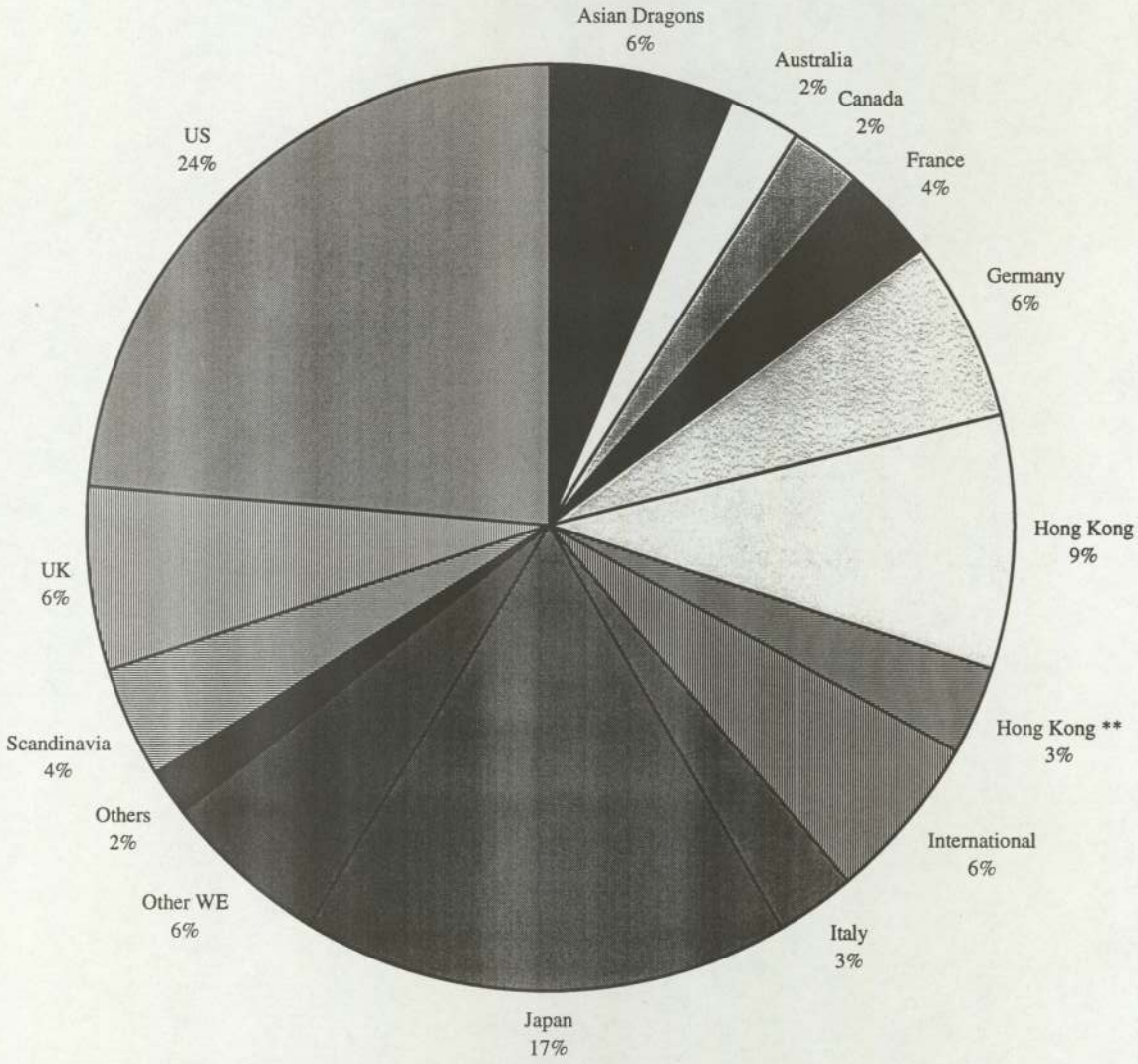
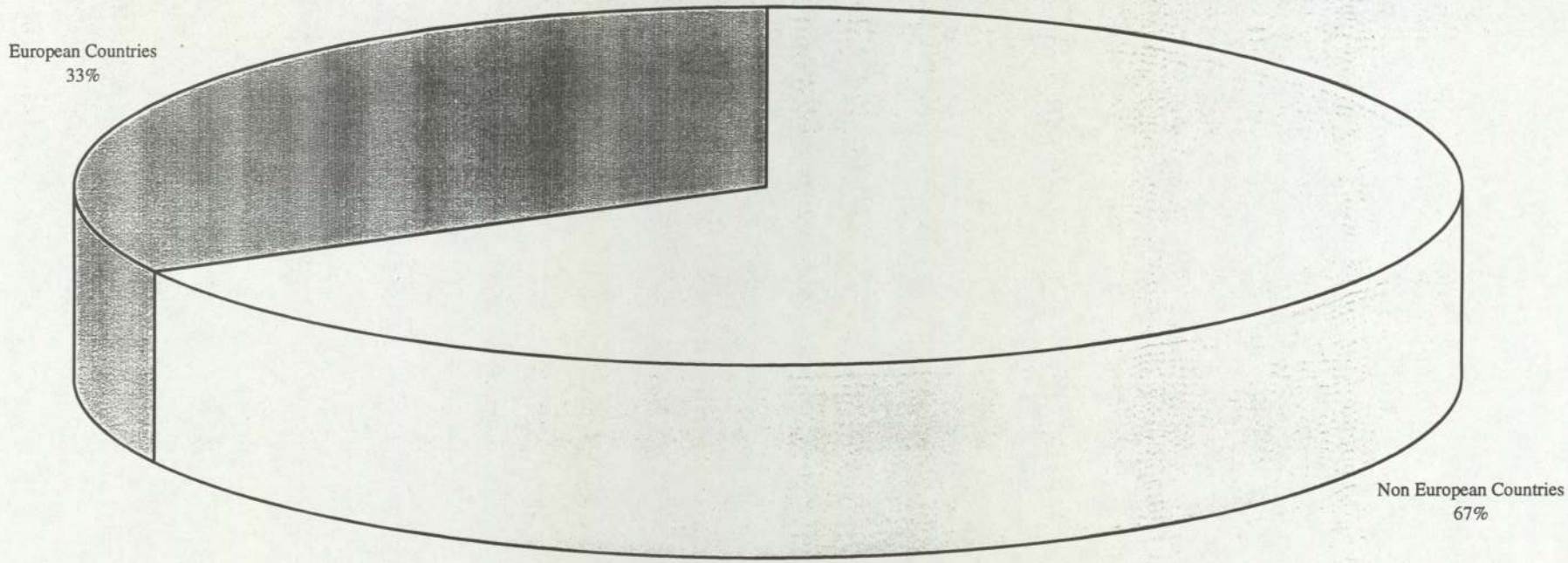


Figure 2.1 Europeans vs Non-Europeans



Smaller countries are grouped according to geographical regions and economic integration. Scandinavian countries (Denmark, Finland, Sweden and Norway) enjoyed a healthy 4% over the years (Figure 2). As we will see later, they had a big share in the telecommunications sector, in which Ericsson and Nokia have both established a strong presence in China. Printing technology, as I noticed in the database, has been frequently imported from Denmark. Other western European countries (Other WE), which include Austria, Belgium, Netherlands, Spain, and Switzerland, accounted for 6%. Their presence in the industrial sectors is spread around, with Austria strong in machinery technology exports, Philips from the Netherlands in electronics and light industry, and Nestle from Switzerland in the Food industry. The shares of individual European countries are illustrated in Figure 2.2. More comparisons among European countries in relation to industrial sectors, types of agreement, and regions will be shown later.

The Asian Dragon economies, namely South Korea, Taiwan, Thailand, and Singapore, had 6% of the total contracts (Figure 2). The figure looks lower than expected because economically they are thought to be more integrated with China than most European countries. There are several reasons behind this relatively low figure. Similar to Hong Kong, Taiwan has been mainly involved in industries which require little technology. Its investment in China, at least officially, only started in 1990. It was the same case for South Korea, which until 1992 did not have diplomatic relations with China. It's investment in China, and particularly in Shandong, a coastal province opposite Korea, has nevertheless been increasing steadily, though most of the projects are small apart from the ones signed by Samsung. Singapore, which has traditionally had a strong anti-communist policy, was late in entering the business scene in China. Like Germany,

Thailand did not have a large number of contracts, but the volume of investment was huge, considering its economic size. Virtually all investment in China from Thailand was by one company, the Chia Tai Group, a conglomerate specialising in the agriculture sector. One could say that due to more and more economic integration between China and these countries, their shares in technology transfer will increase as well in the near future. However, as China has more companies to choose from, the level of technology will probably determine whether a contract will be signed or not. If this is the case, the Southeast Asian countries will still lose out to the Japanese, the Americans and the Germans as far as technology transfer is concerned.

4.2.1 Germany, Hong Kong, Japan, UK and US

Since the US, Japan, Hong Kong, Germany and UK counted for over 60% of the total number of contracts, it is no surprise to see that the trends of the numbers of contracts signed by the five countries, as illustrated in Figure 3, are all ,with the possible exception of Hong Kong, similar to the overall trend in Figure 1.

The trend for the US in particular draws a resemblance to the one in Figure 1.. This can be explained by the US dominance in the comparisons of the total number of contracts discussed earlier. This is also an indication that the overall trend might be biased by the high proportion of the number of US contracts. Compared to the other four lines in Figure 3, the US line has a much clearer turning point at 1991. There seems to be a negative liner relationship between the number of contracts signed by US companies and the years from 1989 to 1991, but a positive one afterwards. It seems that the US

companies were relatively more effected by the two political events mentioned earlier than the other four countries. The low points in 1990 and 1992 were the direct results of the Tiananmen Square events in 1989, if the lengthy time needed to form a joint venture or settle any other similar deal is taken into consideration. On the other hand, the high points in 1993 and 1994 show that the American companies started to rush into the Chinese market after Deng's visit in 1992.

The lines for Japan, Germany, and the UK are slightly different from the US one. The trend for Japan shows that there were slightly more contracts signed in 1990 after Tiananmen Square. It coincides with what was said in the last chapter that Japan looked like it was more interested in economic relation after 1989. But the sluggish economy in China during that period did hit Japanese companies, and the number of contracts went down significantly in 1991. It was a similar case for British and German companies, except that the number of contracts signed by German companies went up a bit in 1991. But that anomalous increase might not be a significant indicator because the number of German contracts was already low. An interesting point is that the slopes for Japan, Germany and the UK are not as steep as the one for the US. The US companies seem to be more committed to China than the companies from the other three countries after 1992 (the time lapse is taken into account of course) , when the Chinese economy started to boom.

A seemingly surprising result from Figure 3 is the trend for Hong Kong. It seems that the number of contracts signed by Hong Kong companies have been decreasing steadily since 1989 despite the economic boom in the early 1990s. It is nevertheless evidence

Figure 2.2 Comparisons Between European Countries

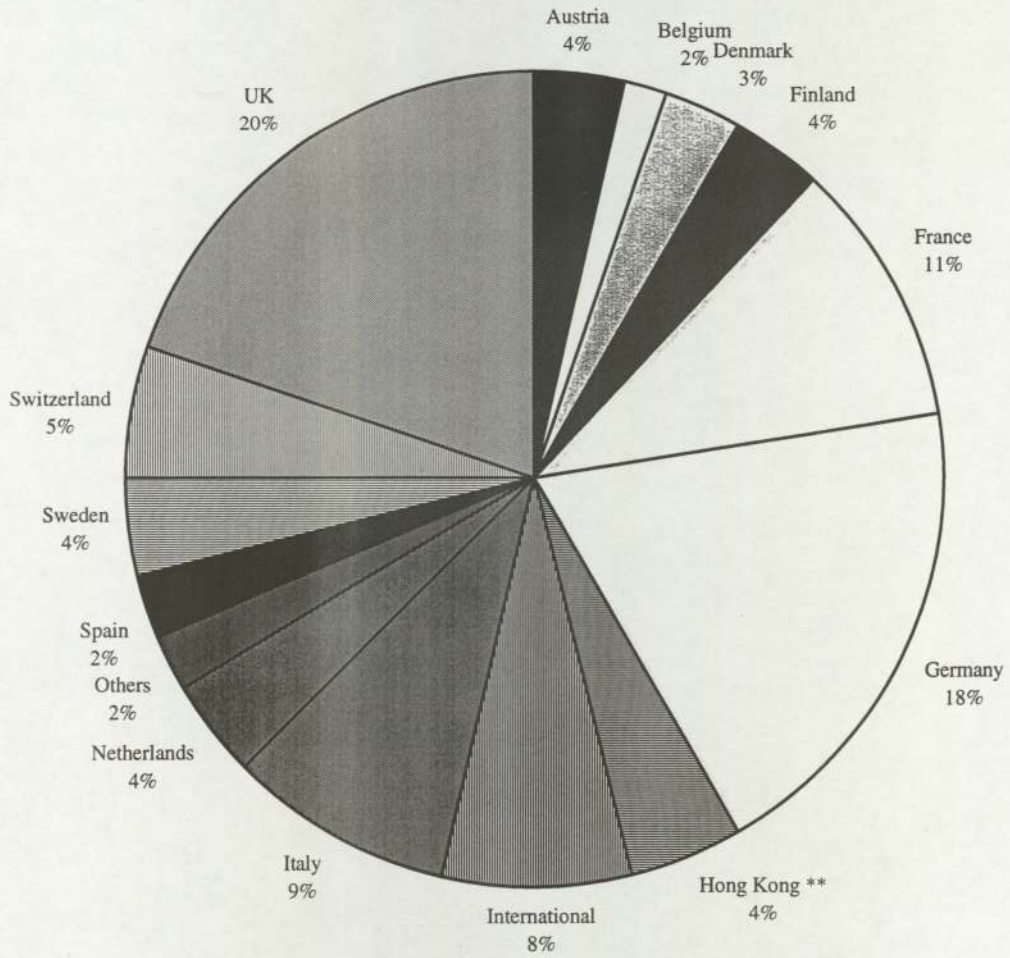
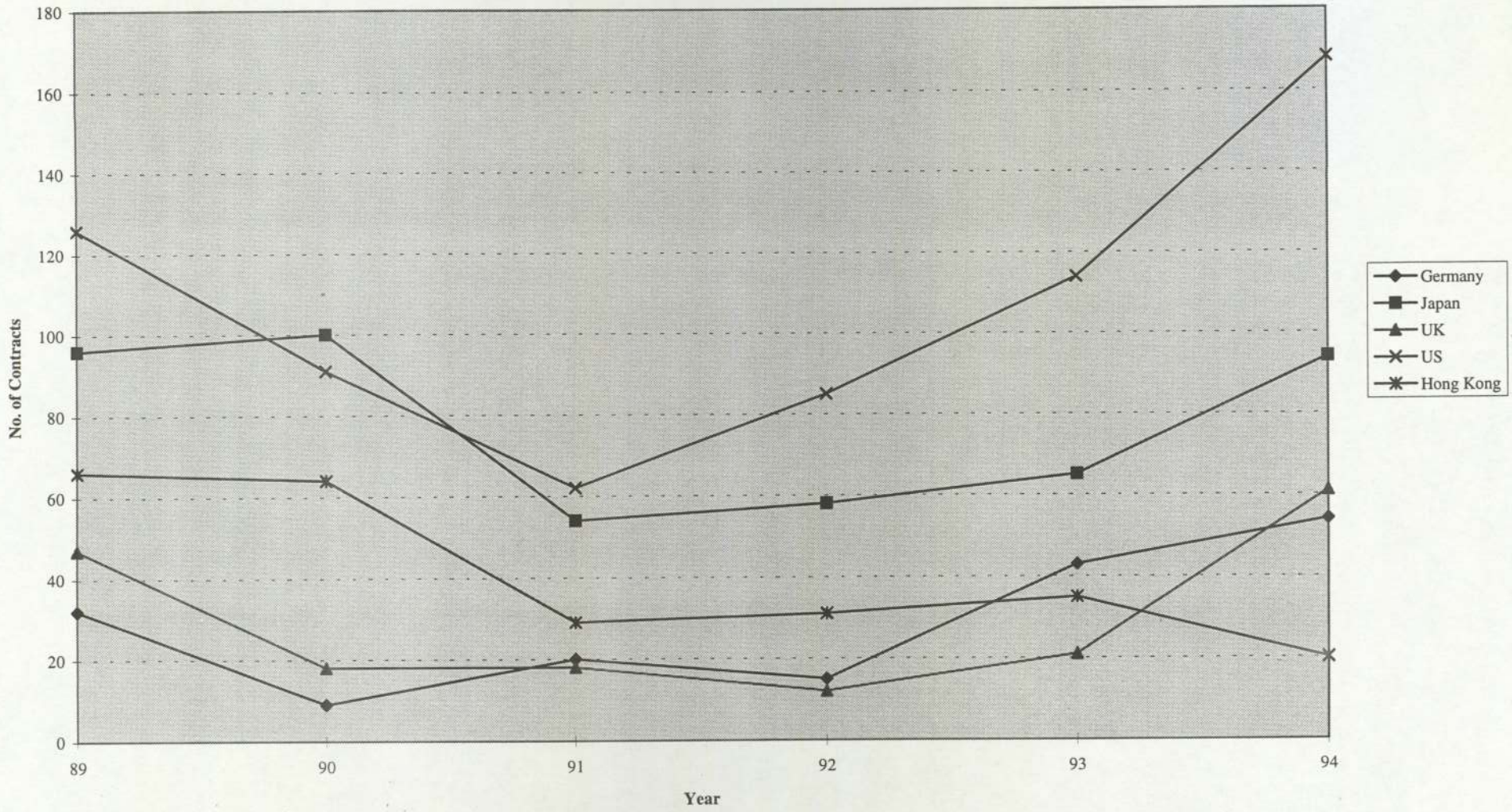


FIGURE 3 Trends of Five Dominant Countries



that the importance of Hong Kong in terms of technology transfer has been declining over the years. Hong Kong companies have been more involved in property and tourism investment as well as roads and ports construction rather than other more technically oriented projects.

4.3 Industrial Sectors

There are five most prominent industrial sectors in which large numbers of contracts were signed over the six years. They are Chemicals, Electronics, Light Industry, Telecommunications, and Transportation, each of which shares more than 10% as illustrated in Figure 4. All of the five sectors are strongly technical-related, with three of them --- Chemicals, Telecommunications, and Transportation --- forming the foundation of the infrastructure for China's further development. On the other hand, the high volume of foreign investment and technology transfer in both Electronics and Light Industry are the results of the local Chinese becoming more affluent and the high attractiveness of exporting, which brings in more hard currency, and consequently more technology.

Figure 4.1 shows that apart from a huge dip in 1990, Chemicals enjoyed very big shares in all other years. It had a huge lead over all the other four industries in 1989, but the graph shows the industry was severely hit either by the Tiananmen Square events in 1989 or the Austerity Programme in 1988 or both. The number of contracts in Chemicals then climbed back up so that in 1994 it was near its previous peak value. The steep slope of the line for Transportation after 1992, highlights the biggest boom in

aviation, aerospace, automotive, and railway industries. It is a similar story, though to a lesser extent, in the electronics sector. I noticed that during the construction of my database, there was a major shift from consumer electronics to high-tech oriented computer software development. Both Telecommunications and Light Industry saw a decline after 1989 but have bounced back since 1991.

Since these five sectors are of the most importance, the following sections focus on the discussion of foreign countries' shares in each of them.

4.3.1 Dominant Countries in the Chemical Sector

The US and Japan are two dominant countries in the chemical sector (Figure 4.2). As a matter of fact, the fact that foreign countries' shares in the chemical sector is so similar to those in all the industries (Figure 2.) may indicate that the overall result is slight biased by the high number of contracts in the chemical sector, just as the reason for the similarity between the US trend and the overall trend discussed early on. By their standards, Italy and France have a good share of 8 per cent and 7 per cent each , on a par with the UK and Germany respectively. Hong Kong, on the other hand, only accounts for 5 per cent. The Scandinavian countries, which gained 4 per cent of shares in all industries, has got merely 1 per cent.

4.3.2 Dominant Countries in the Electronics Sector

The even bigger dominance by the US and Japan in the electronics sector (Figure 4.3) clearly represents the global superiority of the two countries, to say nothing of their superiority in China. The number of contracts signed by the two countries covers almost 60 per cent of all contracts. German and British companies do not seem to be significant at all, with a mere 3 per cent and 4 per cent respectively. Hong Kong , which has some of the most advanced Chinese language related software packages, had the highest share of all the other countries, at 9 percent. If technology transfer through Hong Kong is included, the share will up to 13 per cent. Like Hong Kong , Asian Dragon economies, of which Taiwan has some joint ventures in Chinese software engineering and South Korea's Samsung has several electronics manufacturing plants in China, enjoy a high of 7 per cent. I also noticed that the 5 per cent share enjoyed by other western European countries (Other WE), was largely a contribution by Philips of the Netherlands. The Scandinavian countries, on the other hand, have virtually no presence at all in the electronics industry in China. They do however, as we will see later, have an important role in the telecommunications sector.

4.3.3 Dominant Countries in Light Industry

Though the US has a healthy 19 per cent of total contracts in light industry, it is Japan that takes the lead with 24 per cent (Figure 4.4). The Japanese consumer products normally have better brand images than their American counterparts, and hence are preferred by local consumers in China. Again. Germany and the UK do not have a significant presence in this area, with a total of 9 per cent between them. Even more significant than in the electronics sector, Hong Kong has a 12 per cent share. If

technology transfer through Hong Kong is added, the share would rise to 16 per cent, even closing up on the US one. The heavy involvement of Taiwan in light industry in China also pushes the share for the Asian Dragons up to 8 per cent. One major difference between the Hong Kong or Taiwanese companies and the American or British companies in light industry, is the size of the companies. Companies from Hong Kong or Taiwan tend to be small or medium sized businesses, whereas the ones from the US or the UK are well-known multinationals such as P&G, Unilever, BAT, and Philip Morris. In the case of British companies, many contracts in this industry were actually signed by Unilever. I do not think that the share of UK companies will lose too much ground in light industry in the near future, if financial terms are counted, since Unilever alone is going to invest 65 million pounds per year in the next five years in China.

4.3.4 Dominant Countries in the Telecommunications Sector

The shares of contracts by foreign countries in the telecommunications sector are illustrated in Figure 4.5. The pie chart looks significantly different from the ones we have seen before . The US was the only dominant country in the sector with a share of 28 per cent. The major contributions for the US dominance were from AT&T and Motorola, who have established a series of joint ventures or even wholly foreign owned ventures as well as exporting equipment and technology to China. Unusually, Japan has only 6 per cent, sharing the same amount as Hong Kong. Though NEC and Fujitsu have a presence in China, they have been slow in expanding their activities. The Scandinavian countries, primarily Sweden and Finland in this case, reached second

place. The 11 per cent share underlines both Ericsson's and Nokia's successes in China. Ericsson in particular has been expanding at such a rapid pace that it can comfortably compete against, or even overtake, AT&T or Motorola. As discussed in the last chapter, Ericsson also has huge support from its own government for its operations in China. Another winner in the telecommunications sector over the years was Northern Telecom from Canada. It is this company's contracts that add up to the 9 per cent share enjoyed by Canada. Germany has a 7 per cent share, of which quite a lot of contracts were signed by the Telecom division of Siemens. There is a doubt over the 5 per cent share by the UK. I note that Cables & Wireless play an important role in China. Though the company is domiciled in Britain, its Chinese operations are conducted from their Hong Kong headquarters. It is classified as a UK company rather than a Hong Kong company according to my classification criteria, but it does show in practice that the UK has very little involvement in the telecommunications sector in China.

4.3.5 Dominant Countries in the Transportation Sector

The US is again the leading country in the transportation sector (Figure 4.6). It certainly dominates in the aviation/aerospace industry. It also has a large number of contracts in car components manufacturing. The 15 per cent share of Japan refers to its strong presence in car components manufacturing, motorbike joint ventures, and some car assembly lines. Though only counting for 10 per cent of the total number of contracts, Germany certainly enjoys the highest place in the automotive industry --- car manufacturing. Lufthansa is also competitive in aviation engineering projects. The majority of the British contracts, which cover 9 per cent, were of the form of exporting

technology and equipment in the industry. The case for Hong Kong is similar. The Asian Dragons, surprisingly, occupy 9 per cent, considering they are still importing technology for their own transportation sector. But only two companies there count as significant. Hyundai and Daewoo from South Korea in car components manufacturing.

4.3.6 Comparisons of European Countries in Industrial Sectors

As we can see from Figure 4.7, the UK had a share of between 15 per cent and 30 per cent in almost every industrial sector over the six years. The only exception is in Medicine, in which the pharmaceutical industry is the major player, as well as medical equipment and technology. This may be explained by the late entry to China by Glaxo, which only set up their representative office in the early 1990s. The overall picture shows that the UK's presence in every sector is significant, if not the largest. The graph also shows that although Germany's overall share is bigger than the UK's, its technology transfer to China is not as evenly distributed in the industrial sectors as that of the UK. It has a leading position in Textiles, Transportation, and Medicine. There is however hardly any technology transferred to the food industry, in which the UK and Switzerland have much bigger shares thanks to companies like United Biscuits, Cadbury and Nestle.

In the chemical sector, the UK, Italy, Germany and France have roughly even shares. The electronics and light industry sectors are evenly distributed among European countries according to their economic sizes. But as was said earlier, the European presence in these two areas is very limited. The Scandinavian countries have virtually

FIGURE 4 Percentages of Contracts Signed in Industrial Sectors

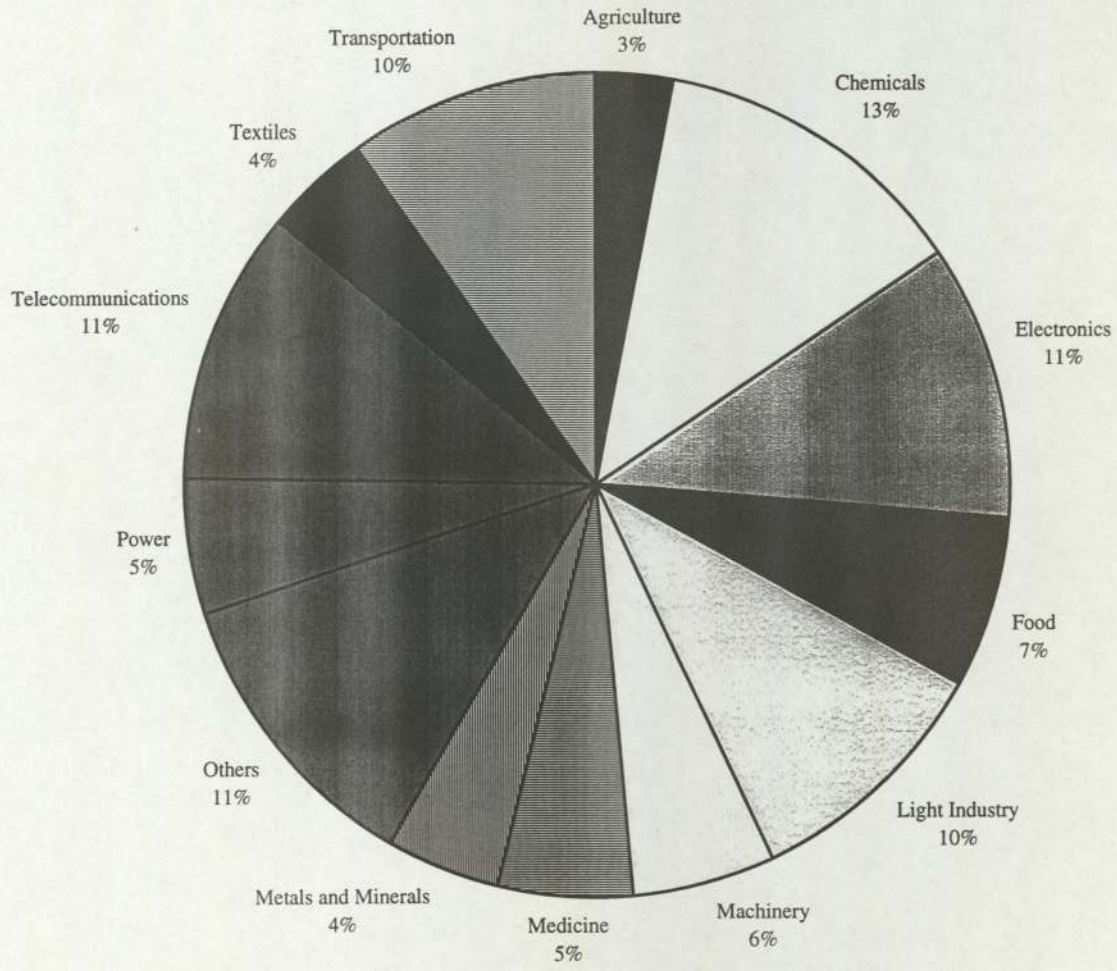


FIGURE 4.1 Trends of Dominant Sectors

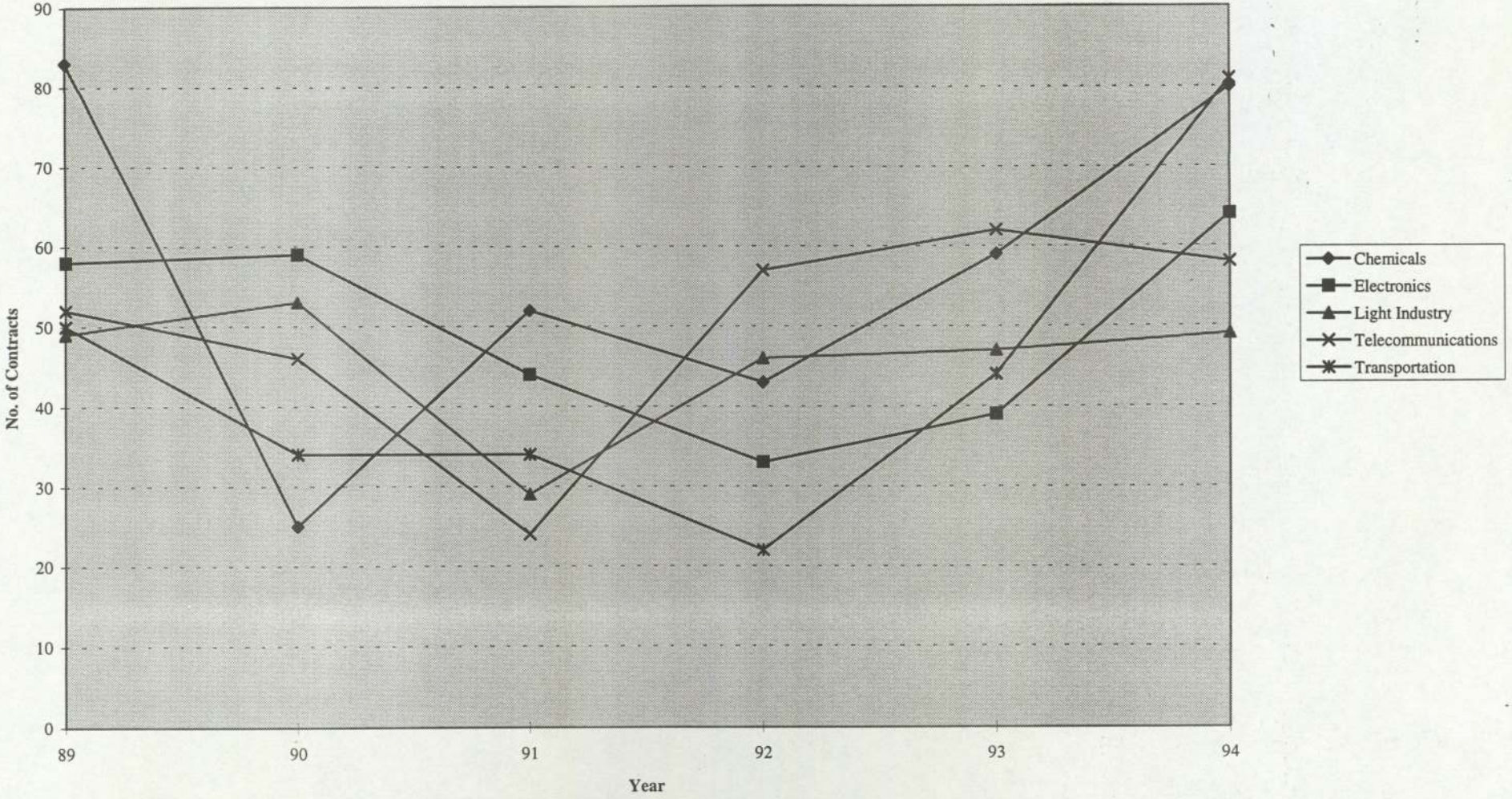


FIGURE 4.2 Countries' Shares in Chemical Sector

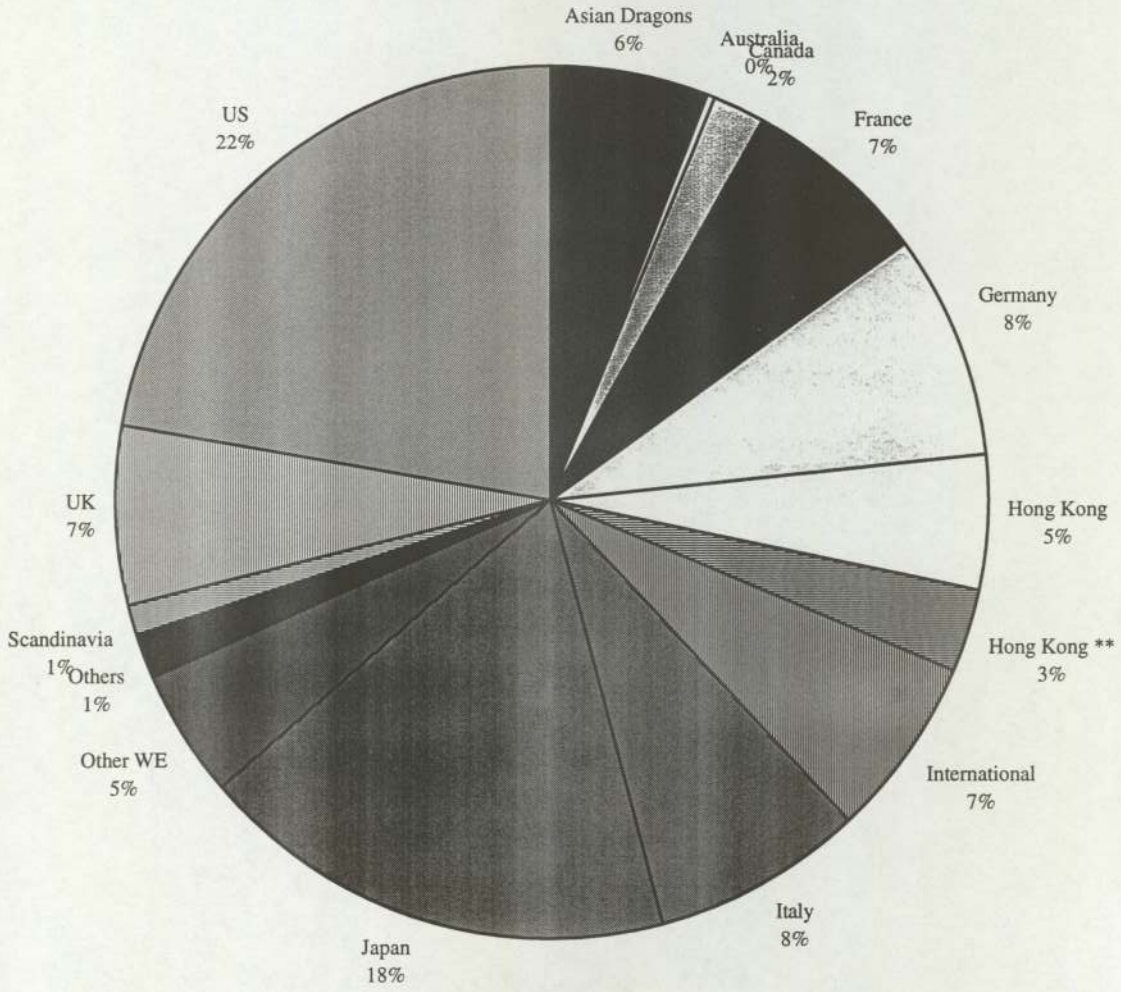


FIGURE 4.3 Countries' Shares in Electronics Sector

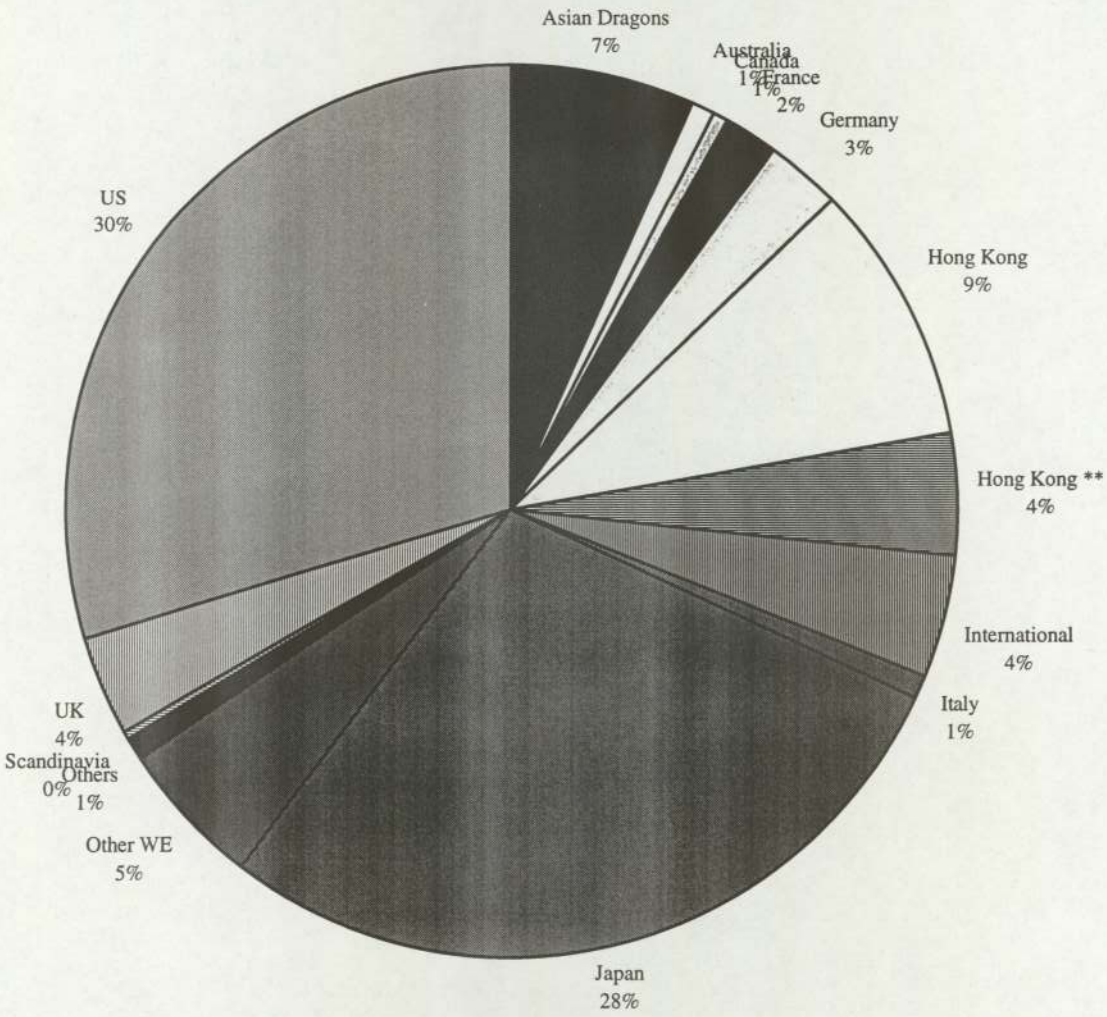


FIGURE 4.4 Countries' Shares in Light Industry

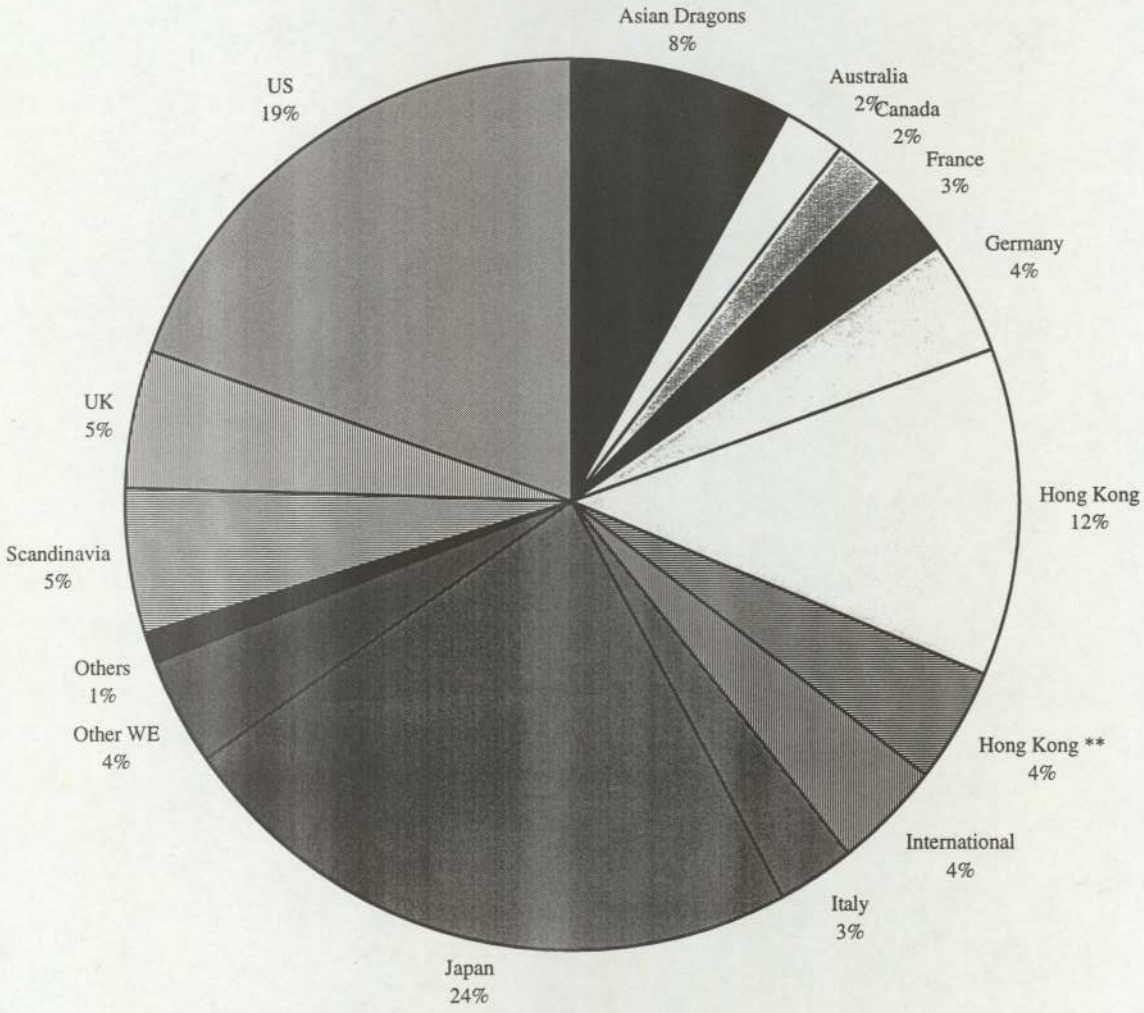


FIGURE 4.5 Countries' Shares in Telecommunications Sector

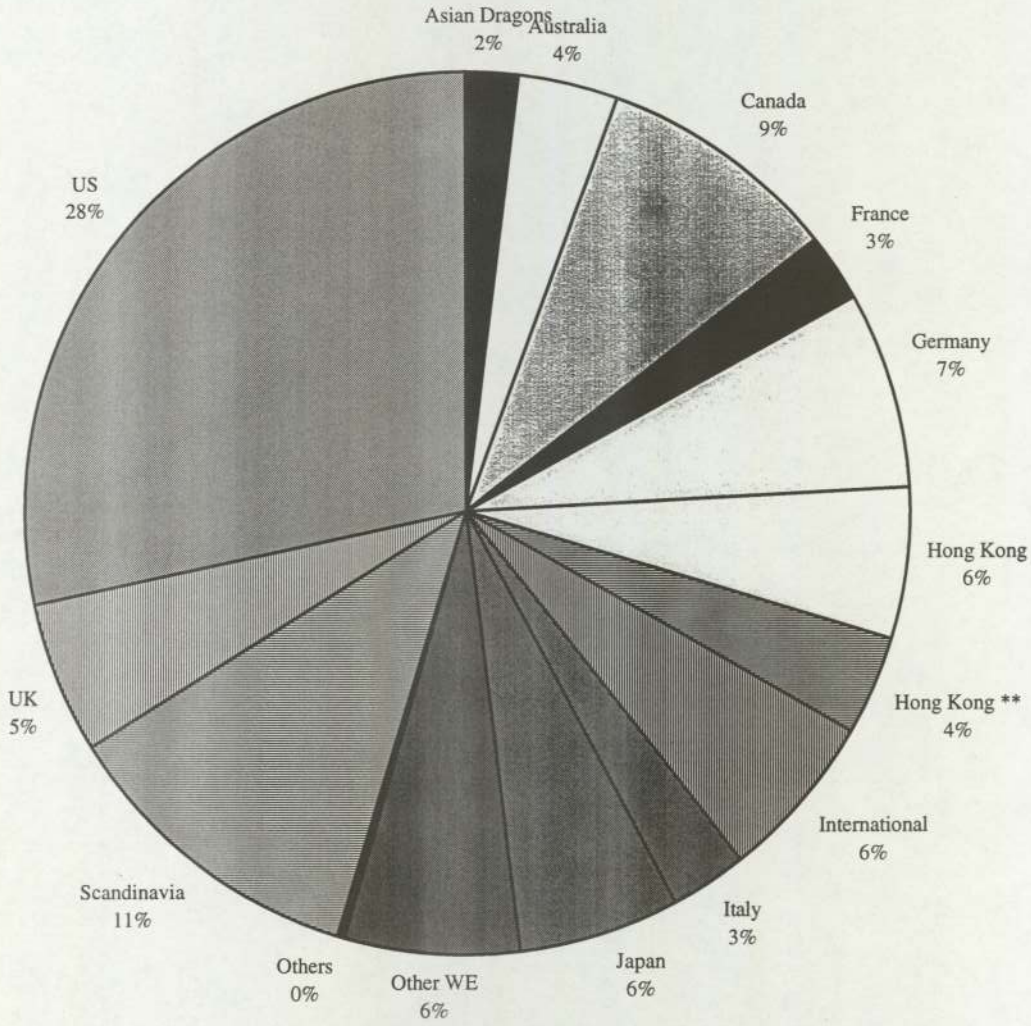


FIGURE 4.6 Countries' Shares in Transportation Sector

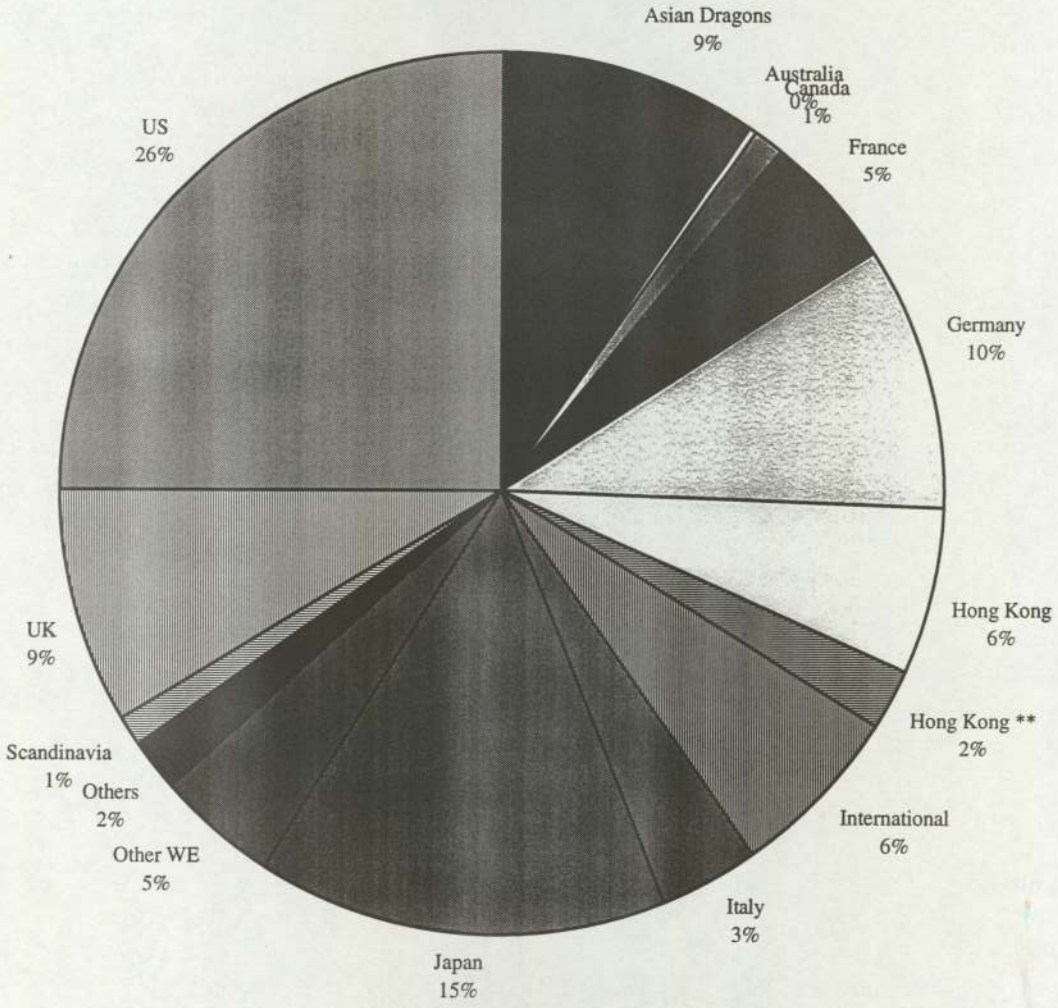
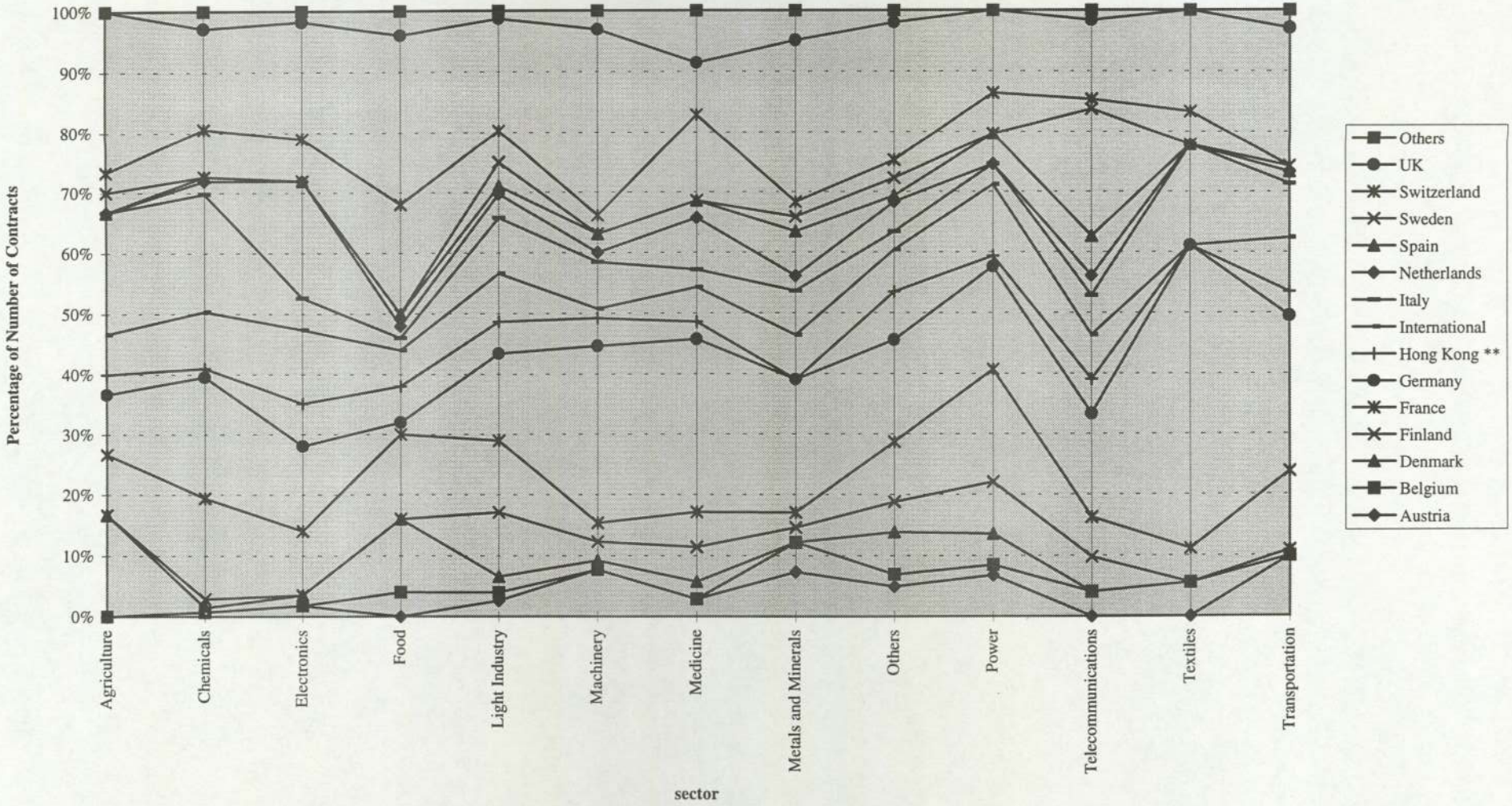


FIGURE 4.7 Comparisons of Europeans in Industrial Sectors



no share in any other industrial sector except Telecommunications, in which they are the leaders in Europe. The transportation sector was dominated by Germany and UK among the Europeans.

4.4 Types of Agreement

The fact that the joint venture type of enterprise was used in 62 per cent of all contracts (Figure 5), indicates that it is the prominent choice by foreign partners. Sale of equipment, in which technology is embodied, is another frequently used type of agreement. Direct technology transfer (TT), wholly foreign owned ventures, and co-operation accounted for between 3 per cent and 4 per cent each. Only 1 per cent of all contracts are signed in the form pure licensing.

Over the six years, joint ventures were consistently preferred to other forms by foreign partners, and they have been increasing steadily since 1992 (Figure 5.1) . The reason for such preference is twofold. Firstly, foreign companies have been more interested in gaining potential market shares in China, and a joint venture is one of the two ways to manufacture their products locally. The other way is to set up a wholly foreign owned venture. But it requires an exceptional understanding of the local market and more top Guanxis (connections), since there is no local partner in the deal. Secondly, some foreign companies have been gradually "forced" to switch from exporting or licensing technology and equipment to China to setting up joint ventures in order to sell their products, because of the policy of adding extra duties on imported equipment imposed by the Chinese government. This is the case in almost all key industrial sectors such as

Telecommunications, Aviation/Aerospace and Automotive Industries, which will be discussed in detail in the next chapter. We knew from the review of Kent's results in chapter two that joint ventures did not dominate in the 80s, hence the dominance by joint ventures has been a fairly new trend. More comparisons between the trends in the two periods will be made later.

4.4.1 Types of Agreement Used in Industrial Sectors

The preference for joint ventures by foreign partners from 1989 to 1994 was particularly true in the light industry and the electronics sectors (Figure 5.2), with nearly 80 per cent of the contracts signed in such form in the light industry and 70 per cent in the electronics sector. Both sectors, and light industry in particular, have always had a strong export orientation, the advantage of low labour costs and the potentially biggest consumer market. This is also in line with Hong Kong's significant presence in these two industries. Hong Kong companies, with more connections in China and with their marketing skills in the west, normally opt for joint venture manufacturing in China and exporting the products abroad. The relatively higher proportion of wholly foreign owned ventures in the electronics sector compared to other industries, is due, as I discovered from in the database, to the strategic expansion in China of some well established multinational companies.

Foreign car manufacturers want to gain the potentially biggest market in the world have to form joint ventures in car components manufacturing (details will be given in the next chapter). The situation in the aviation industry is similar. These two facts may be

the reasons for the much higher proportion of joint ventures over "Sale of " in the transportation sector shown in Figure 5.2. In the chemical sector however, I did not find any policy that would force foreigners to invest in joint ventures if they wanted to gain market shares. There is therefore a relatively healthy proportion of "Sale of" in the graph.

The shares of types of agreement used in the telecommunications sector are totally different from the others. More technology transfer to China is in the form of sale of equipment than through setting up joint ventures. The reasons for such a distinctive phenomenon are twofold. The demand for switching systems was so huge that most foreign companies exported their equipment to China until the policy of extra duty for Chinese importers was introduced. As we will see in the next chapter, the policy forced foreign companies to invest in China, but it took some time from the signing a deal to start of production. Foreign companies continue to export equipment to those who have the cash available in China while setting up joint ventures, or even helping their Chinese importers to get financial assistance such as in the Ericsson case. The other reason is that as we will see later, European countries have the tradition of preferring the safe route of exporting to the risky one of investing. And European countries have a strong presence in the telecommunications sector!

4.4.2 Types of Agreement Preferred by Foreign Countries

Hong Kong companies prefer joint ventures in not only the light industry sector, but also in all the sectors. Figure 5.3 shows that over 80 per cent of contracts signed by

Hong Kong companies are joint ventures. About 80 per cent of technology transfer via Hong Kong, in terms of the number of contracts, is also through joint ventures. A Hong Kong company usually has good connections in China and hence an ideal local partner can be found easily to form a joint venture. Japanese and American companies , with their relatively early involvement in China, also have more joint venture contracts. Their dominance in the light industry sector and the electronics sector, in which joint ventures are preferred due to the temptation of exporting, is also reflected in the graph.

The difference comes when Germany or the UK is compared with Hong Kong, Japan or the US. While it appears that there are more German contracts of the joint venture form than of the "sale of" form, the gap between these two types is however not as significant as the ones in the cases of Hong Kong, Japan, and the US. On the other hand, British companies seem to be even less committed to joint ventures. The number of contracts involving selling technology embodying in equipment by British companies is much higher than the number of joint ventures. Hence, relatively speaking, British companies and German companies are more interested in exporting to China than investing in joint ventures. The next section also shows that this is a fairly general propensity among European countries.

4.4.3 Types of Agreement Preferred by European Countries

Figure 5.4 shows the proportions of types of agreement adopted by individual European countries. As we can see from the graph, the only countries with percentages of the

FIGURE 5 Shares of Types of Agreement

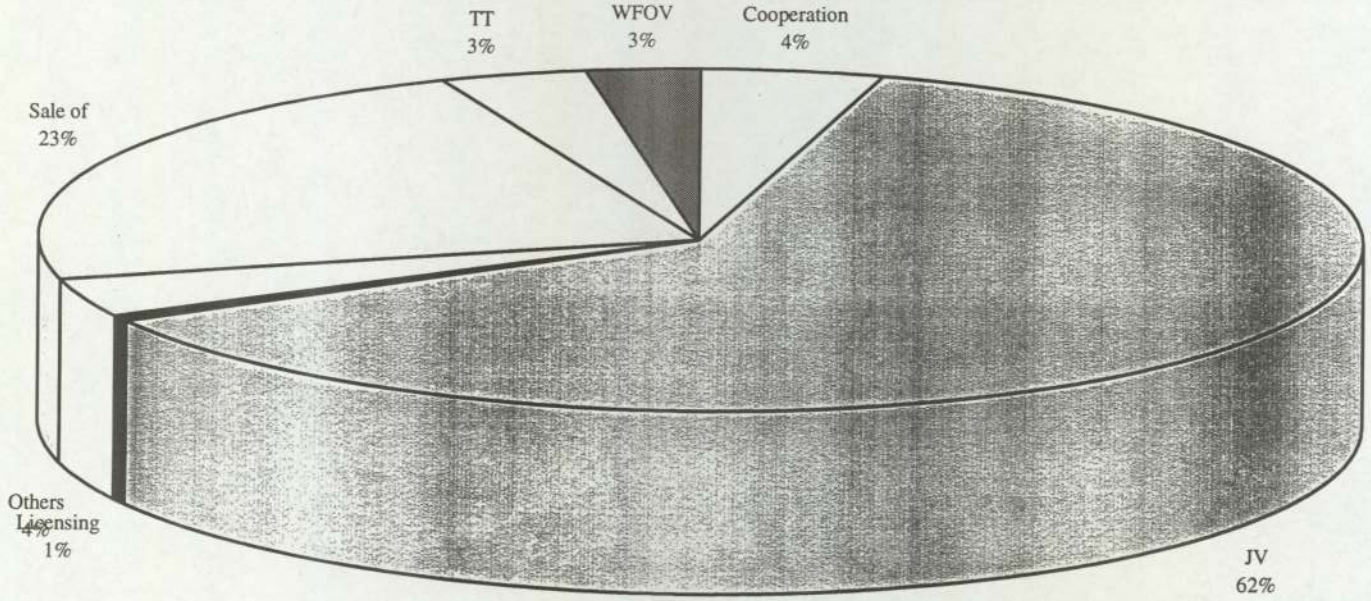


FIGURE 5.1 Trends of TOA

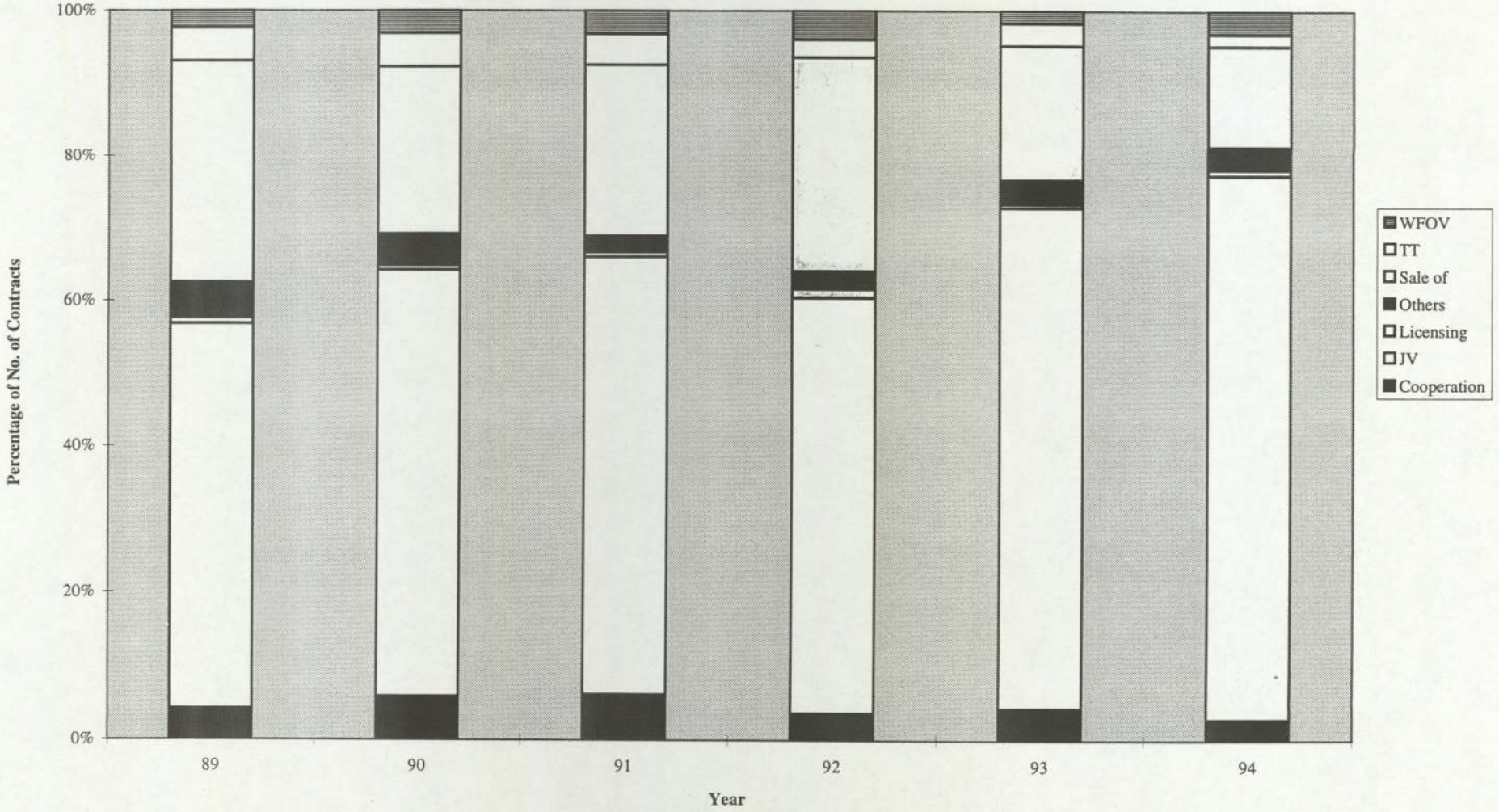


FIGURE 5.2 TOA Shares in Industrial Sectors

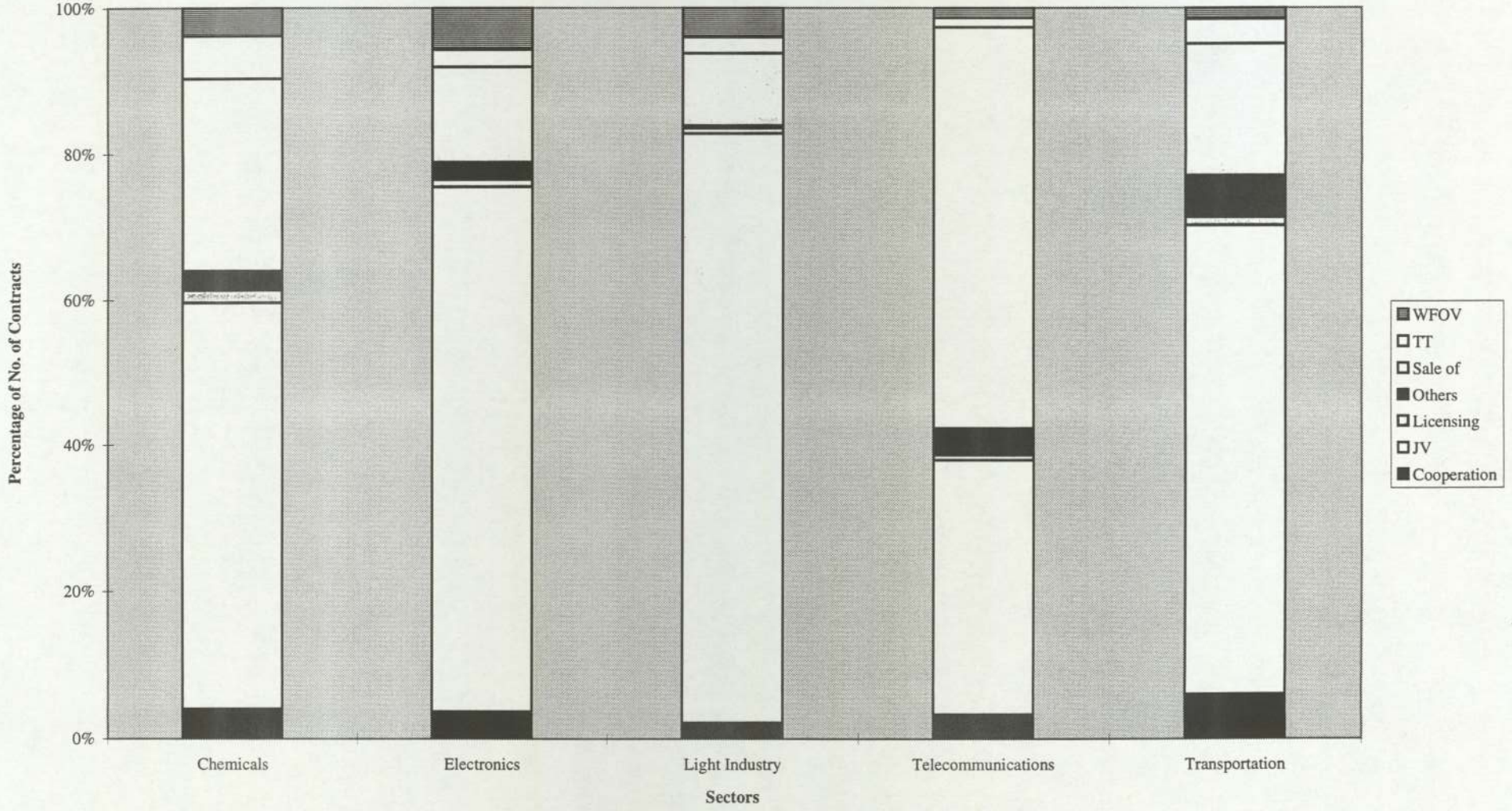


FIGURE 5.3 TOA Preferred by Dominant Countries

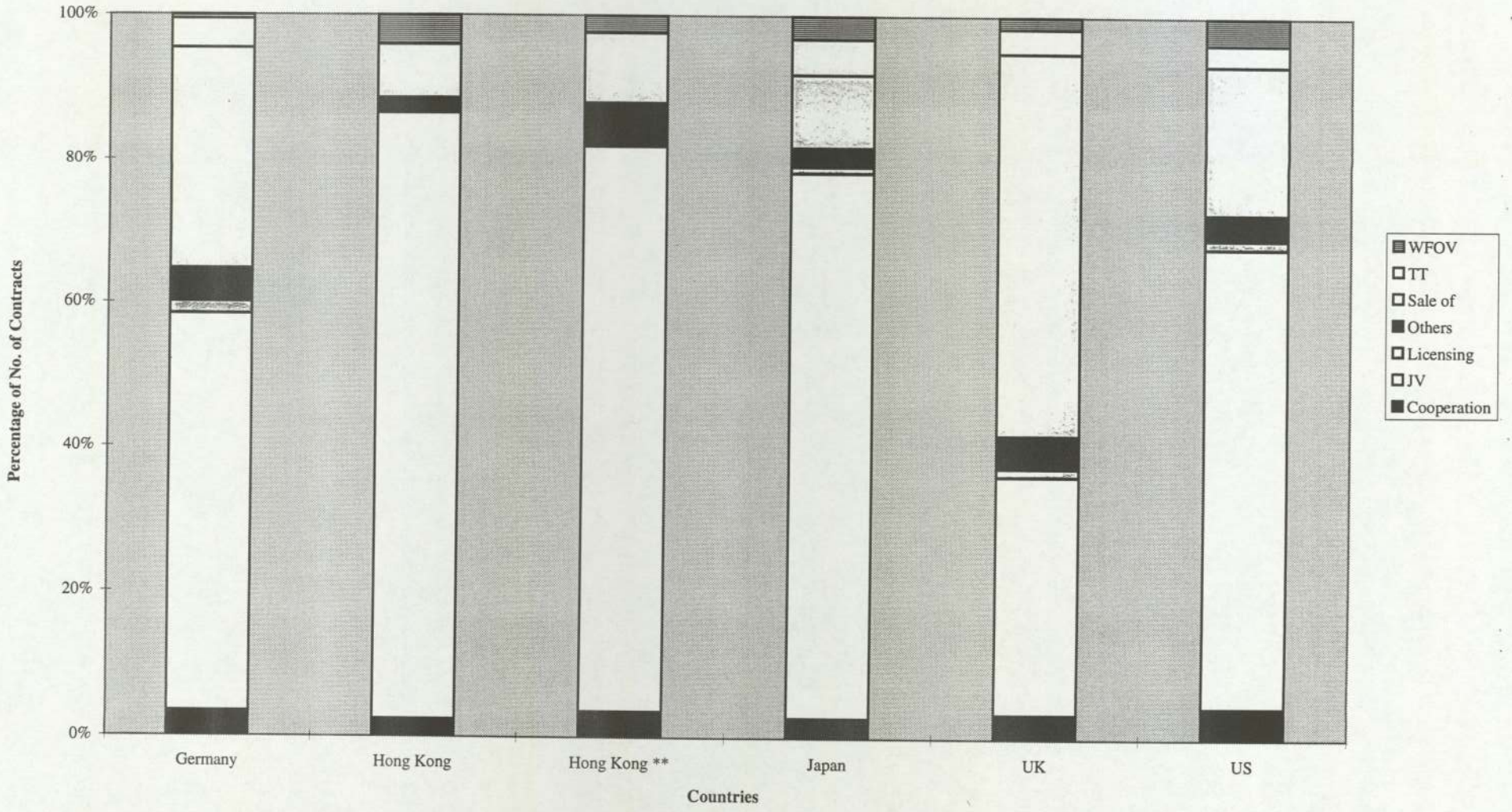
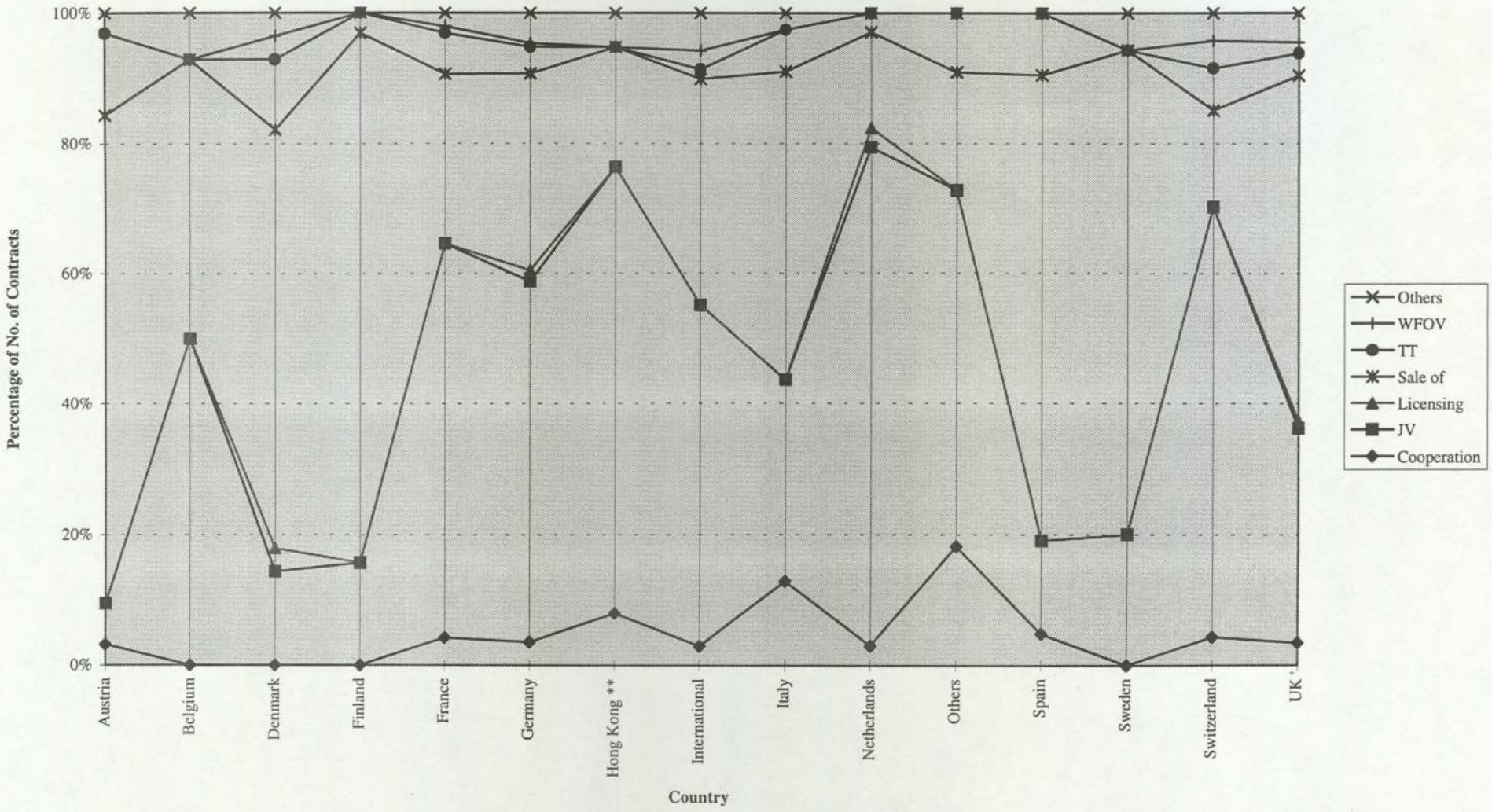


FIGURE 5.4 TOA Preferred by European Countries



joint venture type comparable to the ones for Hong Kong or Japan are Switzerland, and the Netherlands, from which two companies, namely Nestle and Philips, play a major part. Like Germany, France has a higher proportion of contracts of the joint venture type, but contracts for selling equipment also account for nearly 30 per cent, more than the 20 per cent figure for the US, and far more than the ones for Hong Kong and Japan. Almost every one of the other countries have higher proportions of "Sale of" than joint venture. The most noticable ones are Austria, Denmark, Finland, Spain, Sweden, and the UK. It can therefore be concluded that, compared to Japan, Hong Kong, and the US, the European countries tend to export equipment and technology directly to China rather than through investment in joint ventures.

4.5 Regions in China

We know that the economic development of China has been extremely unbalanced, with the coastal areas attracting most investment from the industrialised countries. We would like to know how this unbalanced economy has affected technology transfer to China. But one of the problems with the database is that the provinces or cities from where some Chinese partners come, are not published. Some contracts also involve more than one Chinese partner, and they are based in more than one province or city. In either case, the region is classified as N/A. As we can see from Figure 6, the combination of the contracts of both kinds count for 17 per cent of the total number of contracts. Although somewhat flawed as an assumption, we shall assume that in each of the regions 17 percent of the contracts belong to this "missing" category.

The results from Figure 6 nevertheless show the dominance in technology transfer by one city and one region in China. The southern region, which includes the dynamic Guangdong province, attracts a similar number of contracts as Shanghai, the biggest city and the industrial base of China. Beijing and the eastern part of China, which mainly includes the coastal provinces located on both the northern and southern sides of Shanghai, also attracts a significant number of contracts. Tianjin, the third biggest city in China, falls far behind Shanghai and Beijing, only managing to attract in signed contracts, a number similar to that of the South West. Northern China, which includes provinces around Beijing and Tianjin, and the North West, which consists of three provinces once occupied by Japan during the war, also had significant shares. Both Central China, the equivalent of the Midlands in this country, and the North West , only have a small number of contracts signed.

The unbalanced technology transfer to different regions of China has been a direct result of the government's strategic coastal development programme. The major special economic zones introduced in the 1980s are all concentrated in southern China, near Hong Kong. The special economic zones provide better tax incentives and local government supports for foreign investors. Shanghai, on the other hand, has always been regarded as the economic centre of mainland China. It received an extra boost when Pudong, the eastern part of the city, was set up as a special economic zone in the early 1990s. Foreign investors have consequently poured into the area. Some areas have historical connections with certain foreign countries. Some heavy industries in the North East, for instance, were firstly established by the Japanese in the 1920s and 30s.

We will see these connections remain the same even after 70 years or so. The central part of China and the North East have always been the poorest in China. Despite some occasional calls from the Chinese government to invest in these areas, they have attracted little attention from foreign investors due to reasons such as the lack of a basic communication structure and the shortage of educated people.

4.5.1 Industrial Sectors in Active Regions

We shall now see how the numbers of contracts in each industrial sector vary from region to region in China. Seven regions (Beijing, East, North, North East, Shanghai, South, Tianjin) are chosen for this analysis because they all have coastal lines along the eastern and southern parts of China (Figure 6.1).

The first seemingly surprising result from the graph is the participation of the South in light industry. Southern China, and particularly Guangdong, has always been considered to be the light industry base of China, but the graph shows that Shanghai has more contracts in this industry than the South. Consideration for the level of technology in selecting the data might have affected the results. All contracts involving low-tech manufacturing, which are largely in Guangdong, were eliminated. There is also a shift to other industrial sectors such as the power industry in the South. I noticed that several of the biggest contracts in power plants took place in Guangdong. There is also evidence showing that Southern China has more contracts in the food industry than other regions.

Shanghai's involvement is generally significant in all industries, except the agricultural and power sectors. It is a logical result because Shanghai is the most populous city in China, and has never been a place for agricultural development. Moreover its power industry is already well developed and technical assistance from foreign companies is not as much needed as in other places. Shanghai also has the highest shares of some highly technically oriented industries such as the electronics industry, in which Shanghai has increasingly become the software development centre, the pharmaceutical industry (Medicine), and the machinery industry. Two reasons for foreign interest in high-tech development in Shanghai are the fact that the proportion of highly educated workers is greater than anywhere else in China and that some of the best R&D centres in China are also located there. The two reasons form a satisfying "infrastructure variable" of environmental factors in our technology transfer model in chapter one.

The East and the North, both of which produce the highest quality rice and grain for China, naturally attracted most technology contracts in agriculture. Because of the nature resources of the area, the North also has more contracts in the metals and minerals industries than other places. The East, influenced by Shanghai, was traditionally strong in textiles. Its dominance , together with Shanghai, in this industry is also illustrated in the graph. The development in the telecommunications sector, which has been one of the most dynamic industries since the early 1990s, is evenly distributed between the two most affluent places --- Shanghai and the South, with Beijing coming close behind them.

4.5.2 Foreign Countries in Active Regions

As I said earlier, foreign companies have specific preferences for certain regions over other regions in China. The reasons are mainly historical, geographical and political. Figure 6.2 shows that Shanghai is the first choice for German, Japanese and American companies. Shanghai was an international city before 1949 when the communist government was first set up. Its connections with the international community survived during the 30-year isolation. The revival of Shanghai after 1979, and especially after 1992, has attracted most multinational cooperations. It also provides the most educated labour force in China. Because it is the economic centre for China, it boosts the highest level of technology in virtually all industries when compared to other regions. Such strong industrial base also helps Shanghai to import more advanced technology. This is clearly underlined by the low involvement of Hong Kong companies in Shanghai. Hong Kong companies are considered to be technically inferior to their counterparts from Japan, Germany and the US. Though the involvement of UK companies in Shanghai was also significant, they have more contracts in Southern China. It does not necessarily mean that UK companies are less interested in Shanghai. They might lose some contracts to the Japanese, Germans or American companies due to technical reasons. Their stronger presence in Southern China, is also probably due to the special influence of Hong Kong.

The special interest of Hong Kong companies in Southern China is clearly illustrated in the graph. Geographically, Hong Kong could be considered a city in Guangdong province, the richest province in southern China, and in the whole of China as well. People on both sides speak the same dialect, and it is not unusual to see a joint venture being set up based on some personal connections. Hong Kong is economically so integrated into southern China that around 30 per cent of the Hong Kong dollar notes are currently circulated in the region. However, there has recently been a new trend for Hong Kong companies to move towards the north, as some parts of northern China have gradually opened up more. But the base of operations in China for Hong Kong companies remains in the south.

Figure 6.2 also indicates that UK companies are not as committed in Beijing as they are in some other places in China. It is possibly caused by the continuing row over the democratic reform in Hong Kong . Economically there is little to lose for the Chinese if they want to discriminate against British companies. And Beijing is the most politically sensitive place in China. The central government's dislike of the British government may directly influenced the involvement of UK companies in the capital city. Local Chinese governments in other parts of China, and in the south in particular, usually tend to be more business oriented than politically oriented. So British companies in those areas may not be affected. Unlike the Anglo-China relationship, China has too much to lose if they tries to punish US companies whenever there is a Sino-US row. China has been enjoying a huge surplus trade with the US in the past few years, and any US trade sanctions would hurt the Chinese economy badly. It is one possible reason why UK

FIGURE 6 Shares of Contracts by Different Regions

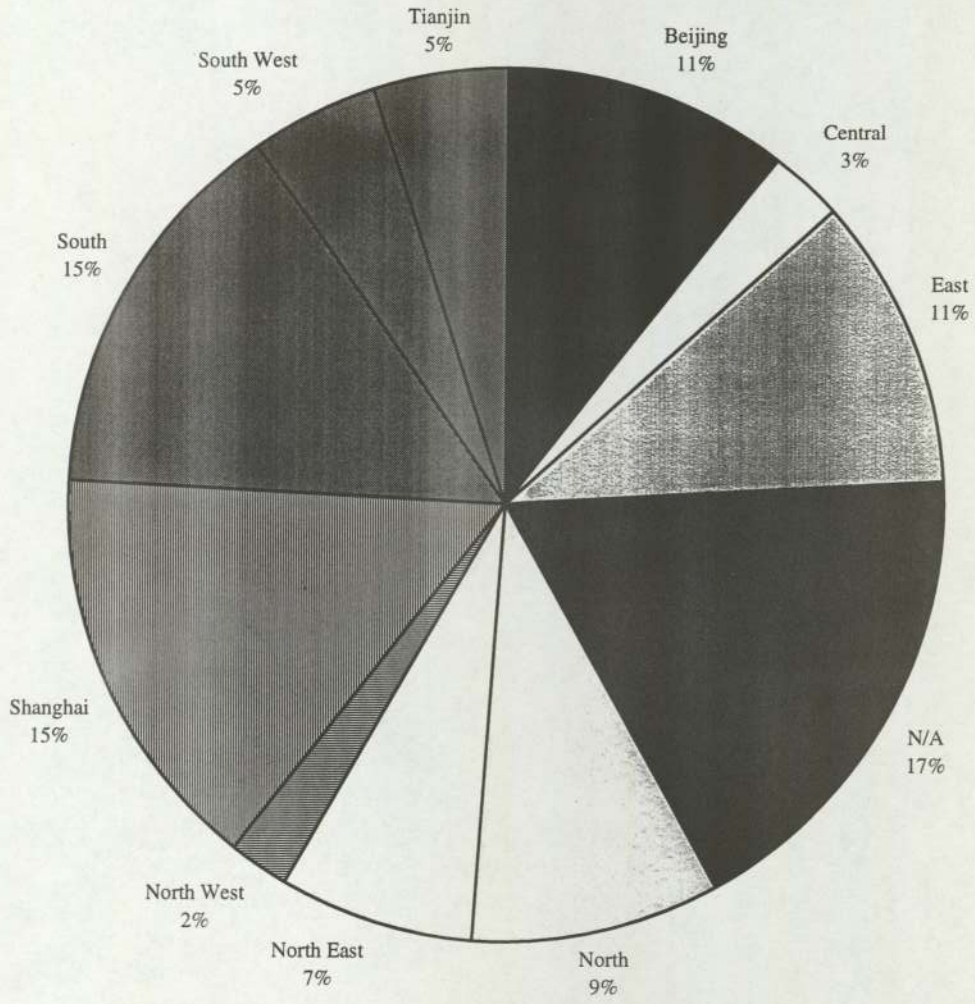


FIGURE 6.1 Industrial Sectors in Active Regions

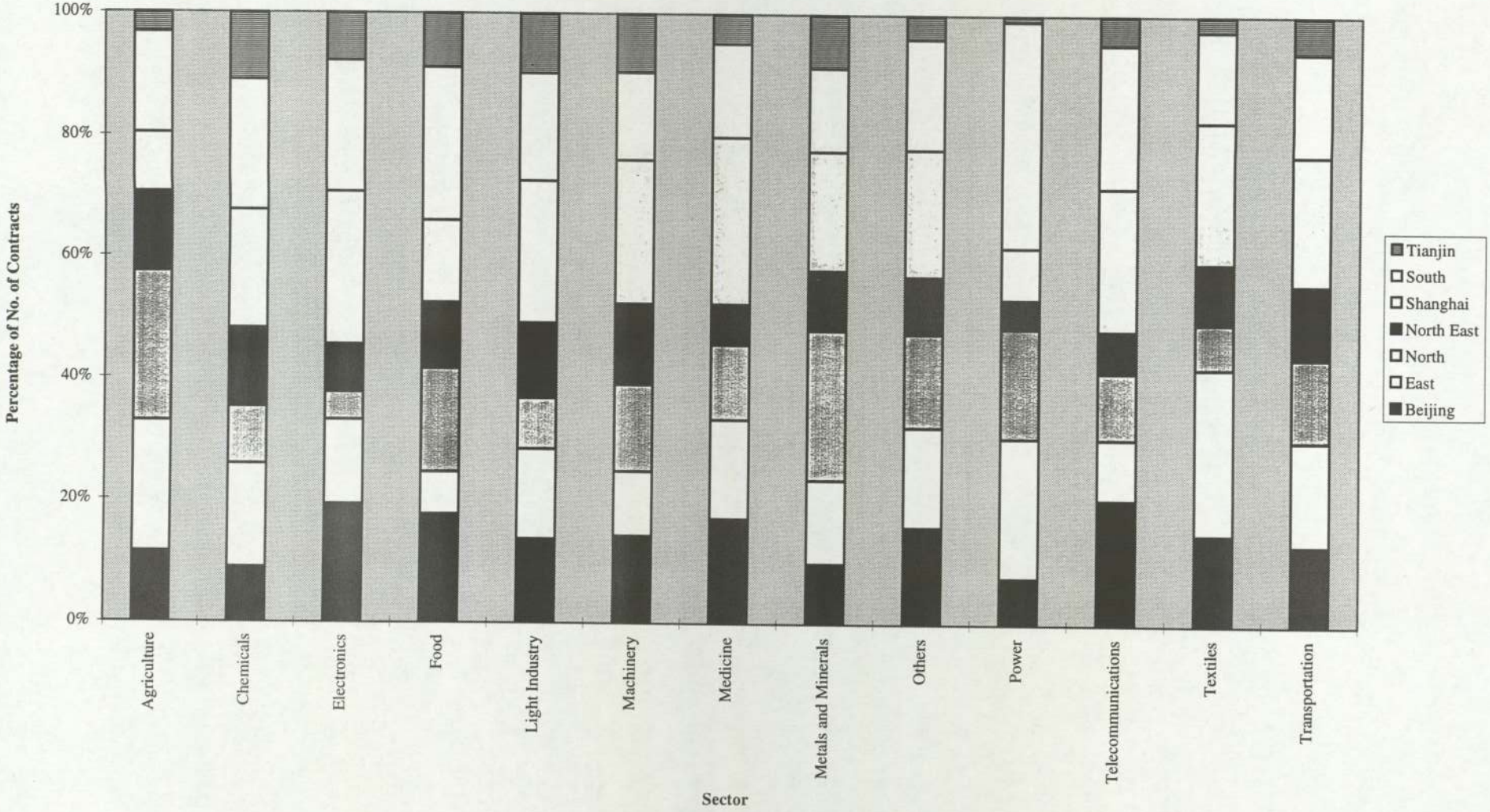
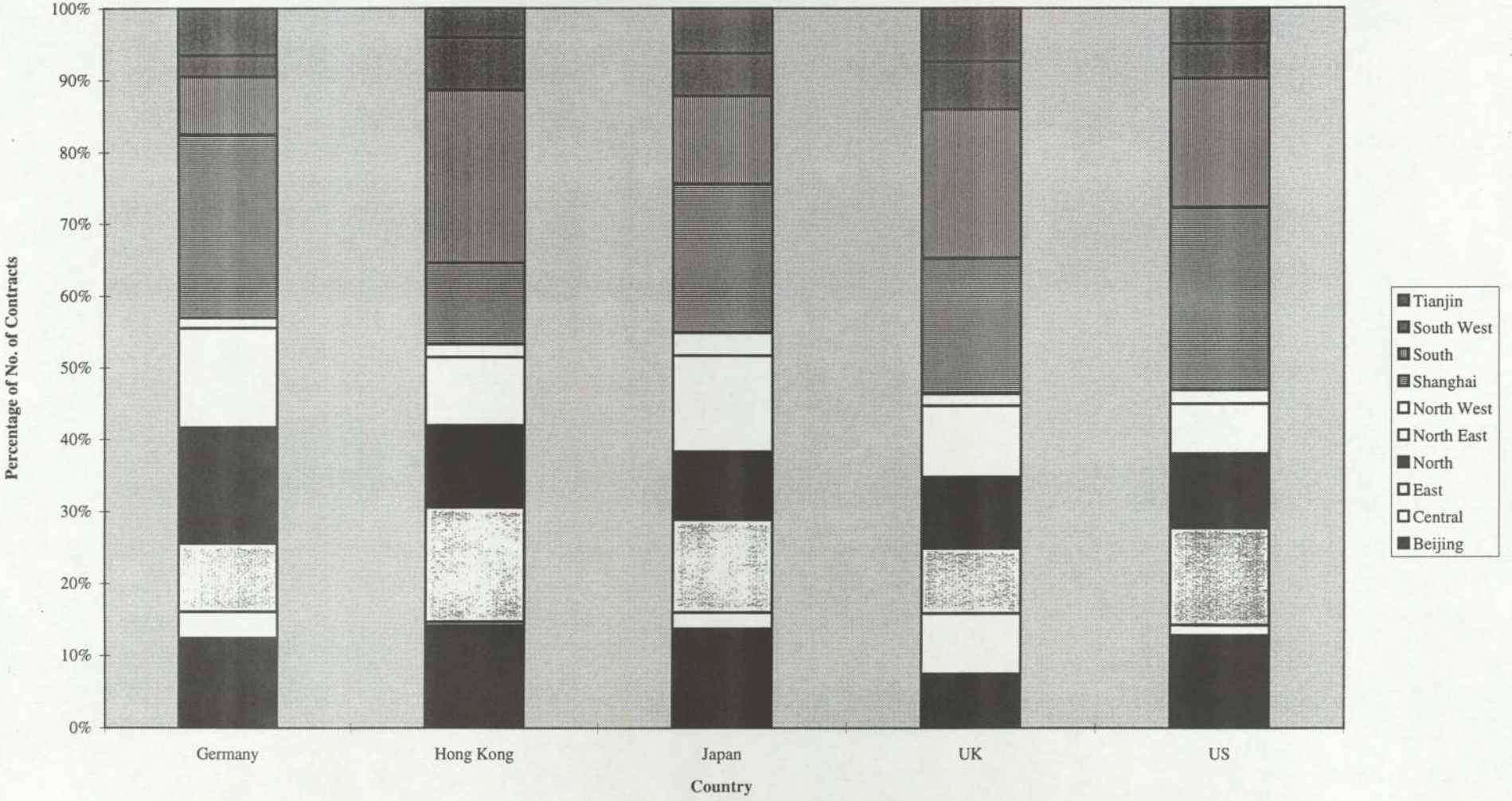


FIGURE 6.2 Dominant Countries in Active Regions



companies are less interested in Beijing than US companies, which had over 10 per cent of its total contracts signed in Beijing, a figure similar to the one for Germany or Japan, neither of which has had a major row with the Chinese government.

As mentioned earlier, Japan is more interested in the North East compared to other countries, except Germany. It is for purely historical reasons. The North East has been a heavy industrial base in China, and many of the industries were initially established by the Japanese in the 1920s and 30s. Germany's involvement had mainly to do with the strong automotive and machinery industries in the region. And Germany has been the leading country in the world in those two sectors in terms of the level of technology.

4.6 1980s versus 1990s --- A Comparison

The trends of technology transfer to China during the 1980s were analysed by Kent and were reviewed in chapter two. A comparison between the trends in the 1980s and in the early 1990s will be made in this section. The comparison will show some major shifts in the participation of foreign countries in China and their relations to different industrial sectors. However, it is necessary to point out that the database used by Kent was constructed by using the UK publication only. Hence as a result there is a possibility that her final analysis might be less accurate.

4.6.1 Foreign Countries

There were three most dominant countries in the 1980s --- Japan, US and UK. Germany, on the other hand, was not even in the same league. But there was a clear decline by British companies and an increase by the West German companies , especially in the late 1980s, when both Japan and the US maintained their lead. The trend was in line with our result. It seems that the positions of these four countries in the early 90s was a continuation from the late 80s. The US and Japan continued to dominate, while Germany finally caught up with the UK. A logical prediction based on the two results is that Germany will overtake the UK in the near future. There will be three divisions with the US and Japan still leading , Germany standing in second place, and finally the third place for the UK. There will be however a major political event ahead that may change the whole structure --- the return of Hong Kong to China in 1997.

The number of contracts involving Hong Kong rose steadily towards 1989. It seemed that it would continue to increase in the 1990s. On the contrary, it has been decreasing ever since. The reasons for the decline are twofold. Firstly, there is Hong Kong's increasing participation in projects requiring little technology. Secondly, more and more Japanese, German, and American companies have been going to China, and their technology is generally speaking superior to that from Hong Kong. Since Hong Kong will be officially part of China in 1997, it will be eliminated from the heading of "foreign countries" in future research on international technology transfer to China. Hence any prediction for Hong Kong's involvement would be, at least officially,

pointless. But for the sake of making a prediction, I believe Hong Kong's involvement in technology transfer will become less and less significant.

4.6.2 Industrial Sectors

There are two prominent industrial sectors that attracted most of the contracts involving technology transfer in the 1980s. They were Power & Energy and Electronics.

The number of contracts in the power and energy industry declined throughout the decade. As shown in our results, the number of contracts in this sector only counted for a mere 4 per cent in the 1990s. The number of contracts in the electronics sector was the highest for five years from 1984 to 1988. Our results show that though it was no longer the leading industrial sector, it nevertheless still belonged to the top division.

There is also a trend in Kent's results that the chemical industry was increasing over the years and reached its peak in the late 1980s. This finding is definitely in line with our results showing that the industry finally became the leading sector in the early 1990s. There were also signs in Kent's results that the number of contracts in light industry and the telecommunications sector were going up at the end of the 1980s. Our results prove that both of them later became the members of the "big five" sectors, i.e. Chemicals, Electronics, Light Industry, Telecommunications, and Transportation. The only sector in the "big five" that was not shown in Kent's results as increasing in the late 1980s is the

transportation sector. This has possibly to do with the different classification used in Kent's analysis. But the impact of booming business in both the automotive and aviation industries after 1992 is probably the real reason. Both industries had been growing very slowly during the 1980s, but really took off in the 1990s.

In addition, Kent also found that the electronics sector, the leading sector in the late 1980s, was dominated by US and Japan. It seems that there was no radical change in the 1990s in this sector. Countries that were the leaders in the world in the electronics industry were also the countries transferred most technology to China.

4.6.3 Types of Agreement

The most radical change from the 1980s to the 1990s was probably the type of agreement for contracts which was most frequently used. Generally speaking, the number of contracts in the form of " Sale of" was much higher than the one in the form of joint venture in the 1980s (shown in chapter two) . Though the number of joint ventures increased steadily towards the end of the decade, the sale of equipment/technology was still most popular for foreign companies. The lack of opportunities in China and the healthy economy at home might have some effects on the preference of foreign companies to export to China rather than investing in China. Large number of joint ventures set up by Hong Kong companies during the 1980s were low-tech labour intensive manufacturing companies, which were excluded from our research. For these two reasons, the prominent type of agreement used in the 1980s was

the sale of equipment/technology. As we saw earlier, the prominent type of agreement in the early 1990s was joint venture. It was a result of the booming economy in China and the recession in the industrialised countries. Foreign companies trying to establish a presence in China had to invest and set up joint ventures in the three cases of automotive, aerospace/aviation, and telecommunications industries (see chapter five).

Another major change from the 1980s was the huge drop in the number of contracts signed in the form of licensing. It was the dominant type of agreement in the early 1980s, but had been declining after 1983. It nevertheless still had a strong presence in the late 1980s. Our results show that licensing which only counted for 1 per cent of the contracts, was not important at all in the 1990s. The reason is similar to the one for the decline in sales of equipment. As a joint venture was set up, a licensing agreement might well be part of the investment package by the foreign partner. As was mentioned in chapter one, simple licensing is not sufficiently effective because it did not impose any commitment on the supplier. And the Chinese partners on the contrary normally intend to establish a long term business relationship with their foreign partners. We also predict that as an individual type of agreement in technology transfer, licensing will gradually vanish in the future.

Another significant change in the 90s was the steady rise of wholly foreign owned ventures, which was hardly mentioned in the Kent's results. The reason is partly due to the later introduction of such kind of agreement than the joint venture in the 80s. As we said earlier, a foreign company that wants to set up a wholly foreign owned venture

must have a deep knowledge of the local Chinese market and well established connections. As more foreign companies get to know more about doing business in China, I would say that this type of agreement, which gives the foreign company total control of the venture, would become more and more popular.

CHAPTER FIVE

POLICY SHIFTS AND INDUSTRIAL SECTORS

One of the major obstacles for efficient development in China has been its inadequate infrastructure, which has been considered to be a "bottleneck" for industrial development. As we have seen in the last chapter, telecommunications and transportation are counted as two of the most active sectors in terms of technology transfer. The automotive industry, as a part of development in transportation, has enjoyed great success. The chemical sector, which is directly related to China's energy output has also been important. The other two sectors --- Electronics and Light Industry --- represent technologically intensive industry and export oriented industry respectively. Export oriented industries, which also include Textiles, form the key foundations for the sources of hard currency, which is needed to import more technology. The rest of this chapter is focused on relations between the government policy changes and technology transfer in the Telecommunications, Aerospace/Aviation, and the Automotive industries. These three sectors are selected for discussions because there were strong policy shifts over the years, and their relations to technology issues can be established. Some quantitative analyses of technology transfer in these industries have been presented in the last chapter. The discussion in this chapter is therefore concentrated on some qualitative analyses.

5.1 Telecommunications

The lack of telephone lines was a complaint constantly raised by both Chinese and foreign investors in the 80s. The efficiency of all other industrial areas depends, directly or indirectly, on the efficiency of the Chinese telephone network. The government wanted more advanced technology and equipment to improve its service in telecommunications, but it did not want foreign companies to participate in the service. The policy adopted was to allow joint venture equipment manufacturing in addition to importing advanced technology or equipment, but to forbid foreign companies to engage in telecommunications operations. Up to 1992, the Chinese telephone network had been growing at rate of 20 per cent per annum, making it the largest telecommunications programme ever in a developing country (Dixon, 1992). The absolute number of telephone lines was however only eight million, merely equal to the number in London. The Chinese government wants to install 120m telephone lines by the year 2000. There has been enough evidence to show that the growth rate in the industry is tremendous. The local phone numbers in Shanghai were of six digits at the end of the 1980s, but they have now been upgraded to eight digits.

In order to attract more joint ventures to manufacture products locally, which effectively transfers technology and know-how to China, the government has levied a 23% duty on imported equipment unless the importer has its own financing (Adonis and Simon, 1993). The largest growth area is in switching equipment. Alcatel, Siemens, and NEC were well established in this market before the boom, and the Chinese government initially did not allow other multinationals to set up switching equipment joint ventures. Some other multinationals such as the Swedish company Ericsson, trying not be left

out, asked its own government to provide interest free loans to Chinese importers who were willing to buy their equipment. The demand for the equipment was so huge that the Chinese government finally eased the policy (Curry, 1993 [1]). Ericsson, Northern Telecom, Fujitsu, AT&T etc. all set up manufacturing bases in China. In practice, however, they have to make semiconductors (Curry, 1993 [2]). It is extremely expensive to set up a semiconductor line, but the foreign companies had to do it because they had to be in the switching market in order to sell other products. The tactic of the Chinese is to fully optimise its status as a "buyer" to have more advanced technology transferred to China. The competition in other areas such as optical fibre networks is also fierce, and China will not buy any technology less than the latest. Because of the lack of telephone lines, the mobile system has become increasingly popular. Ericsson , Motorola, NEC , Nokia etc. all competed in the market, and again the latest technology was soon introduced in order to gain more market shares.

The biggest prize of all would be the operation of the telecommunications network. China so far has been very cautious about foreign approaches to this area. The original policy was designed to protect the national telecommunications industry until it no longer needed preferential government treatment and its technology had reached a level that could compete internationally. The establishment of Unicom in 1994 , a consortium of three ministries - railways, electronic industries and electrical power, however was a signal of relaxation of the monopoly policy by the Chinese government (Adonis, 1994). The changed policy was also thought to be a flexible move so that foreign companies would not shift too much of their investment from China to other south Asian countries, where a similar but smaller boom was taking place. Though all

the investment in Unicom was from domestic groups, a US company has signed a memorandum of understanding with one of the ministries. Another more open sign is that AT&T will possibly build and operate a $1 billion telecommunications network in Pudong, east of Shanghai , the hottest investment place in China at the moment (The Economist, 1995).

5.2 Aerospace/Aviation Industry

The tactic that China has used of introducing the more advanced technology that in the telecommunications sector also applies in the aircraft manufacturing and aviation industries.

The Chinese aviation industry took off in the early 1990s. The increase in the standard of living and booming business means more and more people are travelling by air. The demand for aircraft from regional airlines was so huge that orders from China to Boeing counted for 14% of their total number of orders in both 1993 and 1994. An optimistic estimate by Chase Manhattan says that China will need more than 1200 new aircraft in the next 15 years. Air traffic has increased exceptionally despite a series of accidents, and the Chinese aviation market has proved to be a lucrative target for international airlines.

Just as in the case of the telecommunications industry , China had long kept the door closed to foreign companies who want to participate in the very profitable domestic airline business. However, joint venture in areas like engineering , maintenance ,

training and computer reservation systems, which are more technically oriented, have been encouraged. It was again a tactic of " you give me the technology first, I will give you the market share later". Though not as enormous as in telecommunications , the interest from western airlines was nevertheless large enough to cause substantial competition. BA, Lufthansa, Qantas, Singapore Airlines, Cathy Pacific and Japan Airlines all invested in those areas. China finally opened it airline sector to foreigners in 1994 when it allowed foreign participation in domestic airlines on the condition that the foreign investment would be limited to 35 per cent and the voting rights could not exceed 23 per cent (Walker, 1994 [2] ; Betts and Walker 1994). Though not mentioned, it was widely expected that the airlines that had already made contributions to other areas in the Chinese aviation industry would have clear advantages in the competition for setting up joint ventures.

China's huge appetite for aircraft in the next decade or so has also attracted the three biggest aircraft makers in the world ---- Boeing, McDonnell Douglas, and the European Airbus consortium. They have been competing for orders in the past five years, when the aviation industry in the west has been sluggish. In the early 1990s, China proposed an aircraft manufacturing programme to develop the next generation of aircraft in China. The objective was clear --- to build China's own aircraft manufacturing industry. Again, technology transfer would be included in the project. Boeing and McDonnell Douglas, being afraid of losing future orders from China, were then engaged in an intensive battle, which lasted four years (Curry, 1991 ; Mudie, 1992). Boeing was the winner in the end, but MD also expanded its co-operation agreement in their aircraft manufacturing in Shanghai (Betts and Walker, 1994). The biggest winner was China,

because apart from the fact that more advanced aircraft manufacturing technology would be introduced in China, the contract requires that 15 per cent of the value of the aircraft must be from Chinese sources and that some of the country's cost must be absorbed by export contracts. In addition, the rules also apply to sub-contractors, including engine makers, which mean more capital and technology in these areas will be transfered to China.

5.3 Automotive Industry

Compared to the telecommunications and aviation industries, the development of the Chinese automotive industry in the past six year perhaps has been an even more classic case of how China deliberately designed certain policies in order to attract more technology to where it was needed most. One of the few foreign car makers that entered China in the early 1980s was Volkswagen. Now, VW is one of the most successful of all foreign companies there, and it certainly dominates the domestic car market in China.

The government policy set for the car industry in the 1980s was to establish three large manufacturing plants in First AutoWorks in central China , Second Auto Works in the North East and a local auto works in Shanghai. Three smaller plants in Beijing, Tianjin and Guangzhou will also be established. VW firstly moved to Shanghai to form a joint venture and to the First Auto Works to set up an assembly line , whereas Peugeot moved to Guangzhou. Chrysler also established its presence in Beijing producing jeeps.

The austerity programme introduced in 1988 and consequently the Tiananmen Square events, greatly affected those foreign car makers in China (Robertson, 1989 ; Pauley and MacDougall, 1989). All three manufactures closed or cut production temporarily due to the collapse of the domestic market. The government begun a rescue operation at the end of 1989 (MacDougall, 1989). The People's Bank and the Industrial and Commercial Bank provided massive loans to the government to buy cars so that production could be reopened. A year later, VW bought the 40 per cent stake in the First Auto Works, marking the end of its recession there, as well as the beginning of the implementation of its ambitious plan to become the leading car manufacture in China (Elliott, 1990). Citroen also signed a joint venture contract at the Second Auto Works. Honda's announcement of its first motorbike joint venture in China in 1992 also indicates that the market started to boom (Thomson, 1992). At the end of 1993, all the car makers in the industrialised countries were trying to rush into China, and China announced in spring 1994 that it would freeze car joint ventures until 1996 (Walker, 1994 [3]).

Such a policy would have been unimaginable in the early 1980s when China called for help with its automotive industry but few replied. It was a policy welcomed by foreign companies that had already established a presence in China, and VW in particular. It was viewed as a "reward" for VW's loyalty and commitment to the market in China in the past decade. It was also considered to be a deliberate demonstration to other foreign comapnies that China will reward those who have made substantial contributions to Chinese industries. China always emphasised the importance of using locally made components and whole technology transfer rather than simple assembly. The percentage

of locally made components in VW cars in China has already reached 80 per cent, and the company intends to introduce more new production lines for the development of new models. The locally made components for VW were the products of approximately 100 Chinese suppliers which had know-how licensing agreements with foreign companies, of which most were German. While the opportunity for car making joint ventures has vanished, car components making joint ventures are encouraged (Way, 1994). China realises that in order to achieve one hundred per cent locally made cars, local components must be of the same quality as the imported ones. This policy was designed to import new technology for car components manufacturing and thus improve the overall standard of car manufacturing. For foreign car companies that do not have any presence in China, it is the only way to establish a platform for future opportunities after 1996 because the policy clearly stated that those who want to participate in the next automotive development, which will be after 1996, are required to show their commitment by setting up component manufacturing operations.

Two important projects excluded from the policy are the family car project and the minivan project. The family car project, which since then has attracted virtually all the car manufactures in the world, is a clear indication of China's ambition to become a motorised country. The project is still in its initial phrase and the decision may not be made until the end of this century. The minivan project, in which both Chrysler and Ford had once been considered to be front runners , has eventually been awarded to Mercedes-Benz. The Americans who lost have said that it was an unfair competition because Sino-US relations were going through a bad patch at the time. Another more direct, and probably more logical explanation is that it was a pure business deal because

Mercedes-Benz would provide superior technology. And the earlier commitment shown by Volkswagen, another German manufacture, had also helped.

CHAPTER SIX

CONCLUSIONS

There are four groups of factors influencing international technology transfer, i.e. technology factors, environmental factors, organisational factors and transfer factors. When the overall picture is considered instead of individual cases, it seems that environmental factors and technology factors are of the most importance in technology transfer to China.

Economic, cultural, political, administrative-legal, and infrastructure variables, which are all part of environmental factors, have some direct or indirect effects on the trends of technology transfer to China. Evidence has shown that political events caused drastic economic development in China, and consequently caused some unique changes in technology transfer from other countries. The lengthy bureaucratic administrative process and cultural differences also caused delay in signing deals. The delay is reflected in our graphs. The level of local scientific and research ability, which is an infrastructure variable has some effects on the location where foreign companies will invest.

The level of technology , a technology factor in our model, determines which foreign company will have a better chance of winning a contract in an increasingly competitive market like China. It also determines the region a certain type of technology will possibly be transferred to.

Though both major political events --- the Tiananmen Square incident in 1989, and Deng's visit to southern China in 1992 --- altered two continuing trends of the late 1980s and early 1990s respectively, the latter event caused China to gain more than it lost. It has mainly to do with the coincidence of the booming Chinese economy and the recession in the West, which gave China a stronger position in bargaining for more advanced technology. International technology transfer was hit by some tight credit control austerity programme after 1988, but it was hardly affected when a similar programme was introduced a few years later as Chinese companies become more directly linked with foreign companies which provide capital as well as technology. This phenomenon will possibly continue since more foreign funds will be accessible for Chinese companies.

Evidence has shown that the overall attitude among foreign companies towards major political event in China varies from country to country. The US companies seemed to hold back more after 1989 and more committed when there was an economic boom in the early 1990s. The Japanese companies, and the Japanese government, were not interested in political issues with China. Germany, the UK and Europe as a whole, were certainly more cautious. One similarity among companies from these countries is that they have certainly got more interested in the Chinese market as the economies in their own countries continue to struggle out of recession. Though foreign relations between China and the US have been far worse than those between China and the UK, it is the British companies that need to be most worried, since there will be no significant counterattack if they get unfair treatment from the Chinese government.

The level of technology will however continue to play a more important role than the political issues, at least in real business practice. It is expected that as more international companies want to share in the Chinese market, the ones with the most advanced technology will get huge advantages over the others. Japanese, US, and German companies will certainly be the winners, but in different industrial sectors. The US and Japan will continue to dominate the electronics sector, but I believe there will be a new trend with the US surging ahead. The reason is that computer software engineering will become more attractive than consumer electronic goods, as the government tries to achieve a higher status in "high-tech" industries. German companies will lead in the machinery industry and automotive industry. And as more medium and small companies get to know the Chinese market, we will see a big proportion of contracts signed by German companies. UK companies, however, will possibly lose out because of their relatively inferior manufacturing technology. The Bristish financial services industry, however, can perform competitively in the Chinese market as China opens up its financial sector more. Though not included in this project, it will be very intresting to see the trends in soft technology transfer to China, particularly in the financial area. Banking, accountancy, and insurance all have been developing fast in China, but the Chinese government has generally been very cautious about introducing more rapid reform policies in the financial sector. All foreign banks with four exceptions are only allowed to conduct business in foreign currencies. Accountancy firms have to set up their offices as joint ventures with local partners, though the management structures have been adopted almost identically from foreign offices. The lack of local expertise in these areas means both managerial and technical skills have to be imported from abroad.

It will add another dimension to this project if we can see how this soft technology transfers to China in the future.

Hong Kong's involvement in technology transfer will be even more limited, despite its increasing volume of trade with China. It has never been active in technically-oriented manufacturing, and there is no sign that this will change in the near future. As China opens more to the outside world, more companies will conduct business with China in a direct way rather than through Hong Kong. Some multinationals have started to move their regional headquarters from Hong Kong to China. Technology transfer to China will also be limited for South Eastern Asian countries, as it will take more than a few years for them to reach the same technology level with Japan, the US or Germany.

Technically intensive industries like Electronics, Telecommunications, Chemicals, Automotive and Aerospace, will continue to be the leading sectors in the technology transfer market. Light industry will survive to be among one of the preferential industries because China does need it as a hard currency earning machine. The competition among foreign industries in these fast growing industries will be more fierce. The Chinese will continue to set up some carefully designed policies to attract more technology in the areas that foreign companies are not that interested in. The government will keep optimising its status as a "buyer" until the desired technology is in place. This tactic will be adopted in virtually all industries. Foreign companies in general will be "forced" to sign some contracts, but they know that the rewards will probably be bigger in the future.

As long as economic development in China is unbalanced, so will be the technology transfer to different regions in China. Shanghai, Guangdong, and Beijing will certainly attract the most advanced technology. This will also result in greater participation by Japanese and US companies. German companies will also have a stronger presence in the base of the machinery and automotive industries in China --- the North East. UK companies may do well in some dynamic regions with less requirements for the level of technology such as in the eastern part of China.

Finally, it is worth pointing to the most important factor in the whole economic development in the near future in China --- the imminent death of Deng Xiaoping. All the predictions in this project are based on the assumption that China will continue as it is after Deng's death. One simple visit by him to southern China caused a dramatic change in recent years. And his death will certainly have an even greater impact!

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