TECHNOLOGY TRANSFER TO CHINA THROUGH FOREIGN DIRECT INVESTMENT

Ping Lan

A thesis submitted to:

Centre for Planning
University of Strathclyde

For

DOCTOR OF PHILOSOPHY

May 1995

Glasgow, Scotland
The United Kingdom

THIS THESIS DEDICATED TO:

My late father Jun-tong Lan,

My mother Shi Cheng, and

My family

ACKNOWLEDGEMENTS

For me as one of the generation of Chinese who experienced the 'Cultural Revolution', an opportunity to gain a Ph.D degree abroad is highly cherished. For this, I am most grateful for the help and encouragement given to me while undertaking this study.

First of all, many thanks go to the Overseas Research Students (ORS) Committee and the University of Strathclyde for the financial support which enabled me to undertake this research.

I am extremely grateful for the assistance I received from Dr. Ivan Turok, Professor in the Centre for Planning and my first supervisor. His sharp and constructive comments kept me always focused on the prime issue. His inspiring discussion and language correction helped me shorten the learning process.

I owe a debt of gratitude to Professor Urlan Wannop, my second supervisor. He not only arranged for me to come to Scotland, but also gave me a thorough instruction at the beginning of this study. His kindness, understanding, humorous comments and Chinese greetings made our meetings stimulating.

Professor Keith Hayton, Professor Daniel Rich and Professor Stephen Youngs' insightful and critical suggestions and comments have kept me in the right direction. Thus I am indebted to them.

Very special thanks go to Ms Margaret Dunn. Her help for me spread to every aspect and was far above the call of duty. I was very fortunate to have Margaret working in this department.

In particular, the substantial help provided by Ms. Magda Montgomery, tutor in the English Language Teaching Centre, and by Dr. Andrew Allan, Dr. Berce-Bratko Branka, Dr. George Geogiou, Dr. Asmat Khan, Mrs. Anne Lockhart, Mr. Adrian Healy, Dr. Timothy Pianzin, Dr. Jinghong Zhong, Dr. Jie-ming Zhu, Staff and colleagues in the Centre for Planning, are gratefully acknowledged.

Thanks are also due to many people in Dalian City. Without their cooperation in the field survey, it would have been impossible to finish this study. I would particularly like to thank Mr. Da-wei Sun, Mr. Cheng Ma and Ms Xiao-Lan Ji who kindly assisted me during the field work for this study.

Thanks also go to my pals in Glasgow: Big Danniel, Wee Dougie, Uncle James, and particularly Brenda. Their understanding and whole hearted support made my three years in Dennistoun very happy.

I am grateful for the assistance I received from Mr. Tim Brown and Mr.Trevor Hayward, brothers in Covonant Life Church, and Mrs. Celia Fisher, tutor in the English Language Teaching Centre. They, with Uncle James, read through the final draft of this thesis and indicated the necessary language changes.

To my late father Jun-Tong Lan who sadly passed away while I was undertaking my research in Glasgow, my mother Shi Chen, and my family, to whom I dedicated this thesis, my gratitude is beyond any words. Without their support, I could have done nothing.

Last but not least, special thanks to my wife Hansong Xia and my daughter Fan Lan. It is Fan who always keeps my mind peaceful.

PAGE NUMBERING AS ORIGINAL

LIST OF CONTENTS

Contents **Page**

Contents **Page**

Contents **Page**

Contents **Page**

Contents **Page**

LIST OF TABLES

LIST OF FIGURES AND MAPS

CHAPTER 1. INTRODUCTION

1.1. Rationale for the Study

1.1.1 Aim of the Study

This study concerns the issue of international technology transfer, particularly to China through foreign direct investment (FDI). Through a case study, it aims to investigate: (1) what is the level and character of technology transfer through FDI into China at present ? and (2) how could the positive impact of FDI on the host region's technology development be enlarged?

The reference region of this study is Dalian City. It is one of 14 Chinese open coastal cities, and the twin city of Glasgow in Scotland. Dalian is located in Northeast China. Nearly a hundred years ago, inward investment from Russia and Japan launched the construction of modern Dalian. The excellent harbour condition, combined with a huge hinterland of three provinces in Northeast China, have facilitated its development in this century. At present, Dalian accounts for about 1% of national economy in most aspects, but enjoys over 3% of total FDI. Its economy is characterized by diversified industrial activities, a comparatively advanced economic structure, and a high volume of exports. It is also one of the forerunners in adopting an openness policy and is the most important destination of Japanese investment. So, Dalian offers a good location to check the technology transferability of FDI.

1.1.2 Motivations Behind the Study

There are two motivations in carrying out this study. First is the lack of attention and effort given to investigate technology transfer to China through FDI. The rapid growth of China's economy and the pouring of FDI into her territory are two outstanding characteristics of China in the last decade. According to international monetary fund (IMF), the average annual economic growth rate of China between 1983 and 1992 was 9.6%, which is the highest in the world. At the same time, FDI utilized by China increased from US $2.7 billion in 1983 to $68.5 billion in 1992 (Chu 1987, Walker 1993). The parallels between the two phenomena have drawn many people's attention (Moser 1984; Oman 1989; Casson et al 1992; Li et al 1991; Currey 1991,1993; and Zhang 1994). However, few people have studied the quality of FDI, especially technology transfer. How much technology is transferred through this channel? What are the characteristics of technology transfer of FDI in China at present? The answers to such questions are unclear. It has been widely assumed that

the quality or 'technology value' of FDI and its transferability bring long term benefits to the host economy, since it is not only a trans-blood to a host region but also an incubator to create competition (OECD 1987, 1988, 1990, 1993). It has been suggested that a lack of necessary data for Western commentators and a lack of international comparisons for Chinese researchers are two main reasons for this deficiency in the study of technology transfer (Conroy 1992, Li et al 1991).

Secondly, there is no suitable framework for analyzing the transferability of FDI in China at present. Since the 1970s, technology transfer has been described as the crux of FDI. Many studies have attempted to identify the role of FDI on technology development in host countries under various circumstances (Steuer 1973; Lall 1977, 1989, Germidis 1977; Frank 1980; OECD 1977, 1979, 1981, 1988, 1989, 1990, 1991, 1993; Smali 1985, UNCTC 1985, 1987, 1990; Roman 1986; Young 1982, 1988; Blomstrom 1990; Yu 1990; and Turok 1993). Nonetheless, there is not yet an agreed method of measuring the transferability of FDI around the world. The involvement level of FDI in host country's economy, the 'royalties' flowing from host country to home country, the recruitment of local personnel in FDI enterprises, and the linkages of inward investment with indigenous firms are often employed by the previous studies. Each of them shows certain transferability of FDI, but none is suitable for the issue of China at present. This is because (1) involvement level of FDI cannot reflect knowledge flow **within** FDI firms. (2) The repeat construction of inward investment may exaggerate the impact of FDI on technology transfer. (3) The other measures may underestimate the results of technology transfer through FDI, since various know-how can neither be the main stake of inward investment at the beginning stage of FDI entry, nor be completely put into the package of 'royalties' flow. Moreover, the local integration of FDI is still at low level, and the huge pool of labor in China will shadow the role of FDI viewing from local personnel recruitment.

1.1.3 Contribution of the Study

Against this background, this thesis combines empirical measurement and methodology development under one umbrella, and seeks to make a two-fold contribution to the field of international technology transfer, in the spheres of theory and practical analysis. The main findings of the study are summarised below:

1. Six facts were revealed in terms of practical analysis. (1) There is technology transfer along with inward investment. About 90% of FDI firms show a positive technological gap over local firms. Through the local operation of FDI, 75% of foreign investors can transfer some of their technology to local partners or local

personnel within the FDI firms in production or management aspects. The consequence of this transfer is a technological leap forward of indigenous firms by about ten years. It is apparent that foreign funded firms constitute a very important channel for China to obtain outside technology.

(2) Current technology transfer through FDI is mainly reflected in two ways. One is the 'show-how' of foreign investors through their existence in the local economy. The high involvement of FDI in Dalian's input (newly FDI accounts for 25% of local annual fixed capital investment) and output (nearly half of exports are conducted by FDI firms) provide local firms and local personnel with opportunities to learn by watching. The other is the technology flow within FDI firms, particularly in joint ventures and cooperation enterprises, of which 85% show an obvious international technology flow.

(3) The limitations of technology transfer through FDI can be observed from two aspects: First technology flow is dominated by hardware transplants, while various documents of know-how and innovation skills are rarely transferred. The structure of technology flow in the three knowledge forms eg. hardware, software and mediumware is about 3:2:1. Secondly, the technology value of foreign investment is still low. Over 70% of foreign investors cannot show comprehensive technology advantages in their investment package, and few FDI firm conduct R & D activity.

(4) The transferability of FDI varies according to different foreign investors. Market entry investment shows higher technology transfer than cost saving investment both inside and outside FDI firms. Western investors usually combine high capability and willingness to supply technology. Japanese investors possess high technology capability but are unwilling to transfer them. Against this, Hong Kong, Macao and Taiwan (HMT) investors show high enthusiasm for transferring technology, but their technology capabilities are more limited. From the view of the local partners, unusual motives, and unbalanced learning capabilities distinguish China from other developing countries.

(5) Six scenarios for technology transfer were identified from interviewed FDI firms. Current transferability spectrum of FDI firms is made up by six models, in which most firms' technology transfer are basic.This spectrum, on one hand, shows the diversity of transferability; on the other hand, it shows the primary stage of technology transfer in FDI firms.

(6) The current economic policy of the host region shows a bias towards exports, and technology transfer has not been treated with enough priority. The limitations and

problems of current technology transfer are partly connected with current policy. Some of them arise from offering incentives and imposing restrictions, and the others are raised by the absence of certain measures in current policy package. Therefore, an adjustment in the policy package is recommended.

2. Two methods were developed in terms of theoretical analysis. Firstly, this thesis develops a framework for measuring the transferability of FDI in developing countries, based on the mechanism of technology progress and the dynamic of FDI development. It consists of three measuring effects. (1) Accessing effect, which combines new technology development model (TEP 1991, 1992) and Dunning's eclectic paradigm (1977, 1991), and aims to measure the accessibility of indigenous firms and local personnel to inward investment. It either checks the involvement level of FDI in the local economy, or explores the existing features of its local operation. (2) Obtaining effect. Based on various learning mechanism (Arrow 1962, Rosenburg 1982, Malecki 1991), this effect intends to check the process of technology acquisition by local partners or local personnel from foreign investors within FDI firms. (3) Diffusion effect. According to the local linkages model of FDI (Germidis 1977), it attempts to examine the spin-offs of inward technology outside the boundaries of FDI firms, which results from the exchange of materials with indigenous enterprises and the outflow of local personnel. These three effects not only constitute a comprehensive measurement of transferability of FDI from indirect, direct and relative examination, but also connect transferability of FDI with its other impacts on host country.

Secondly, it synthesizes a 'technology ball' to show the complexity of technology contents, in which a matrix of technology components is chosen to scrutinize the knowledge flow. It is hoped that both of them can be used in other circumstances. Drawing on the findings of previous studies, such as technology contents (Schmookler 1966), technology forms (Steuer 1973, UNCTC 1984, UN 1989), technology levels (OECD 1981, Hobday 1991), technology destinations (OECD 1979, Adeoba 1988), and technology corridor (Georghiou et al 1986, Gomulk 1990), a technology ball is developed in this thesis, in which a six-part matrix combined by three technology forms and two technology destinations is used to analyze technology transfer in components level. It (1) bridges the gap between production and organization technology occurred in most previous studies; (2) emphasizes the importance of various documents which is defined as half-soft/hard or mediumware technology in this study, and (3) overcomes the shortcoming that aggregate analysis about technology transfer tends to miss out much of its complexity and diversity.

1.2 Organization of the Thesis

1.2.1 Scope of the Thesis

Technology transfer through FDI is a marriage between FDI and technology development. The overlapped feature of this issue determines that there are three ancestors of this study--technology progress, FDI development, and technology transfer through FDI. The scope of the thesis in these fields is set by the combination of research objectives and methodology.

In terms of technology development, studies have mushroomed after Schumpeter's (1939) initial work. Schumookler (1966) analyzes the causes and consequences of technology development cycles in an opposite way from Schumpeter. Arrow (1962), Rosenburg (1982) and Malecki (1991) identify the different learning mechanisms; Solow (1957), Abramovitz (1956, 1993) Dension (1962), Heertje (1977), Scott (1993) concern with the contribution of technology to production system. Freeman (1982), Methe (1991) sorted out different types of innovation and their relation with industry. Price(1969), Gomulka (1990) studied the relation between technology and science. Mackenzie (1985) described the reaction of society to technology. Hall (1985, 1987), Nelson(1984), OECD (1988, 1989) analyzed the high technology development pattern, contents and role. However, when the focus is set on the flow of technology, as Methe (1991) states that notions of technology used by previous studies have been inadequate in catch all the dimensions of technology. Therefore, it is a priority of this study to further the discussion on the contents of technology and obtain a tool to observe technology flow.

In terms of FDI dynamic, four main theories and one paradigm are emerged from the early studies since 1970s (Cantwell 1991). They are Hymer's (1970, 1972) market power theory; Buckley and Casson's (1976) internalization theory; Vernon's (1974) competitive international industries approach; Vernon's (1966) macroeconomic developmental approach, and Dunning's (1977,1988a) eclectic paradigm. Although a general picture about the evolution of FDI can be drawn from the theoretical discussions and many empirical analyses (Reuber 1973, Steuer 1973, Lall 1983, 1989; Frank 1980; Vernon 1981, UNCTC 1985, 1987, 1990; Young 1982, 1988; Hoyle 1990; OECD 1981, 1987, 1988, 1989, 1993), it is rarely applied to the case of China. Therefore, another priority of this thesis is to test the validity of these analyses on the operation of FDI in current China.

In terms of technology transfer through FDI, most previous studies are involved in the identification of possible impacts of FDI on host country's technology

development from positive and negative sides (Steuer 1973; Frank 1980; OECD 1981; Hood et al 1982, Aggarwal 1984; Samli 1985; UNCTC 1984, 1985, 1987, 1990; Roman 1986; Young 1988; Yu 1990; Jegathesan 1990 and Blomstrom 1990). At the same time, the model of direct technology transfer through FDI (Smali 1985, TEP 1991), the trickling down of knowledge through the linkages of FDI local operation (Germidis 1977, Michalet 1977, Turok 1993), and the channels of technology transfer (Vernon 1981; Dunning 1981; Cavusgil 1985; Marton 1986; UNCTC 1987, 1990; Young 1988; Oman 1989; Hoyle 1990; Brown 1990; Michalet 1991) are also widely discussed. Nonetheless, the discussion on the measurement of the transferability of FDI has received little attention. Up to now, there is not yet a comprehensive method that could be employed in China. Therefore, it is another priority of this thesis to compare the previous methods and synthesize them into an analytical framework for examining the transferability of FDI in China at present.

1.2.2 Structure of the Thesis

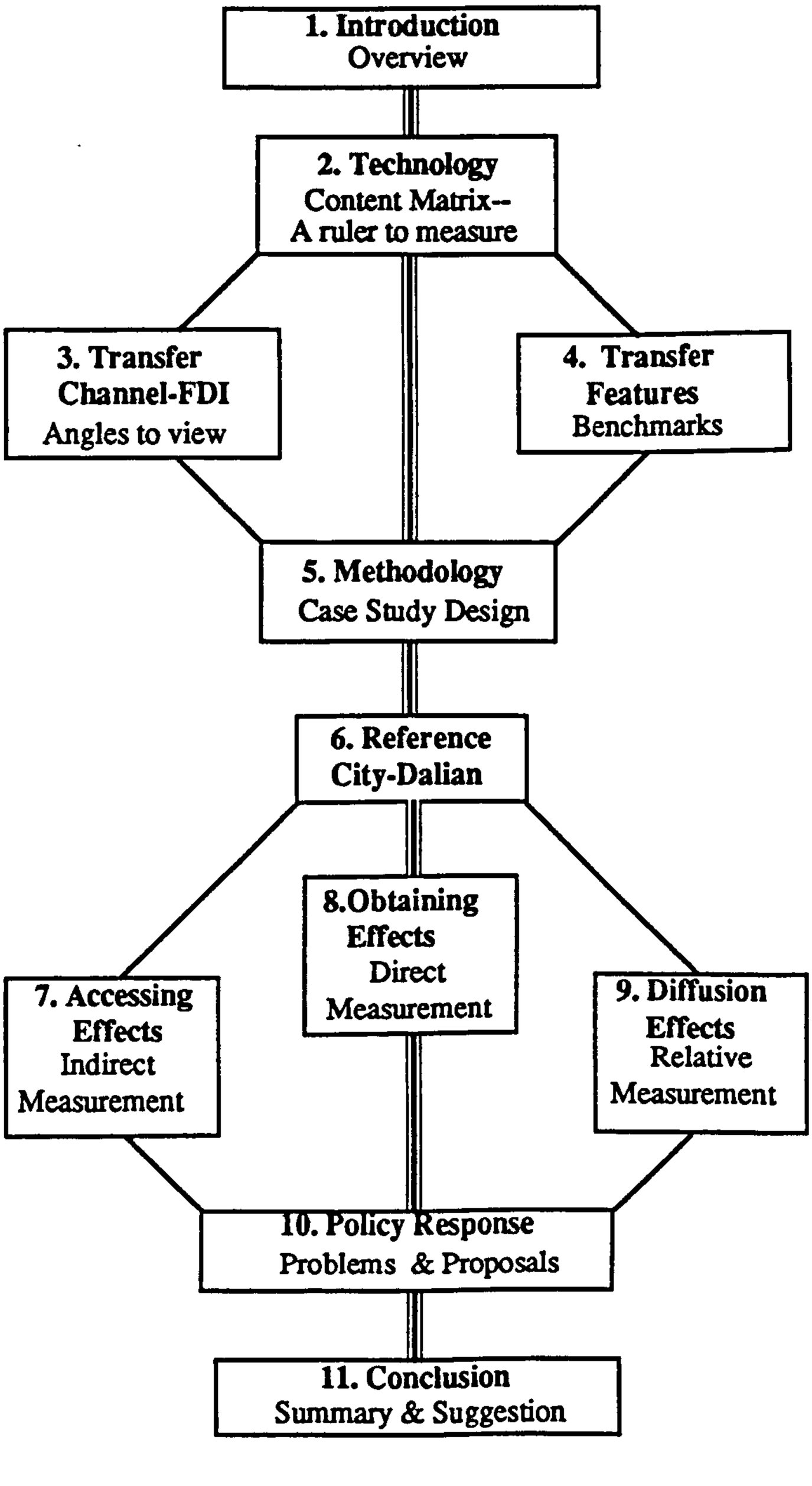
Based on the purpose of the study, the structure of this thesis is shown as Figure 1-1. It consists of two parts and 11 chapters: chapters 2 to 4 constitute literature review, and case study covers chapters 5 to 11.

After setting the scene of this study in the opening chapter, chapter 2 surveys the literature on technology development, so that clues for observing technology flows could be obtained. First of all, it identifies the basic elements of technology by comparing various definitions, and points out that managerial knowledge is excluded in most previous studies. Secondly, it shows the complex of technology through exhibiting its different structures and relations. Thirdly, it reviews the role of technology to economic development, either in its impact or in its methods. Finally, it locates technology transfer in the context of technology progress by examining the learning mechanism and the models of technology development.

Digesting the main theories on the dynamics of FDI, and examining some empirical studies are the topic of chapter three. 3.1 outlines a picture of FDI evolution based on previous theoretical analysis. 3.2 discusses the impacts of FDI on host country's economy from various aspects. 3.3 compares the attitudes towards FDI in home country and host country, and then discloses the policy package employed by developing countries.

Combining the mechanism of technology progress and the dynamics of foreign

Figure 1-1 STRUCTURE OF THE THESIS



investment, the characteristics of technology transfer through FDI are shown in chapter four. 4.1 displays a basic model of technology transfer through FDI, and discusses the factors which affect the process of technology flow. 4.2 compares the three channels which are often used by FDI--joint ventures, wholly owned subsidiaries and licencing. 4.3 analyses the procedures and methods of technology sending and technology receiving, which constitute the whole process of technology transfer. 4.4 focus on the studies which concern the issue of China. The survey, both inside and outside China, finds that insufficient information and poor methodology are handicaps respectively keeping Western and Chinese scholars from undertaking systematic research.

Chapter 5 is the methodology chapter. It bridges the literature investigation and practical study. Based on clarifying the objectives of this study, 5.1 sets up six hypotheses and discusses their origination. 5.2 develops an analytical framework for the case study. It consists of three measuring effects, one matrix of technology components, and six comparison angles. 5.3 explains the sources of the secondary data, the employment of postal questionnaires and face-to-face interviews in obtaining first hand information, and the analysis and application of data from different sources.

Chapter 6 concentrates on discussing the reference region--Dalian City. First it gives a concise introduction to the geographical condition and development history of Dalian. Secondly, it reveals the characteristics of Dalian in China's economy by comparing the main economic indicators between Dalian and the average level of China. Finally, it outlines Dalian's investment environment based on the analysis of the infrastructure and policy framework.

Chapter 7 deals with the findings on accessing effects, which constitutes the indirect measurement of the transferability of FDI. It begins with the measurement of the level of involvement of FDI in Dalian's economy. Through analyzing the participation of inward investment in Dalian's input and output, the accessing possibility for indigenous enterprises and local personnel to FDI is checked. It is then followed by the examination of the accessing environment between inward investment and host region--contact motives, objectives, channels and fields, which also determines the accessibility of FDI.

Directly measuring the technology flow within FDI firms is the topic of chapter eight. First it analyzes the technological gap between foreign investors and local partners (for wholly owned subsidiaries, it assumes to compare with local same trade), which shows either the technology value of FDI, or the potential of local partners or local personnel to obtain technology from foreign investors. Secondly, it

discusses obtaining results or technology transferability of FDI by checking the technological leap forward of local partners or local personnel under the above technological gap. Finally, it scrutinizes the obtaining process at the level of technology components using the technological matrix developed in chapter 5, and generalizes the different models of technology transfer among interviewed FDI firms.

Chapter 9 focuses on technology transfer outside FDI firms through checking diffusions of imported technology via various local linkages of FDI enterprises, which constitutes relative measurement of transferability of FDI. It begins with the examination of technology diffusion through forward linkages of FDI firms. Then, it discusses the technological impact of FDI firms' local purchase on local suppliers. Finally, it examines the multiplier effect induced by local personnel who leave FDI firms.

Policy evaluation and proposals are the theme of chapter ten. 10.1 discloses the current policy package both in incentive and restrictive aspects. 10.2 evaluates the achievements and limitations in implementing these policies. At the same time, it discusses the gaps in the current policy package. Based on the survey findings and the experience of some other Pacific Asia countries, 10.3 proposes six measures to promote technology transfer through FDI.

Chapter 11 deals with the review of this study and suggestions for further studies. Conclusions derived from the theoretical discussion and field work are summarized in 11.1. The limitations of this study are discussed in 11.2. At the same time, the problems raised from this study indicate the direction for further research.

1.2.3 Limitations of the Thesis

Lack of associated literature was the major problem in this study. As no other similar study has been undertaken as far as the researcher is aware, he was unable to carry out a thorough comparison with previous research, whether in the three effects measurement or in the analysis of technology flow at components level. Since the research is an original effort, it is acknowledged that it may suffer from certain shortcomings.

CHAPTER 2. TECHNOLOGY AND TECHNOLOGY TRANSFER

2.0 Introduction

This chapter discusses some basic issues of technology such as its structures, relations and development, because the traditional ideal of technology is too narrow, and cannot catch all the meanings of technology, which hinders the measurement of technology flow and the identification of the impact of this flow. In order to lay down a sound theoretical foundation for carrying out this study, the first part of this chapter aims to clarify the contents of technology by analyzing various technology definitions and technology structures in the previous studies. The second part reviews the role of technology to economic development, either in its contribution contents or in its contribution methods. The final part locates technology transfer in the context of technology progress by examining both mechanisms and models of technology development.

2.1 Contents of Technology

2.1.1 Definition of Technology

Technology is a slippery term. Various definitions can be found in the literature, which can be divided into five groups, according to their similarity. The aim of comparing different definitions here is trying to examine the characteristics of technology from various angles and get a good start which allows us to connect all the parts of this study easily.

1 **Technology is the "application" of science.** Because of the special relation between science and technology, some authors define technology as the application of science, or human rationality, or other human skills. Haos (1966) emphasizes aims of the application are the creation of plans, designs and means for achieving desired results. Goulet (1989) specifies the results of the application--asserting control over nature and over human processes of all kinds. OECD (1977) highlights the environment of the application. According to its opinion that the use of scientific knowledge by a given society at a given moment is to resolve concrete problems facing its development, drawing mainly on the means at its disposal, in accordance with its culture and scale of values.

2 **Technology is a process.** Another group of authors define technology as a process (Methe 1991, Georghiou et al 1986, McIntyer 1986, The Encyclopedia

Americana 1971). Methe (1991) points out that this process is characterized by (1) using knowledge; (2) reducing the uncertainty, and (3) achieving desired end. So it is a process for creating solutionsto problems. McIntyer (1986) emphasizes the driving forces of the process and regards technology as a part of R & D process.

3 **Technology is a structure.** The third group of definitions is connected with pattern or structure. Meissner (1988) defines technology as the configuration of processes, plans, techniques, knowledge and skills. The function of this structure, according to his idea, is to effectively produce, process, and market a product or service. Feibleman (1980) not only states that technology is a special and stabilized pattern, but also points out that this pattern is made up by various inputs such as labor, capital, methods.

4 **Technology is knowledge.** In recent years, more and more definitions connect technology with knowledge (Schmmokler 1966, OECD 1979, Rosenburg 1982, Knaap 1987, Jegathesan 1990). The differences between those authors are in two aspects. One is in the description of quality of knowledge. For example, Meissner (1988) thinks that technology is a quantum knowledge. Haos (1966) emphasizes that it is scientific knowledge. Adeoba (1990) used the word "technical" to describe it, and OECD (1979) suggests that the characteristic of knowledge is systematic. The other difference is in the range of knowledge. Most authors limit the scope of the knowledge only in production or only in industry. For example, Schmookler(1966) defines technology as the knowledge of industrial arts, and Knaap (1987) says that the body of knowledge is used in the production of goods. However, some authors do not satisfy the narrow scope and try to enlarge the traditional scope of technology. OECD (1979) includes management and marketing in its definition. Adeoba (1990) puts human skills as an important component of technology, and Jegathesan (1990) covers services in his definition.

5 **Miscellaneous Definitions.** In addition to the above four groups of definition. There are some other definitions. Although varying in literal, the method of giving definition in this group is the same--emphasizing certain characteristicsof technology. For instance, in order to stress the function of technology, Been (1971) states that technology simply means getting more of less. In order to stress the complex contents of technology, Morphet (1987) claims that any tool or technique, any product or process, any physical equipment or method of doing or making, by which the human capability is extended belongs to technology. In order to highlights the creative quality of technology, Price (1969) treats technology as the conception and/or demonstration of the capability of performing a scientific elementary function using new or untried concepts, principles, techniques, or materials, or the

development of new manufacturing fabrication, or processing techniques. The entry of technology in the Encyclopedia Americana highlights the wide usage of technology by defining it as ways of making or doing things.

It is apparent that the definition of technology varies according to author and context. Definitions are not right or wrong, just more or less useful. Scrutinizing these definitions and observing the usage of them in the previous studies, we can get two conclusions: First, there are two basic components in most definitions of technology. They are: (1) knowledge or technique; In the groups of knowledge and knowledge application, it is apparent. In the group of process and structure, it is also implied. Without knowledge, any structure or process is rootless. In miscellaneous groups, various characteristics result from the existence of this knowledge or technique. (2) doing things. No matter in which group of definition, technology is always connected with getting certain results, resolving certain problems, and finishing certain tasks. Combining the two basic components, we can define **technology as knowledge of getting things done.**

Secondly, most definitions of technology are too narrow and limited to the production field. This can be seen from the following aspects. (1) Among knowledge definition group, most authors draw the scope of technology just in production, and pay little attention outside it. (2) Although other definitions do not draw the scope literally, they focus only on the tangible parts of knowledge. (3) In practice, few studies keep its definition in a broad sense, although it may include other aspects in their definition at the outset. Comparing the basic components of technology with the narrow scope of its traditional definitions, it is obvious that technology should include not only production, but also organization/management knowledge. It should consist of both tangible and intangible parts.

2.1.2 Origination of Technology

The various definitions suggest two origins of technology. One is science push. The other is market pull. Science push means that technology development results from the injection of new science (Price, 1969). The push role of science to technology is reflected in two aspects. (1) The contents of science push are both adding knowledge and offering method. That means, on one hand science expands the knowledge bases from which technology could get answers to practical problems. On the other hand, scientific method--theory guided hypothesis testing offers technology methodology guide for solving problems (Methe, 1991). (2) The process of science push has lead technology more to rely on science than before. Price (1969) describes the relation of science and technology as two dancing partners who dance in

an-arm distance. Freeman (1982) points out that there are some new "dances" along with the development of science and technology. Some of them are 'cheek to cheek' dances. Many other studies such as Monck (1988), Gomulka (1990), and TEP (1991) also show the intimating process that technology has been increasingly dependent on the progress in science.

Market pull means that market solution inevitably drives technology (Wade, 1990) or as Schmookler (1966) says that it is the expected profitability of inventive reflecting condition in the relevant factor and product markets, that determines the pace and direction of technology development. Goldhar (1974) reviews eight case studies and finds that between two thirds and three fourths of all successful innovations were stimulated by information about a market need (refer to Gomulka 1990 p44-45). Faber and Proops (1990) further point out that market pull is mainly through the signal of price.

Recently, more and more studies such as Mowery and Rosenbury (1989), Pattie (1987), Ayres(1987), Methe (1991), TEP (1991,1992) attempt to combine the two origins. They state that science push and market pull cannot be separated in technology development. There is a trend that in the very early period, science push can be quite important for knowledge accumulation, but in the later stages of a life circle of technology development, market pull takes over.

2.1.3 High Technology and Its Identification

The contents of "knowledge" and the method of "getting things done" vary over time; market pull and science push to technology show deviations in different development phases. It is apparent that it is the advanced part of technology or high technology that shapes the trajectory of technology progress in different historical stages. However, the idea of high technology is subject to much disagreement. The following definitions have often appeared in previous studies: (1) High technology is new technology (NEDC 1989). This definition transfers the unclear judgement of technology quality to a clearer judgement of technology appearance. However, there are two problems in this definition. First not all new technology is high technology. Secondly, technology often emerged over a period of time which straddles a number of phases of innovation. (2) High technology is knowledge-based technology (Shanklin 1984, McIntyer 1986, Monck 1988, OECD 1988, Methe 1991). This concept emphasised that high technology is closely tied to scientific knowledge base, and is the result of large scale investment of Research and Development. High technology is characterized by its advanced and sophisticated knowledge among technology family. (3) High technology is leading and strategic technology (Nelson,

1984; Hisao, 1987). This opinion pays more attention to the consequences of the application of high technology. It not only states that high technology can make existing technology obsolete; create or revolutionize markets and demands; increase industrial opportunity, but also points out that it possesses high risk. It is clear, as Aydalot and Keeble (1988) state, that high technology lacks a coherent definition, so many studies define high technology by its characteristics.

The following methods are often used to identify high technology from standard technology, from which the further features of high technology can be observed: (1) By human capital input. Some studies such as Shanklin et al (1984) use the input of human capital as a criterion to identify high technology. In their study, an industry with more than 5% 'natural' scientists, engineers and technicians in its total employment is a technology intensive industry, and has more than 10% in high technology. (2) By Research and Development (R & D) expenditure ratio. This approach establishes a link between high technology industry with the cost of obtaining new technical knowledge. According to the criterion, an industry which spends at least 10% of its gross product on R & D is a high technology industry, while the ratio is between 5-10%, it indicates a high technology intensive industry (Hall et al. 1987). (3) By job or other growth rates. This method intends to show the relation between high technology industry and its performance. Among the indicators, job creation, total sales, profits, patents growth are used in different contexts (Reed 1987, Aydalot et al 1988). (4) By production sophistication. Vinson and Harrington (1979) use production sophistication as criterion identify chemicals, machinery, electrical equipment, transportation equipment, scientific instrument, commercial service, and technical service industries as high technology. (5) By a mixed criterion. Many governments draw a scope of high technology based on the impact of high technology on the national economy, the prospects of the technology development and the demand of this development.The Chinese government defines high technology to include the following ten technologies: electronic & information, air and space aviation, photo-electronic, biotechnology, new energies, new materials, environmental protection, ocean, radiation, drugs and other developments based on traditional technology (Committee of Science & Technology of China 1991).

2.1.4 Research & Development

Research & Development (R & D) is defined as any creative activity undertaken to increase the stock of scientific and technical knowledge and to devise new applications. It excludes scientific and technical information, general-purpose data collection, routine testing, standardization and other technological activities related to production or use of established products or process (DTI, 1973). Markusen et al.

(1986) distinguish the differences between research and development. According to their division, "R" consists of two components: basic and applied research. The former refers to scientific exploration for the stake of advancing knowledge. The latter makes up the majority of industrial research and is the application of economic returns for the effort. "D" refers to such a stage, in which processes and products identified in the earlier research phase as having market potential are further tested and eventually become commercial products or processes. So as Freeman (1982) summaries that R & D covers three activities: basic research, applied research and experimental development.

R & D has been widely proven a necessary condition for firms to be innovators and successful adopters, and for regions to maintain a comparative advantage in technology, new products, and new industries (Rosenburg 1982, Nelson 1984, Hall et al 1987, Julder and Junne 1988, Hilpent 1991). Markusen (1986) states that many firms in which their R & D expenditure is 2.5% above the average level, new products usually accounts for over 20% of all their products, while the firms in which their R & D expenditure is 2.5% below the average level, the share of new products in all their products is usually under 10%. A DTI report (1989) points out that for each 1% rise in UK R & D capital, its export share would increase by a third of that percentage, and its balance of trade will be improved by one and a third of that percentage. Gomulka (1990) states that gross social rates of return on R & D investment (both the average and the marginal) are high, usually between 20-50%.

Although R & D is important to any industry, the distribution of R & D expenditure is uneven among different sectors. According to the data of OECD (1989) agriculture, mining and services generate about two thirds of industrial value added, they perform only about half of all industrial R & D. R & D in the current world is concentrated in the following fields: (1) The electronics chain which includes electronics components, telecommunications, computing, data transmission, new service, to robotics--and information technology. (2) New materials which consist of composites, ceramics, new metal products and raw material as well as energy saving. (3) Biotechnology and superconductors.

In addition to the uneven distribution of R & D in industries, it varies across regions and countries, and constitutes an important criterion to measure the technology level. TEP (1991) according to the R & D intensive divided OECD countries into four categories: (1) The technological leaders; (2)The other high-tech countries; (3) the middle technology countries; and (4) the low technology countries.

2.1.5 Structure of Technology

In addition to the difference between high technology and standard technology, the following identification of technology structure further displays the connotation of technology.

1 Knowledge contents structure. According to the types of knowledge included in technology, Schmookler (1966) regards technology as the combination of four parts: applied science, engineering knowledge, invention and subinvention. In his opinion, the first part concerns how thing "are"; the second means how a product can be made; the third is the creation of producible product or operable process; and the final one is an obvious change in a product or a process. Because there is a transformation from applied science to subinvention over time, as pointed by Schumpeter (1934), Freeman (1982) and Methe (1991), this contents structure can be also regarded as a phases structure of technology development.

2 Knowledge forms structure. It is a tradition to divide technology into two parts: tangible part or hardware and intangible or software technology (UN 1989). However, there are also some authors who do not satisfy the division. Steuer (1973) in terms of input-output of technology, argues that output of technology takes three forms: know-how, records of variety kinds, and prototypes. UNCTC (1984) states that technology can be embodied in various forms. In addition to machinery and human capital, written documents are also a very important form. Kranzberg (1986) suggests that there are three elements in technology: material element, design element, and capacity element. Although there are deviations among the knowledge form divisions, it is common that all of them want to identify a form between hard and soft part of technology.

3 Knowledge level structure. OECD (1981) sets a four-level structure of knowledge according to its sophistication in producing a new product or mastering a new process, when there is technology transfer. They are, from the bottom to the top, operation knowledge, maintain knowledge, modification knowledge and design knowledge. Hobday (1991) points out that there are two types of relations among the four levels of knowledge. For technology developers, the knowledge flows from the high level to the low level, whereas for the late comers, the knowledge is accumulated from the low to the high level.

4 Knowledge usage purpose structure. Although technology has boundless application, many authors such as OECD (1979), Adeoba (1988), Jegathesan(1990) and Monck (1988) states that technology is used to sort out two

types of problems: one is in the management field, which deals with the relation among people. The other is in the production aspect which copes with the challenges raised by natural environment. Monck (1988) divides technology into three types based on the targets of technology: (1) organization technology, (2) operative technology, and (3) proprietary technology. The first targets management activities. The second aims to physically control machinery, and the last one is associated with the specific requirement of a project or a process.

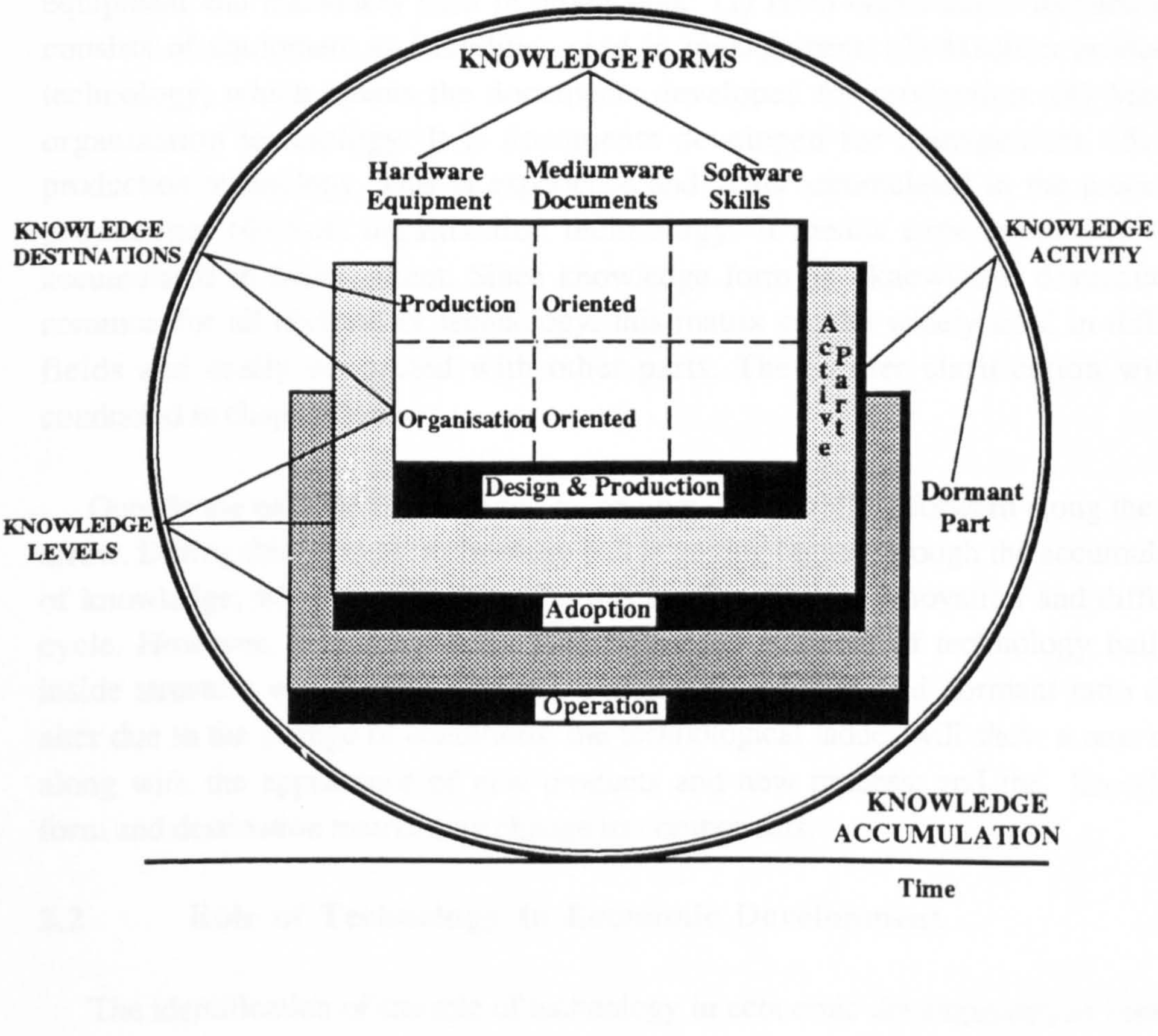
5 **Knowledge activate structure.** In addition to the above divisions, some authors such as Georghiou (1986) and Gomulk (1990) suggest another technology structure, which is based on the activity of knowledge. Although it differs in words, eg. Geoghiou's technology corridor and Gomulk's set of techniques, they all believe that technology is made from two parts. One is active, and the other is dormant. It means that because the limitations of certain factors such as price, function, financial constraints, only a small fraction of knowledge or techniques is used at each moment in time, while the other possible methods or techniques remain dormant. When these factors change, the dormant part may be activated and be used. So the scope of technology cannot be limited only in currently used or active part.

2.1.6 Technology Ball

Combining the above survey we can see that technology is rich in its connotation, and the division of technology also varies according to the context and the author. Since there is not a single structure which can catch all the meanings of technology. We try to use a "technology ball" as a framework to accommodate the above divisions of technology and carry on the measurement of technology flow. It is shown in Figure 2-1.

Inside the ball there are three levels which reflect the capability of absorbing or acquiring technology. From the bottom to the top, technological capability increases measured by producing the same product or mastering the same process. The bottom level means the operation can be controlled. The middle one refers to the modification and refinement of the operation. The top level implies the duplication and development of the same operation. When a firm or a region climbs up in the ladder, technology advance takes place.

Figure 1 Technology Ball



Source: Developed by the author

Within the technology ball, the space occupied by the three knowledge levels and the space which remains empty are used to reflect the combination of active part and dormant part in technology. When there is a technology flow, the relation between the two parts may change, because the injection of new knowledge may activate of former dormant technology or obsolete previous methods.

In every technology level within the ball, there is a matrix formed by knowledge forms and knowledge destinations. Three knowledge forms are: hardware or machinery (such as a computer); software or skills (such as a tutor); and (C) medium ware or documents (such as manual). Two knowledge destinations are: organization-oriented technology, and production-oriented technology. The combination of them forms a matrix of six areas. (1) Hard production technology which refers to the equipment and machinery used in production. (2) Hard organization technology. It consists of equipment and facilities used in management. (3) Medium production technology, which means the documents developed for production. (4) Medium organization technology. It is documents developed for management. (5) Soft production technology. This is experience and skills accumulated in the process of production. (6) Soft organization technology. It means experience and skills accumulated in management. Since knowledge form and knowledge destination are common for all division of technology, this matrix can be widely used in different fields and easily connected with other parts. The further clarification will be conducted in chapter five.

Outside the ball, the figure shows technology ball is rolling forward along the time arrow. During this process, technology ball is getting bigger through the accumulation of knowledge, which results from the repeat of invention, innovation and diffusion cycle. However, it is noteworthy that during the augment of technology ball, the inside structure will also be changed. For example, active and dormant ratio could alter due to the change of conditions; the technological ladder will show a new cycle along with the appearance of new products and new process; and the knowledge form and destination matrix may change its components.

2.2 Role of Technology In Economic Development

The identification of the role of technology in economic development, as Freeman (1982) comments, can be traced back to the discussion of Adam Smith on the improvements of machinery and the wealth creation more than 200 years ago. In this century, technology development as a wellspring of economic growth has been well-documented by scholars (TEP 1992, Methe 1991, McIntyer 1986, Freeman 1982, Rosenburg 1976, Schmookler 1966, Solow 1957, Schumpeter, 1934). This section,

on one hand, discusses the aspects of the contribution of technology to economic development; on the other hand analyzes the mechanism of the contribution.

2.2.1 Contents of Contribution

Various discussions of the role of technology on the economy in literature tackle the issue from different angles. However, the main contributions of technology to economic development can be summarized into the following aspects. First technology provides resources for creating new wealth and for increasing efficiency. In macro level, modern technology has emerged as one of the primary sources of national power, prosperity, and strategy (McIntyre 1986). And one nation can take-off only when it masters certain technology (Rostow, 1960). Moreover, a sustained high rate of growth depends upon a continuous emergence of new inventions and innovations (Kuznets 1959). In micro level, Ryan (1984) argues that the functions of technology as resources are shown in the following aspects: (1) it can be marketed as know-how; (2) it can provide a product; (3) it can facilitate a product. In addition to the qualitative analysis, quantitative measurement has repeatedly revealed the role of technology to create economic growth (Abramovitze 1956, 1993, Solow 1957, Dension 1962, Press 1987, and Scott 1993).

Secondly, technology shapes the organization of the economy. Many scholars have been attempting to establish the linkage between technology and economic system. Marx (1886) states that in acquiring new productive forces, men change their mode of production (refer to Rosenburg 1982). Schumpeter (1939) further explores how technology development leads to a new combination of resources and forges a new production function. Kuznets (1966) finds that the rate and the focus of knowledge increase markedly affect the rate and structure of economic growth. Although according to Heertjie (1977) there is a time lag between them, and economic systems are the result of past technical change.

Thirdly, technology forges the economic fluctuation. After Schumpeter's (1939) comprehensive study of correspondence of technological cycle and economic cycle by three waves, there are many studies along the direction. Schmookler (1966) divides technology change into two types. One is technology producing or progress. The other is technology duplication. He believes that economic growth is matched by technology progress, and economic stationary is associated with technology duplication. Methe (1991) relates economy change with three types of innovations. When radical innovation comes, it results in the emergence of a new industry. When innovation is the kind of major improvement through the introduction of a new tool or the substantial improvement in the processing technology of an existing one, it helps

to launch new firms in an already established industry. When innovation is the type of minor or incremental changes in the processing or design technologies, it is only helpful for improving the profit margin of existing firms.

2.2.2 Methods of Contribution

There are two ways through which technology is channelled into the economy. One is "Trigger" or "Snowball" effect. The other is "Spillover" or "Externalities" or "Social returns". The former is usually shown in the market transaction and is more obvious. The latter is usually shown outside market transaction and is difficult to measure.

"Trigger" or "Snowball" effect means that a new product or process innovation in a firm, on one hand, as Schumpeter (1939) suggests, it will increase the purchasing power of the innovator. Because of the increase of demand, suppliers could advance their technology during the process of satisfying the increase demand. Therefore, this initial innovation will be amplified to a very substantial increase over the business phase; on the other hand, the new function, new standard and new demand initiated or adopted by innovators will form uneven development among different firms and industries, the inertia of technology and the flow or reorganization of production factors will creates other investment opportunities in a wide scope (TEP,1992). Under this context, one dynamic innovation triggers off the cumulative "virtuous" processes and leads to wholly new patterns of specialization both by firm and by industry.

"Spillover" or "Externalities" or "Social return" effect means firms can acquire information created by others without paying for that information in a market transaction (Grossman and Heilpman 1990; TEP 1991, 1992). That allows successive generations of researchers to achieve technological breakthroughs using fewer resources than their predecessors. For example, Rosenburg (1982) points out that the cost of the second developer of the same technology in certain cases is only one fifth of the first developer. The reasons for this effect existing is based on the property of technology, e.g. it can be shared by different users. Unlike normal economic goods that are exhausted in use, the use of a new design or production process by the innovator does not preclude others from using it. New knowledge or technology therefore benefits more than just the origin firms. Other firms or industries improve their productivity by building on, and adding to the cumulative stock of knowledge. Under this mechanism, technology innovation creates a much larger social returns (TEP 1991, 1992).

In addition to the theoretical discussion, Clark (1987) sets a market and production

matrix to assess the impact of an innovation at the firm level, which is shown in Table 2-1. In this matrix, we can see that the impact of innovation can be divided into two levels. At the low level, innovation can maintain the firm survival and improve the competition. At the high level, innovation leads firms into a new field and forging new relations. The impact of innovation is also shown in two aspects: both in production and in marketing.

Table 2-1 Impact of Innovation on Market and Production

	High Level	Low Level
To Market & Customers	Disrupt existing and/or create new linkages	Conserve/entrench existing linkages
To Technology & Production	Disrupt and make existing competence obsolete	Conserve & entrench existing competence

Source: Arranged by author based on Clark (1987 p13)

However, it is noteworthy that the identification of the role of technology to economy does not mean technology decides everything among economic development. There are also many studies concern about how technology development is shaped by economic and social conditions. Schmookler (1966) provides the evidence that technology development has economic causes. He finds a close relation between increased purchases of railroad equipment & components and slightly lagged increase in inventive activity as measured by new patents on such items. The lag indicates that increased purchases of equipment by an industry signal the increased profitability of innovation in that industry, and then direct the invention and innovation accordingly. Mackenzie (1985) points out that society not just impassively followed the technology change, it also shaped technology through value system forged in certain society. X-inefficiency theory (Leibenstein 1965, 1976, 1987)--for a variety of reasons people and organizations normally work neither as hard nor as effectively as they could--attempts to show that the same technology can have very different effects in different situations. It is clear that the two-way relation between technology and economy or society displayed by these discussions sets a context to view the international technology flow.

2.3 Technology Development And Technology Transfer

2.3.1 Mechanism of Technology Development

The study of technology development, as Rosenburg (1982) comments, consists of a series of footnotes upon Schumpeter. Although the footnotes may be getting longer, more critical and more complexities, they still occupy the conceptual edifice that Schumpeter built for the subject. It is apparent that there are three corner stones in Schumpter's theory. First, innovation is the core of his study, while invention does not get much attention. According to him, innovation is changes of production functions, and invention is economically irrelevant as long as they are not carried into practice. Secondly, entrepreneurs are the core of innovation, because they take the risk to carry out the new combinations of production factors. They are characterized by initiative, authority and foresight. Thirdly, technology development is uneven over the time. The process of invention-innovation-diffusion forms swarm-like innovations cycles.

Because Schumpeter's study is more concerned about the application of knowledge than the accumulation of knowledge, the breakthroughs of modern studies on technology development are obvious in the latter, which furthers the understanding of the mechanism of technology development in the following aspects. First learning mechanism is widely discussed. Arrow (1962) provides an endogenous theory to explain the origin of technology. He describes the acquisition of knowledge as a learning process, and points out that learning is the product of experience. It can only take place through the attempt to solve a problem. Moreover, learning is associated with repetition of dealing with the same problem. This repetition sharply diminishes the input, especially time input, required for the same output. Based on this idea, he draws a learning curve, and reveals the mechanism of learning by doing. Rosenburg (1982) suggests that learning not only occurs in the manufacturing stage, but also occurs in the stage of using new products, because some new products, especially capital goods, only show some functions in the process of utilizing them by final users. It constitutes another mechanism of acquiring knowledge--learning by using. After them, other mechanisms of learning technology are discussed by some authors. Such as learning by operating, learning by hiring (Bell 1984), learning through training (Enos and Park 1988), and learning by searching (Cohen and Levinthal 1989). Now it is clear that technology accumulation is realized by a wide learning spectrum. On one end is the creation of knowledge, which consists of learning by researching; learning by doing; and learning by using. On the other end is the explicit diffusion of knowledge, such as learning by teaching, or learning by training. Between them learning by sharing, learning by hiring, learning by watching, learning

by leaking etc. spread the spectrum.

Secondly, the characteristics of technology is further examined. Rosenburg (1976, 1982, 1989) lists the following features of technology: (1) Complementarities. That means the productivity of a given invention has turned on the question of the availability of complementary technologies. Often these technologies did not initially exist, so that the benefits potentially flowing from invention A had to await the achievement of invention B,C,or D. These relationships of complementary, therefore, make it exceedingly difficult to predict the flow of benefits from any single invention and commonly lead to a postponement in the adoption of this invention. (2) Cumulative. That means a large portion of the total growth in productivity takes the form of a slow and often almost invisible accretion of individually small improvements in innovations. The spring of these accumulations is originated from improvements in materials handling; in redesigning production techniques for greater convenience; and in reducing maintenance and repair costs. (3) Close interindustrial relationship. It means the benefits of increased productivity flowing from an innovation are captured in industries other than the one in which the innovation was made, because technology development is under a dynamic framework which leads to wholly new patterns of specialization both by firm and by industry. Grossman and Helpman (1991) recognize the two properties of technology. One is non-rival, that means when an agent uses technology to produce a good or a service, this action does not preclude others from also doing so. The other is nonexcludable, that means the creators or owners of technical information often have difficulty in preventing others from making unauthorized use of it at least in some application.

Thirdly, the technology development model is modified and developed. In the study of Schumpeter, technology development follows a linear routine, although his two models (Mark 1 and Mark 2) show some differences (Freeman 1982). Technology development starts at exogenous science and invention; then followed by entrepreneurial activities and innovation investment, which leads to new production pattern and changing market structure; after that it enters the period of reaping profits or diffusing innovation. Based on this model, Gruber et al. (1969) extends the start point into five stages: recognition, fusion, action, solution and economilisation, and attempts to change the technology development from exogenous to ingenuous. Toulmin (1969), Rosenburg (1976), Methe (1991) and TEP (1992) change the model from linear to a net form, which emphasizes the interactive between technology and various factors such as science and market. At the same time various feedbacks of technology development are put into the model. Ray (1984), Faber and Proops (1990) suggest a spiral model in a wider development context. According to their ideas, technology development is an ingenuous process, invention and innovation are

alternative. Both of them are associated with the natural challenge and lead to various spin-offs. From these discussions, we can find that technology progress shows two ways. One is long circuit model. In this case, technology development is an indigenous process, the accumulation of knowledge follows the road pointed by Schumpeter (1939) and Freeman (1982) from invention to innovation to diffusion. The other is the short circuit. In this case, technology development can have an exodigenous--supply. It can be obtained through a short-cut method by forming certain positive feedbacks.

2.3.2. Meaning of Technology Transfer.

According to Brook (1984), technology transfer can be divided into vertical transfer and horizontal transfer. The former refers to the knowledge flow between pure and applied research and product development, as in the stages of a production cycle. The latter means the knowledge flow between different places. Since 1970s, the term usually means the horizontal transfer. In this study, technology transfer only means horizontal transfer.

UN (1987) defines technology transfer as a process of acquiring technological capability from abroad. Meissner (1988) points out that the methods used to acquire this capability are various. It can be buy, borrow, steal, imitation, copy, adapt or beg. Among the different channels, the contents of technology transfer are common (Pattie 1987), which include three parts: (1) The exchange of ideas, which is through seminars, lectures, exhibitions and consultancy. (2) The exchange of people, which is by the methods such as industrial secondments-- or permanent job changes including the movement of people in order to use another organization's facilities, even on a short term basis. (3) The transplant of equipment. Other authors such as Kaynak (1985), Enos and Park (1988) and Hull (1990) emphasis the importance of technology supplier and receiver in the process of technology transfer.

2.3.3 Reasons for Technology Transfer.

In the standpoints of developed countries, there are two explanations for technology transfer. First technology transfer is a tool or a substitute for their entering other countries. Baranson (1978) argues that developed countries use technology transfer or "technology sharing" to avoid the risks of investing in developing countries resulting from the economic and political issues. Oman's (1989) research confirms the opinion. He states that new forms of foreign investment which use more technology control than ownership control are widely welcomed by host countries,

because it can conduct technology transfer. Secondly, technology transfer is a method to share the cost of developing technology. Many authors such as Roman (1986) and Carpentier (1990) points out that scientific resources are scarce and expensive, so the cost of technology production is dear. No nation even developed country has unlimited resources and can afford the luxury of monopoly technology. Therefore, transfer is a way to share these cost.

In the standpoints of developing country, the necessity of technology transfer is that it is impossible or too dear for them to develop technology by themselves. Meissner (1988) states that developing countries cannot afford to do basic research and development, so it takes longer time and more money for them to generate the same technology developed by advanced countries. Therefore, they must try to obtain technology by other means. The high cost of generating technology and the uneven development of technology in the world also forces less developed countries to adopt the mould of follower. They have to take over production from the advanced countries when products become standardized, and the potential economics of large scale production and low wages are usually the offset of inefficiency and poor skills (Smali 1985, NEDC 1988).

2.3.4 Consequences of Technology Transfer

Based on the historical analysis of over two hundreds years, Rosenburg (1982) argues that the basic advantage of being a latecomer is that the recipients could develop through mere transfer of already existing technologies without having to reinvest them. The post-war experience in European countries and Japan proves it and shows that technology transfer is an effective instrument for bringing technology receiver countries gradually to similar levels of technology supplier countries (OECD 1981). When Hisao (1987), explores the technology transfer process in Japan, he highlights two basic benefits Japan gained from technology international flow. First it greatly facilitated the modernization and expansion of Japanese industries by substantially improving Japan's indigenous science and technology capability. Secondly, it brought about basic structural changes in Japanese industry over several decades. For example, iron and steel in the 1950s; machinery, petrochemicals and steel in the 1960s; automobiles and electronics in the 1970s; and robotics in the early 1980s.

The benefits which host countries receive from the technology transfer are generalized as: (1) Obtain more knowledge. During technology transfer, technology supplier may provide more information, offer certain training, and serve as a vehicle to integrate knowledge. All of them increase the knowledge stock of receiver's. (2)

Make better utilization of resources. Inward technology can either strengthen the local production system, or strengthen the other local capabilities. (3) Gain fast industrial process. Since technology transfer could help to close the technological gap between developed and developing nations, and stimulate local R & D activity, it accelerates the technology development process. (4) Eliminate economic underdevelopment. The extra output or increased production resulting from technology transfer would facilitate a more competitive position for the host country in the international market, and the changes in trade may be translated into changes in employment and prices, which would lead to a better quality of life (OECD 1981, Smali 1985, Roman 1986, OECD 1989, 1993, TEP 1992).

However, it is noteworthy that while Pacific Asian countries gain success in economic and technological development, many developing countries do not close the distance between them and developed countries through the adoption of advanced technology. For these countries, it has proved that technology transfer is a complicated and costly process (Rosenburg 1982, Meissner 1988).

Technology transfer not only has impacts on recipients, but also on home countries. It can be observed from the following aspects: (1) To increase exports. No matter which form is used, usually the importance of exports in the home countries' economy will be growing. (2) To strengthen technological base. While technology supply is increasing, home countries are more concentrated on high value-added products and advanced technology, which also leads to less dependency upon developing countries in raw materials. (3) To relocate economic resources. The shed off of standard technology and products changes the production division, which involves drastic sectoral relocation of labor force and other resources. This offers an opportunity for the home country to increase the efficiency of locating production factors. (4) To obtain multiplier effects of income generated from transfer of technology (Dunning 1981, 1989; Rosenburg 1982, 1989).

Summary

Comparing the various definitions of technology, two common basic components among them are apparent: knowledge and problem resolving. Combining the two elements, technology in this study is defined as "knowledge of getting things done". Under this context, it is understandable that the generator of knowledge--Research and Development has been the focus of concerns over high technology, although to define and identify it is more difficult. The limitations of most previous ideas about

technology is that they exclude the contents of organization/management knowledge and only concentrated to production field, which hinders the exploring of technology development, especially in technology flow.

The origination of technology is very clear which is mainly exhibited in science push, market pull and their combination. However, its structure is multiple. Various divisions can be obtained from different angles. A "technology ball" is suggested to accommodate the multiple structure of technology. It enlarges its volume over time. At the same time, it changes its inside structures, such as knowledge level, knowledge form, knowledge function, and currently used knowledge stock.

As a subsystem of society, technology plays an important push role in social development. It can be regarded as resources, driving forces, and tools. The characteristics of technology tailor these contribution in two ways: One is through trigger or snowball effect. The other is through externalities.

Technology transfer or the technology ball rolling across national boundaries could be viewed from two aspects. On one hand, it is part of global technology development, which changes the technological capability of regions by provoking various learning mechanism and offering long circuit and short circuit of technology development paths. On the other hand, it extends the interaction of technology and social development into a more complex context. This interaction can be helpful for both parts, but does not guarantee welfare for any side.

CHAPTER 3. FOREIGN INVESTMENT AND ITS IMPACT

3.0 Introduction

Technology can be transferred in various ways. However, foreign investment has been an important tool to conduct technology transfer in the modern world. This chapter examines this channel. Section one examines the dynamics of foreign investment through displaying its type, motives, operational environment and the relation between subsidiaries and their parent companies. Section two discusses the impacts of FDI on the host country, in terms of employment, exports and balance of payments. At the same time, the deviations of the impact among different national origins and sectoral distribution are examined. Section three deals with attitudes towards FDI and associated policies employed by developing countries when they face the changes of global FDI flows.

3.1 The Dynamics of Foreign Direct Investment

3.1.1 Types of Foreign Investment

Since World War Two, international capital flows have experienced a dramatic increase. Among this torrent, some branches can be identified (OECD 1981, 1988, 1993; UNCTC 1985, 1987, 1990). OECD (1987) divides it into official aid; bank loan; and direct investment. Oman (1989) identifies two types of investor among direct investment. Combining their divisions, we get a spectrum of foreign investment as shown in Table 3-1.

Table 3-1 Division of Foreign Investment

```
                                1.  Aid--Helper
                               /
                              /  2.  Portfolio--Creditor
Foreign Investment
                              \  3.  Direct Investment
                               \ 3.1  Seller
                               \3.2  Investor ---A. Entrepreneurial  Investor
                                \
                                 \  B. Rentier Investor
```

Sources: OECD(1987 p189); Oman (1989 p1-4); Reuber (1973 p52)

As a creditor, foreign investment usually takes the form of portfolio capital, which encompasses governmental loans, loans by international agencies, borrowing via bonds and short-term loans, including bank loans, and export credits (Reuber 1973).

As a seller, foreign capital's main motivation is to sell investment resources such as equipment to the project and not to appropriate part of the project's operation surplus--it may or may not believe in the project's ability to generate a surplus--the project represent a sales operation but not an investment (Oman 1989).

As a investor, foreign investment regards the tangible or intangible investment resources that it supplies to the project as ability to generate a surplus over time, and has some means to appropriate or control at least part of the surplus. Within this category, Oman (1989) also identifies two types of investors. One is entrepreneurial investor who prefer to shift more risk and /or cost to the host country. The other is rentier investor who assumes few if any risks or operational responsibility.

If the difference within direct investment is mainly in whether foreign capital appropriates surplus, the differences between a creditor and an investor are as follows: (1) Portfolio investment implies a fixed obligation to repay interest and principal, whereas direct investment implies a flexible repayment obligation directly geared to the success of the investment. (2) Portfolio flows tend to be more general in character than direct investment which tends to be 'industry specific'. (3) Portfolio investment does not directly affect local ownership and control. (4) Portfolio normally implies a transfer of capital only, whereas direct investment usually comprises a transfer of not only capital but also a package of auxiliary factors (Reuber 1973, Cable & Persaud 1987).

3.1.2 Theories on the Dynamics of FDI

Since the 1970s, there are four main theories and one paradigm of international production merging from the early studies, which aim to explain the development of foreign investment (Cantwell 1991). They are: (1) Market power theory. (2) Internalization theory. (3) Competitive international industries approach. (4) Macroeconomic developmental approach, and (5) The eclectic paradigm. These theories have drawn on various separate branches of economic theory: the theory of international capital movements, trade, location, industrial organization, innovation and the firm. They tackle international production at three levels: macroeconomic--examining broad national and international trends, mesoeconomic--considering the interaction between firms at an industrial level, and microeconomic--looking at the international growth of individual firms.

(1) Hymer's (1970, 1972) market power theory states that international production is a means by which Multinational Companies (MNCs) increase the extent of their market power (to dominate their respective markets). It results from the limitation of domestic market, and results in a repeat market enlarging process abroad which MNCs have experienced in domestic market. By investing in foreign operation, MNCs reduce competition and increase barriers to entry into their industry.

(2) Internalization theory is developed by Buckley and Casson (1976) based on criticism of neoclassical economics. It lays emphasis on the efficiency of transactions between units of productive activity, and argues that the transaction costs of an administered exchange are lower than those of a market exchange. So MNCs tend to internalize an externality into a centralized and hierarchical control empire.

(3) Competitive international industry approach was based on the Vernon's (1974) later version of the product cycle (consider monopoly). It argues that innovation is location-specific as well as firm-specific. In each industry, when products and processes have become increasingly standardized across countries, MNCs attempt to safeguard their competitive position through the continuing differentiation of products and technology. Therefore MNCs expansion can be linked to a process of technological accumulation within the firm, and technological competition between MNCs.

(4) Macroeconomic developmental approach comes in various forms and can be traced back to Vernon (1966) the earliest version of production cycle model. As a result of criticism of the traditional theory of international trade, import- substituting (trade-displacing), offshore or export-platform (trade-creating) and resource-based investment was distinguished. The theory explains that import-substituting investment needs not come from a sector in which the home country has a comparative advantage. It also points out that outward direct investment tends to follow a development course over time: beginning from resource-based activity with fairly limited technological requirements; then shifts towards gradually more sophisticated types of manufacturing. The level of inward and outward direct investment and the types of industries involved in international production, varies with the characteristics of contents and the stages of development which they have reached.

(5) The eclectic paradigm developed by Dunning (1977) grows out of a desire to synthesize the above four theories and provides an overall analytical framework for empirical investigation. It argues that MNCs have two types of advantages. One is the firm's privileged possession of a set of income generating assets--ownership advantage. The other is their ability to co-ordinate existing assets with other assets

across national boundaries in a way which benefits them relative to their competitors--location advantage. These advantages could not be separately sold to independent foreign firms to exploit and could be realized only through vertical or horizontal integration. The advantages and the extent of MNCs perceiving them to be profitable to internalize them, as well as the extent of MNCs choosing to locate value-adding activities outside their national boundaries consist of the basic structure of the eclectic paradigm.

Combining the above theories and other previous studies, we can draw a simple picture about the dynamic of foreign investment. Firstly, it is the advantages possessed by foreign investors that leads capital outflow crossing national boundaries. These advantages can be shown in two forms: production advantage and organization advantage (UNCTC 1987). Secondly, the outflow of investment usually seeks the following objectives: to increase overall sales in the host country; to obtain a flow of real profits from host country; and to generate goodwill for the company and increase their contact with local officials and obtain their backing, and to help the sales of other products of the company (Hoyle (1990). Thirdly, facing the various international conditions, especially the investment environment in host country, foreign investment shows two orientations; market entry or cost saving. When it focuses on or is limited to the former, it usually invests in import-substituting projects, while it focuses or is limited to the latter, it is often involved in export-oriented activities, with intention for third markets or for the home market (Young 1988; Edgington 1991). Fourthly, the control of foreign investment by investors could (1) be linked by ties of a common ownership; (2) draw on a common pool of resources; (3) respond to some common strategy (Vernon 1981). Fifthly, the strategy employed by foreign investor is among the following four categories: exploiting a technology lead; exploiting a strong trade name; exploiting the advantages of scale; and exploiting a scanning capability (Vernon 1981).

3.1.3 Factors Affecting Foreign Direct Investment

The determinants of FDI, as commented by Tsai (1991), are often grouped into demand-side and supply-side factors. The demand-side determinants include political stability, labor cost, market size, regional economic integration, and investment incentives offered by the host country. The supply-side determinants consist of economies of scale, oligopoly reaction, production life cycle, intangible assets, and internalization. However, in practice, investment environments of developing host countries are often analyzed by following the criteria:

1. Stability of investment climate. Many studies such as Frank (1980), OECD(1983, 1993), Fong(1987) have ranked this factor as the most important one for attracting foreign direct investment, because it decides the safety of foreign investment. The stability of investment climate is shown in the stability of general political, social, and economic conditions and the prospect of earning a profit without relying on special government favors. At present, non-discrimination, freedom of capital movements, and satisfactory arrangements for settlement of investment disputes are also concerned to be the contents of stability (OECD 1993).

2. The size and structure of host country's market. As Cabble et al (1987) point out that this condition determines the expected profits of foreign investment, it is the focus of economic concern when investors decide investing abroad. In practice, the size of market is usually measured by the volume of GDP of a host country, and the structure of the market is analyzed by the level of GDP per capita (Frank 1980). The development stage of the host country, growth potential of the local market, and the availability of local resources are also concerned by foreign investors under this title.

3. Technological infrastructure. This factor directly affects the offshore operation of foreign investors, so that it affects the possibility of foreign investment to get enough profits in the current stage. In this category, R & D capability, industrial relations, labor quality, availability of good management, and proper transportation and communication in the host country are criteria used to evaluate the situation of the infrastructure (Dunning 1986; OECD 1993).

4. Other conditions. In addition to political, economic and technological factors, there are some other factors which affect the flow of foreign investment, such as language and cultural considerations, location of competitors, number of competitors, and historical relations.

It is apparent that FDI in different contexts has different demands, and the importance of various factors in attracting foreign investment varies with the situations. Dunning's (1986) research gives a good example. Table 3-2 lists the factors and their influence on Japanese investors when they invest in UK. Where 1 is the least important and 5 is the most important. From it we can see: (1)the factors affect FDI flow between developed countries differ from those between developed and developing countries; (2) that electrical industry and non-electrical industry show different responses to some factors, such as transport cost and physical environment.

Table 3-2 Factors and Their Importance In Attracting Japanese Investment Into UK
(1 is the least important and 5 is the most important)

Factors	Electrical Industry	Non-electrical Industry
(1) Transport Cost & Trade Barriers	1	5
(2) Production Cost	4	4
(3) Environmental Factor	5	1
(4) Government Policy	3	3
(5) Other	2	2

Source: Dunning (1986. p 48-49)

3.1.4 Relation Between Subsidiary and MNCs

The control of foreign investors on their offshore operation is embodied in the relation between subsidiary and MNCs. It can be viewed from two aspects. The type of relation between subsidiary and its parent, and the autonomy of subsidiaries.

The characteristics of a subsidiary determine the relation type of the subsidiary and its parent. Therefore, it is important to identify the differences between subsidiaries. According to the orientation of FDI, Reuber (1973) divides FDI overseas operation into three types: Export-oriented investment--mainly in extracting the product in question from host country and selling it through established market channels; Market-development investment; and Government-initiated investment--occurs at the initiative of the host-country government. Frank (1980) emphasizes the difference between natural resources exploitation and other export-oriented projects. Therefore, FDI subsidiaries in his division are another three types: Natural resources projects; Manufacturing investments to serve the local market; and Manufacturing investment primarily for exports. Based on ownership and associated control power, Oman (1989) divides FDI into traditional direct investment and new forms of investment. The former refers to wholly owned or majority owned affiliates, whereas the latter includes joint ventures with foreign equity less than 50%; licensing agreement; franchising; turnkey and "project-in-hand" contracts; production-share and risk services contracts; and international subcontracting. According to his study, the development trend is the new forms of FDI are getting popular.

In view of the range of production and markets, White and Poynter (1984 referred by Young 1988) outline a general picture of the relation between subsidiary and its

Table 3-3 Subsidiary Autonomy in Different Decision Areas

No autonomy (Decided by Parent)	Part Autonomy (Decided by subsidiary Subject to parent)	Total Autonomy (Decided by subsidiary)
		Hiring and firing of workers
		Payment routines for employee wages
	Preparing financial plan	Responsibility for collective wage bargaining
	Organisation of budget work	Training programme in subsidiary
Raising equity capital	Loans from local bank	Transfer of employees between departments
Dividend policy	Setting sales targets	Restructure of work tasks
Royalty payments and central overhead costs	Salary level for top manage ment in subsudiary	Taking disciplinary action (warning,fines,etc.)
Return on investment criteria	International transfer prices	Security against industrial espionage
Choice of public accountant	Hiring top management in subsidiary	Extent of over-time work
Entering new markets outside country	Changes in manufacturing process	Vacations for employees not legally fixed
Spending unbudgeted capital on investment	Change of subsidiary organisation	Choice of suppliers
Use of cash-flow in subsidiary	Yearly production volume	Purchasing methods
Increase in production capacity	Quality control norm	Maitenance of production facilities
Introduction of new products	Entering new markets within country	Decision on work efficiency studies
Choice of costing system	Choice of distribution channels	Choice of work methods
		Adaption of standard products
		Level of advertising budget
		Choice of advertising agency
		Pricing of products sold locally
		Delivery times or order priorities
		Customer credit

Rearranged by author based on OECD Structural and organisation of multinational enterprises.(1987.15)

parent by dividing FDI affiliates into the following five categories: (1) Marketing satellite. It sells products which are manufactured externally into the local trading area. (2) Miniature replica. Which produces and markets some of the parent's product lines or related product lines in the local country. (3) Rationalized manufacturer. Where the subsidiary produces a particular set of components, parts or products for multi-country or global market. (4) Production specialist. Where the subsidiary develops, produces and markets a limited product line for global markets. (5) Strategic independent. Where the subsidiary is permitted independence to develop lines of business for either a local, multi-country or global market.

The autonomy of affiliates in various decision fields further displays the control pattern and control scope of MNCs over their subsidiaries. Steuer (1973) discusses five decision making areas and the degree of autonomy of subsidiaries in these fields, based on a survey of 50 MNCs subsidiaries in UK. He finds that: (1) In financial decisions, two thirds of sample firms are not given explicit targets such as rate of return on investment by parents. (2) In price setting, two thirds of the subsidiaries are independent to set their price. (3) Export policy is interfered with by parents in two thirds of surveyed firms. (4) There is less autonomy for individual units to make production planning, which includes changes in products and methods. (5) In many companies, personnel policy is tightly controlled by 'network' companies. An UN(1993) recent research reveals that the autonomy of subsidiaries is eroded, as the development of information technology and the falling down of trade barries are leading to a "re-engineering" of relationships between MNCs and their subsidiaries. The former are seeking more control over the later.

OECD (1987) further examines the autonomy of FDI affiliates, based on a world wide investigation of 77 subsidiaries of 39 MNCs. The contents of the survey covers nearly every decision area and is divided into 48 items. The results of investigation are shown in the scale of 1-5 ranking. 5 means the highest autonomy, and 1 means the lowest autonomy. Here, we reorganize them into three categories, as shown in Table 3-3. The left hand column is low autonomy area, in which all the scores are below 3. It means that all the decisions are either made by the parents or by the parents after consultation with the subsidiaries. The middle column, in which items are scaled between three and four, is the medium autonomy area. The decision in this field is usually made by subsidiary, but it must be subject to the approval of the parent. The right column is the autonomy area, with scores over 4. All the decisions in this area are made by subsidiaries. Analyzing these three columns, we can see that in the field of finance, subsidiaries enjoy little autonomy, while in the daily operation subsidiaries show high independence. The comparative long term management and planning work are suggested by subsidiaries, but decided by parents.

3.2 Impact of FDI on Host Country's Economy

International flow of capital exerts two-sided impacts both the on home country and on the host country. For example, when Rosenburg (1982) discusses the reasons why the British lost their technological edge at the end of last century, he suggests that a large quantity of portfolio capital flowing out of Great Britain was a basic reason. Because this study is concentrated on the receiver side, we will mainly limit our survey in the impact of FDI on the host country.

3.2.1 Framework for Tracing the Role of FDI

Table 3-4 Some Criteria For Evaluating Impacts of FDI

Impact Issue	Employed Criteria
Employment & Productivity	Employment in foreign-owned sector
	Plant closures/rationalizations
	Management and labor practices
	Industrial relations performance
	MNCs subsidiaries vis domestic firms
Trade & Balance of Payments	Export/import tendency of MNCs subsidiaries
	Capital flows and remittance to parent company
	Changing MNCs sourcing strategies
Market Structure	Market shares of MNCs subsidiaries
	Spillover effects
	Sectoral distribution of inward direct investment
	Changing corporate strategy
Technology Transfer & Innovation	Sectoral distribution of FDI
	Local R & D activities
	Forms of technology transfer (package/ unpackage; embodied/disembodied)
	Terms of technology transfer
	The extent of technology diffusion
	Technology concentration and dependence
	Corporate/subsidiary strategies and coordination

Source: Young et al (1988 p69)

In order to evaluate the impact of foreign investment on China's economy during 1914-1937, Hou (1965) designed an analytical framework of four effects, although it shows a bias towards political issues. They are the catalytic effect, the oppressing effect, the destructive effect, and the drain effect. Because the data he used shows a positive result in the first effect and negative results in the last three ones, he obtained a controvisial conclusion that FDI had played a positive role in China's development during that period.

During the last two decades, more and more studies concern how to identify the positive role of FDI on host countries. For example, Stewart (1987), through his examination of the development in Southeast Asia, states that four contributions of FDI can be observed. They are: supply capital; stimulating economic diversification; transfer technology; and enhance employment opportunity. When a scholar of Korea looks backward, he attributes the contribution of FDI in the following three aspects: promotion of economic co-operation with foreign country; strengthen the international competitiveness; and introducing necessary advanced technology (Yu 1990). One report from OECD (1993) states that the biggest role of FDI in the development of the developing countries economy is to help them to make the transition from essential agricultural to industrial economies, because FDI is a source of additional capital, technology and management know-how, an incentive to local companies to increase efficiency.

Hood and Young (1982) state that following four aspects should be considered, when the role of inward investment is analyzed: (1) resource transfer effect; (2) trade and balance of payments effects; (3) competitive and anti-competitive effects; and (4) sovereignty and autonomy effects. Young (1988) further develops their idea and provides a comprehensive framework for checking the impact of FDI. Table 3-4 shows his design. This framework is adopted as a guide for literature review in this section and for data collecting in case study. The parts of this section discusses most of these issues. However, the impact on technology will be scrutinized in the next chapter particularly.

3.2.2 Impact of FDI on Employment

There are three major benefits that host country would obtain from inward investment (Dunning 1977, 1981, 1986): One is the enlargement of the volume of employment. Another is the creation of various employment opportunities, such as female employment. The last one is the improvement in skill levels, especially in a depressed area. Young (1988) puts another effect into the benefit package--aggregate or multiplier employment effect result from the inward investment.

The number of employeesabsorbed by FDI firms is often used to measure the contribution of FDI on host economy. It is also a target of host countries' policy, especially in less developed regions. For example, before Singapore's economy took off, job creation had been a requirement for the performance of FDI (Lim et al 1991). The third survey of UNCTC (1985) on the international corporation gives a general picture about the contribution of FDI in some host countries' employment, which is shown in Table 3-5 . It is clear that the smaller the host country, the more obvious this contribution.

Table 3-5 Share of FDI in Employment in Manufacturing in Selected Countries

Country	Year	Employ. Share(%)	Country	Year	Employ. Share(%)
Argentina	1970	10-12	Korea	1978	10
Brazil	1977	30	Malaysia	1978	34
Colombia	1970	28	Mexico	1970	21
India	1977	13	Philippines	1970	7
Kenya	1975	30-35	Singapore	1978	58

Source: UNCTC (1985 p100)

There are also some studies which concern the negative impact of foreign investment on employment. Steuer(1973) argues that hiring of foreign investment is done largely from other firms rather than from the pool of unemployed. Besides that, careful labor utilization of foreign affiliates which emphases supervision, and operations break down mean that little training is undertaken. Cable (1981) reports that the impact of FDI on employment in mining and agriculture shows two pictures. At higher skills level of employment, FDI results in high unemployment; and at lower skills level of employment, it brings about greater income inequality. Young (1988) argues that the change of union's bargaining power also brings certain negative influence to workforce.

3.2.3 Impact of FDI on Exports

Using FDI as a platform to enlarge host country's exports is a basic strategy in many developing countries, especially Pacific Asia. Many researches have proved that there is a close relation between FDI and increased host country's exports. Reuber (1973) based on 75 projects statistics, gets an empirical equation to connect the

ownership of FDI firms and their export performance:

$$Oi = 65.7 + 19.0\ Si$$

Where Oi is the current percentage of total equity held by the foreign investor; Si is the percentage of output that is exported. The equation suggests that the higher the share of foreign investment in the cooperation project, the higher the ratio of product exported. UN (1993) reports that the contribution of FDI on exports is increasing in the 1980s. For example, the US manufacturing affiliates in developing countries export 33% of their output in the later 1980s, up from 22% in the early of 1980s. A reports of OECD (1993) states that the quality of exports from developing countries is also raising as FDI local operation becomes more technology-intensive. Table 3-6 is another finding of UNCTC (1985) survey, which displays the share of FDI in some countries' exports.

Table 3-6 Share of FDI in Exports of Manufactures in Selected Countries

Country	Year	Exports Share(%)	Country	Year	Exports Share(%)
Argentina	1969	>30	Korea	1978	27
Brazil	1969	43	Mexico	1974	34
Colombia	1970	>30	Pakistan	1975	<10
Hong Kong	1972	10	Singapore	1978	92
India	1970	5			

Source: UNCTC (1985 p101)

The mechanism of FDI helping host country raise exports can be viewed in two ways, as suggested by Blomstrom (1990). First is direct promotion. It means exporting from the host countries by the FDI firms themselves, which includes four categories: (1) local raw materials processing. FDI has better export potential than indigenous firms, because of their business contacts abroad, marketing skills, superior technology, both in product and processes, and greater general know-how. (2) conversion of import-substituting industry to export-based activity. The significance of foreign investment in this field is their speeding up free trade such as support for the common markets, custom unions, and free trade areas in the developing countries, since these arrangements enable firms to rationalize small-scale facilitates and develop exports. (3) new labor-intensive final product exports. Foreign investment can help indigenous firms in setting up distribution networks, keeping in close touch with rapid changes in consumer tastes, mastering the technical abilities of

industrial norms and safety standards, and building up a new production image in developed market economies. (4) labor-intensive processes and component specialization within vertically integrated international industries. These exports are directly dependent on the participation of transnational corporations. They are not only as intra-firm trade, but a great part of them are arm's-length transactions between transnational corporations and indigenous developing country enterprises.

Secondly, there is indirect promotion, which refers to the impact of FDI on the export activities of host country firms. This also includes four aspects: (1) Demonstration effects. Local firms may increase their export by observing the export activities of MNCs. (2) Using facilities. Local firms can increase export by making use of the infrastructure of transport, communications and financial services to support those activities. (3) Influence on competitiveness. Because FDI usually have some firm-specific advantages that enable them to operate in host countries, local firms can improve their competitiveness by accessing these firm-specific advantages. (4) Using linkage structures. If export-oriented FDI increase their purchase of output from the host country firms as the subsidiary matures, the host country's trade balance improves.

Negative impacts of FDI on host country's international trade are also listed by some author such as Steuber(1973) and Young (1988). They are mainly concentrated in the following aspects: (1) Import-intensive FDI, which means FDI leads to a great number of parts and components imported; (2) Limitation on local sources utilization; and (3) The restraints on exports.

3.2.4 Impact of FDI on Balance of Payments

The discussions about the impact of FDI on host countries' balance of payments can be put into two categories. One is the method of measuring the impact. The other is the list of various costs and benefits. In the former, many scholars agree that the evaluation of this role should include two parts: direct measurement and indirect measurement, whether in costs accounting or in calculating benefits. For example, Koo (1985) defines direct cost of host country as profit remittance, reinvested earnings, royalties and other service fees, and foreign claims on undistributed profits; whereas indirect cost is the cost that they do not write down in firms' accounts. When Lall (1983) analyzes the benefits brought about by FDI, he uses firms' balances to show direct balance-of-payments, and uses social income to show total balance-of-payments. Among his 159 samples, 97 (61%) net social income effects are positive and 62 (39%) are negative. Young (1982, 1988) argues that the impact of FDI on balance of payments may be negative measured in the short term, and positive in the

long term.

When the costs and benefits are examined, the following aspects are usually in the list of benefits: supplies to the local capital demand; reduces the foreign exchange gap and increases foreign exchange reserves; generates additional revenues and national income, which may encourage the development of auxiliary industries in the less developed countries (LDCs). While the problems or pains caused by FDI usually include: outflow of dividends or profits; management and royalty fees; interests on loans and other remittances can be too costly to LDCs; FDI may lead to greater foreign debt if profit repatriation occurs to the degree that it instills a need to borrow due to the depletion of foreign exchange reserves (Steuer 1973, Rothgeb 1988).

3.2.5 National and Sectoral Deviation of FDI's Impact

Table 3-7 Comparison of USA, EC and Japan Subsidiaries

Items	US	Japan	EEC
Age of Affiliates (Years)	18.1	8.5	20.2
Parent Ownership (%)	85.8	50.5	73.0
Employees (Number)	876	525	1114
Annual Sales ($Mn)	34.8	17.0	23.4
Sales in Host Market (%)	81.8	74.7	90.1
Sales to Home Country %)	3.4	12.3	0.5
Local Purchases (%)	45.9	37.6	34.7
Parent Purchases (%)	20.9	46.7	42.3
Subsidiary Purchases (%)	14.7	5.2	3.9
Other Purchase (%)	17.0	10.5	19.1
Local Production Workers (%)	97.9	95.8	97.5
Local Foremen (%)	98.2	86.2	94.0
Local Clerical (%)	98.7	92.4	94.0
Local Salesmen (%)	95.4	82.2	91.5
Local Engineer (%)	97.1	72.1	50.2
Local Manager (%)	83.9	59.5	50.2

Source: Frank (1980 p184-185)

The impact of FDI on host country is affected by many factors. Among them national origination and sectoral distribution of FDI are two important variables, and have been widely discussed by many authors (Frank 1980, Stewart 1987, Dunning

1988, McCalman 1991). Based on a analysis of more than 200 cases world wide, Frank (1980) outlines a general picture about the deviations among three main FDI suppliers, which is shown in Table 3-7; and two kinds of industries, which is displayed in Table 3-8.

McCalman (1991) develops two models to explain the differences between Japan and US investment, based on his study in Scotland. The American model, in his opinion, is characterized by Fordist heritage; the functional specialism; the framework which fails to fully exploit and commercially capitalise on innovations creates for new start-up generation; and neglect of manufacturing as a sources of innovative potential given the correct organization climate. While the Japanese model is characterised by: alternative patterns of workforce organization; the development of integration with suppliers; attention to the innovative/ manufacturing link; and a focus on internalizing spin-off rather than externalising them via labor market.

Table 3-8 Differences of FDI In Two Types of Sectors

Items	High Tech Sector	Traditional Sector
Competition	Limited to other subsidiaries	Local competition is high
Motivation	Market penetrating dominant	In addition to market, others are also important
Entrepreneurial Freedom	Tighter central control	Low level central control
Technology Transfer	Unwilling or reluctant	Will carry on if profits are reasonable
Use Brand, Trademark etc.	Not permitted	Conditioned Permit (Under control)
Attitude to Joint Ventures	More Hesitate	Do not care
Restraints to Local Firms	Tends to prevent them from entering	Do not prevent them from entering certain product line
Takeover	Few takes place	1/3 in this way
Subcontracting	Most extensive user of subcontracting	More limited to use subcontracting

Source: Developed by author based on Frank (1980 p43-72)

Lall (1983,1989) expands the difference identification into newly industrializing Countries (NICs). He displays some features of FDI out of these countries: (1) Their motivations are mainly in purchasing low cost. (2) They use FDI as a tool to access developed country markets; secure their critical material supply; serve regional local markets; and access foreign technology. (3) They undertake various changes for their affiliates. For example, imported equipment was modified to take account of low labor skills and cost in the affiliates, of different operation scales, and different product mix. (4) They prefer entering into joint ventures with developed country firms, and are active in the industries where the frontier grows slowly.

Frank's comparision shown in Table 3-8 suggests that FDI in high technology sector and in non-high technology sector adopt different strategies, so that the impact of FDI on host country varies both in methods and in contents. The studies of Vernon (1981), UNCTC(1985, 1987), Oman(1989), OECD (1988,1989,1993) not only confirm the trend, but also further explore the deviations among industries. For example, UNCTC (1985) points out that in aeronautical, chemical, drug, scientific instruments, transportation equipment, and machinery industries, MNCs aim to exploit their technology lead; in foods, soft drink, tobacco, and drugs, MNCs intends to take advantages of their strong trade names; in oil, copper, aluminum, heavy chemicals and other large quantity scale industry, FDI intends to get scale economy; and in textile, motorbike, automobile industries, foreign investors attempt to maintain their profits by relocating their workshops. UN (1992) and OECD (1993) report that the share of FDI in high or medium research-intensive industries in developing countries, especially in Pacific Asia has increased.

3.3 Attitude And Policies Towards FDI

3.3.1 Changing Attitudes Towards FDI

Along with the development of FDI, the attitudes towards to FDI experienced some changes both at home country and at host countries. The former shows a liberal trend, but the latter gives an opposite turn.

The international flow of capital has been regarded by home countries as a tool to promote a more efficient allocation of available economic resources and can contribute significantly to the development of their economy (UNCTC 1985, 1987). But along with these countries becoming FDI destinations as well as FDI originations, they adopted more liberal attitudes towards the flow of FDI. Codes of Liberalization of Capital Movements and National Treatment Instrument is the corner-stone of investment policy in OECD countries. As OECD (1993) mentions that now all OECD

governments share the view that established foreign owned firms should be treated no less favorably than domestically-owned firms. They have promoted a more liberal policy where obstacles and disincentives to FDI have been replaced by policies that facilitate foreign participation. Which can be seen from no restrictions remain on outward investment; replace authorization procedures by simple notification procedures; abolition or reduction of sectoral restrictions; and make investment procedures even more transparent.

The attitude towards to FDI in developing countries has experienced a radical change (OECD 1983, 1987,1993; UNCTC 1985, 1987, 1990). Before the late 1970s, FDI had been accused of denationalizing local industries and undermining the sovereignty of host countries, of engaging in monopolistic and other unfair trade practices; of extracting rents through illegal transfer-pricing mechanisms; of being major contributors to the structural balance of payments deficits associated with import-substituting industrialization; and of employing inappropriate technologies or worse, failing to transfer technology to the host economy. But after that, many developing countries have silenced, or forgotten their earlier critique of FDI, and tried to attract foreign investment. Now FDI are widely regarded as a resource which is particularly useful for the economic development of developing countries, especially for their industrial development. They hope through inward flow of FDI to acquire developed country's technology; to generate exports and/or reduce imports; to obtain hard currency; to gain advanced management skills and techniques; and to channel to world networks (Goulet 1989, Hoyle 1990).

3.3.2 Changing Pattern of FDI Flow

In addition to the change of attitudes towards FDI, FDI itself has also experienced many changes in the past several decades. While the flow is getting stronger, more and more FDI is flowing into developed countries instead of into developing countries. Table 3-9 shows this change in term of geographical distribution change of outward investment from US, which has been the biggest FDI home country. The data in the table shows that the decrease of FDI to developing countries is obvious, both in manufacture and in service. This trend is continued in the second half of the last decade. According to UN (1993), the world stock of total FDI in 1990 is $1.7 trillion, four times than 1985. However, between 1986-1990, the share of developing country in total FDI dropped to 17% from 25% between 1980-1985. at the same time, the United States became the leading host country, followed closely by the European countries.

The explanations for the decrease of FDI to developing countries come from two

aspects. One is the handicaps existing in developing countries, such as lack of supportive infrastructure; lack of skilled labor; lack of cohesive development policy; political risk and uncertainties. The other comes from the new strategies employed by MNCs. Because new investment form is adopted widely, before the operation of a project, MNCs require and attempt to secure above-normal rates of return. Investing to developed countries is easier to satisfy their demand--let the investment 'paid for itself' within a short period (UNCTC 1985).

Table 3-9 Geographical Change of US FDI Stock (%)

Year	Total	Europe	LDCs	Rest of the World
In All Sectors:				
1950	100	14.5	48.7	36.8
1967	100	32.2	26.4	41.4
1977	100	45.9	22.6	31.5
In Manufacture:				
1950	100	23.7	21.1	53.3
1967	100	43.4	17.1	39.5
1977	100	49.3	18.3	32.4
1985	100	48.0	19.9	32.0
In Services:				
1950	100	8.8	58.8	32.4
1967	100	29.8	27.7	42.6
1977	100	37.0	17.0	16.0
1985	100	48.5	22.5	29.0

Source: UNCTC (1990 p10)

3.3.3 Policy Package of Host Countries

Over the past two decades, the heavy competition between developing countries in attracting FDI, and the decreasing supply of FDI from developed countries forced developing countries to pay more attention to the policy issue, and try to use policy package to attract more FDI into their territory. Table 3-10 is a summary of the policy contents of developing countries in dealing with FDI. From it we can see that policies or measures employed by host countries are mainly concentrated in following five aspects. Firstly, they offer various incentives, which are mainly in tax and tariff deduction. Secondly, they employ sector selective policies to give special support for strategic industries. Thirdly, they control the dominance of FDI in firm level through

Table 3 - 10 Package of Policies of Host Countries

Policy	Contents of the policy	Main concerns of the policy	Measures to carry on the policy
Setting invest ment priorities	Researve certain sectors Open certain sectors	Strategic or sensitive industry Protect national investment	F.I. type chose Sector choice Activity choice
Domestic ownership & control	Outside ownership & manage-ment level limitation	F.I. impinge on national control Other undesirable conse-quences	Prefer F-L joint ventures Majority domestic participation Dilution of foreign ownership National personnel as top manager
Access to domestic financial resources	Limit or no limit to utilize local financial sources	Scarcity of local finance Higher degree of foreign ownership	Equity control Loan given Foreign borrowing
Perform-ance require-ment	Import intensive Less local linkages	Limit & monitor F.I. behavior	Export obligation Local purchasing Training local personnels Transfer know-how Setting R&D
Invest-ment incentive	Offer tax,tarriff & financial priority	Investment climate Host countryies competition	Tax deduction Investment allowances Lower tarriff & quota restriction

Developed by author based on UNCTC.Transnational Corporations in World Development Third Survey (1985.41-50) Rodina Capitalist investment in Socialist Countries (1991. 62-67)

equity or personnel limitation. Fourthly, they use domestic financial resources or domestic market as lever to lure FDI. And finally, they ask FDI to take some obligations, mostly in promoting exports and conducting technology transfer.

It is apparent that the scope and emphasis of the policy package varies in developing host countries. However, it is suggested by some studies such as Rodina (1991) that the poorer the host country, the more incentives there are in their policy package; the higher the development level in a host region, the more strict performance requirement is employed. For example, while Korea rose its development level, it exerts a strict regulation on establishing a wholly owned or majority owned FDI firm (Yu 1990).

It is noteworthy that a trend of increasing liberalization in economic policies is also apparent in developing countries, especially in Pacific Asia. In some of these countries, foreign firms can now set up under the same conditions as local firms; they can gain access to local capital markets on the same conditions as domestic firms; intellectual property rights are being protected. In other countries the restraints on FDI are gradually being relaxed and some abolished (OECD 1988, 1992 1993).

Summary

Among the four types of foreign capital flow--helper, creditor, seller and investor, the last attracts most attention in previous studies, because the stock of FDI reached about $2 trillion in 1992, which generated about $5.5 trillion in sales by foreign affiliates (UN 1993). Therefore, tracing the characteristics of this multi-country operation has been the main theme of FDI studies.

Based on the four theories, one eclectic paradigm and other studies, some conclusions about the dynamics of FDI can be drawn: (1) The advantages possessed by foreign investors both in production and organisation aspects lead to capital outflows crossing national boundaries. (2) The purposes of these outward flows usually fall into the following categories: to enlarge or safeguard the market, to save production or transaction costs, and to differentiate technology. (3) The controls of foreign investors over their subsidiaries are multiple: -by ownership, by resources, and/or by common strategy, which determines the autonomy of FDI affiliates.

Although MNCs only aim to internalize their advantages outside their countries and exploit resources world wide during their international operation, they do exert positive impacts on the host countries' economy. These impacts have been emphasised since the 1970s, and were divided by most previous studies into: direct

and indirect exports promotion; improvement of balance of payments; creation of employment opportunities and transfer technology. However, how technology transfer co-ordinates with the other impacts still needs to be clarified.

The characteristics of FDI local operations are subject to many factors either in supply side or demand side. Among them, the investment environment of the host country, the origination of FDI and its sectoral destination, and the changes of FDI global flow, as well as the changes of attitudes towards FDI in most developing countries are influencing. The combination of them forges the diversification of FDI's local operation. How technology is transferred to the host region through this complex channel will be the topic of the next chapter.

CHAPTER 4. TRANSFER TECHNOLOGY THROUGH FOREIGN DIRECT INVESTMENT

4.0 Introduction

This chapter intends to bridge the two previous chapters and focus on checking how technology is transferred through foreign direct investment. First of all, it discusses the basic model of technology transfer and the factors which affect the flow of technology. Secondly, it compares the channels which can be used by FDI. Thirdly, it explores the process of technology transfer from two sides: technology sending and technology receiving. Finally, it reviews the scattered discussions on technology transfer to China through FDI.

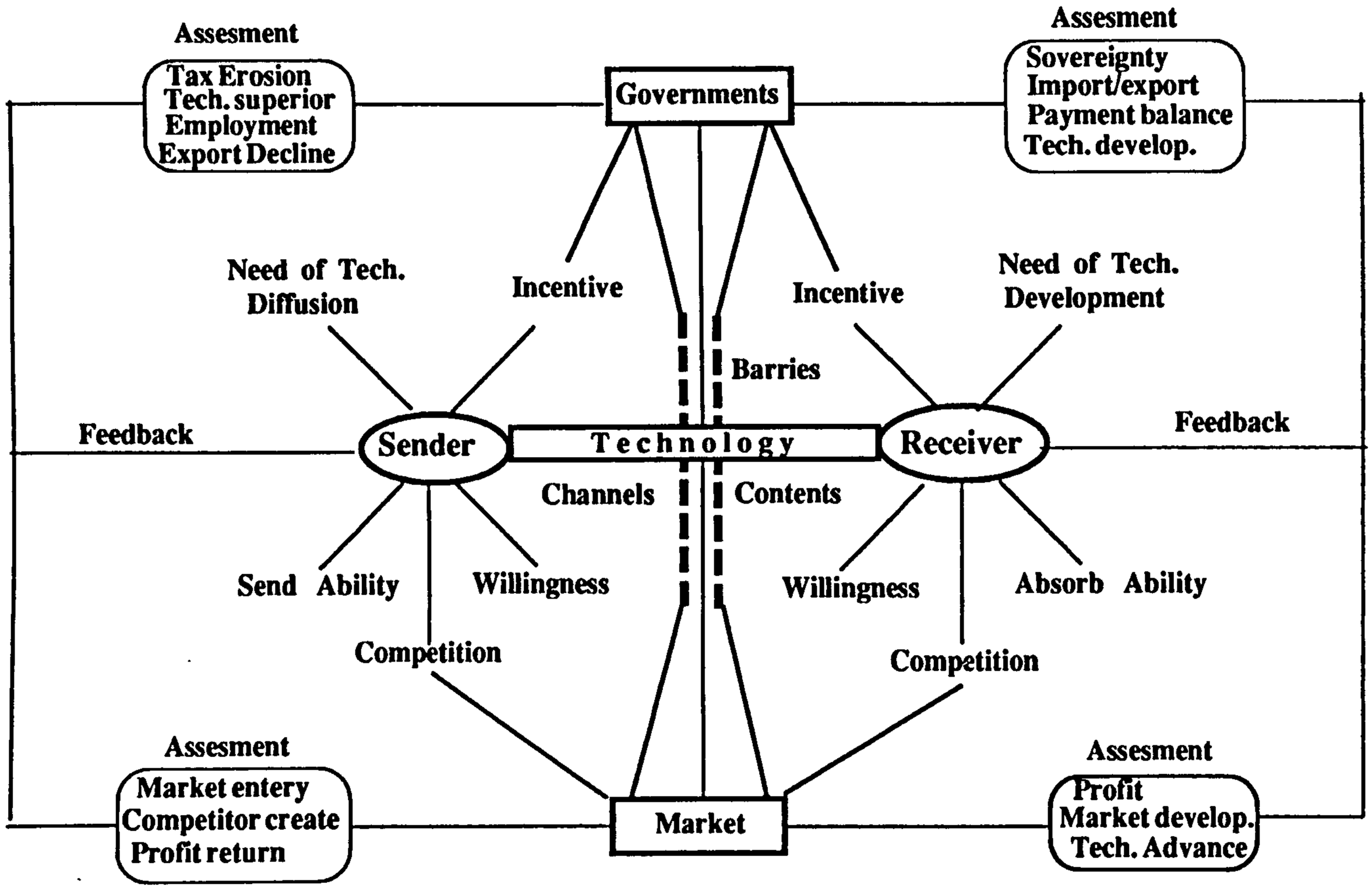
4.1 The Model of Technology Transfer Through FDI

4.1.1 Six Components of Technology Transfer

Smali (1985) presents a basic model for examining technology transfer through FDI. In his model, spender, receiver, technology, aftermath and assessment are key components. This model provides a useful framework for analyzing technology transfer. However, the model is incomplete. First it does not recognise the channels used in technology transfer, which has been regarded as one of the most important factors affecting the degree of effective transfer by many researchers (UNCTC 1985,1987; Young 1988). Secondly, it does not include government in the participants of technology transfer. In fact, as many scholars (Gomulka 1990; OECD 1981,1988,1993; Kraemer et al 1992; Shibusawa et al 1992) argue, governments, especially host governments, play an important role in the process. Combining these discussions, a general model of technology transfer is formulated, which is shown in figure 4-1. This model will serve not only as a framework for the survey of this chapter, but also as a guide for the case study. There are six key components in this model: technology sender; technology receiver; government; technology itself; transfer barrier; and transfer channel.

1. Technology sender. Technology sender is one of two ends of a transfer process. Because technology transfer is concentrated to the supply side and demand is assumed to have no constraints (Stewart 1987), the behaviour of technology sender is more important than technology receiver in determining the consequences of transfer. Technology sender usually means a technology holder (Dunning 1989). But in some cases, it may be a middle man of technology, as Lall (1983) reported in the outward investment from the Third World. In the process of transfer through FDI, it refers to

Figure 4-1 Model of Technology Transfer



Developed by author based on UNCTC(1987), Samli (1985)

foreign investor. The sending willingness and sending capability are two basic features of a technology sender. When the sender's technology capability is higher than the technology receiver's, and its need totally or partially coincides with receiver's, technology transfer will take place. Concerns of the technology sender includes: the amount of technical and other services provided; industry norms; the receiver's market size and profitability; research and development expenditure; money gain; the exercise of control; and competitive advantage over others (UN 1987, Goulet 1989).

2. Technology receiver. Technology receiver is the other end of technology transfer process. A technology receiver can be a private enterprise, a state-owned firm or local personnel. As a technology receiver the following two qualities are crucial for technology transfer. First it must be willing to obtain inward technology, no matter what is the motive behind. Secondly, it should have some capability to absorb contacted technology. Because this capability is based on the technological foundation of receiver and is shown as: (1) The ability to select from available technology; (2) The ability to master imported technology; and (3) The ability to introduce a degree of novelty in the production of products or process. It is clear that the absorb level of imported technology is proportional to the technology creation capability of the technology receiver (Yankey 1988, OECD 1988, TEP 1991).

3. Government. Technology transfer does not only involve the technology sender and receiver; government is also an important participant in this process. Comparing with the host country's government, the impact of the home country's government is weak. This is because most countries do not impose limitation on outward investment except in certain high technology sector such as military-strategic industries. Their concerns are mainly concentrated to job losses, tax evasion or avoidance, stagnant industrial productivity and inflation in the domestic economy. The role of host country's government is obvious and influencing. In most developing countries, especially Pacific Asian countries, the host country's government not only serves to intervene by employing macro-economy policy, but also as a participant of many technology transfer. Under a highly controlled economy, they are more sensitive to technology dependency; deteriorating balance of payments; import increase; sovereignty erosion; culture destroyed, and failure to use local resources (UNCTC 1985,1987; Livingston 1989; Goulet 1989; Lim et al. 1991; OECD 1988,1993).

4. Technology. Technology is the subject of technology transfer. As discussed in chapter two, technology varies in different projects, but its three existing forms, its two destinations, its level hierarchy and its development process are

common and can be shown in a technology ball. Many studies such as OECD (1981), Dunning (1986), Young (1988), UNCTAD (1990) have suggested that the size of the technology package is proportional to the technological gap between the technology sender and the receiver. Between developed countries, the inside structure of technology is simple, and usually shown as certain production know-how, whereas between developing and developed countries, the inside structure is more complicated. Any hard technology transplant needs to be accompanied by some soft or medium technology, and organizational know-how is required to go with production know- how.

5. Transfer channel. This refers to the forms adopted by foreign investors, because the technology ball is rolling across national boundaries within it during the FDI operation. Transfer channel is divided by many writers into "internalized" and "externalized" categories. The fundamental distinction between them is that the former involves continuing direct ownership, control and use of the technological assets within the context of the firm's foreign operation; while the latter does not. (Hymer 1972; Young 1988, Yu 1990, Cantwell 1991). The importance of transfer channel in technology transfer is that it affects the volume of technology flow, and determines the mechanism of technology transfer, since learning method, opportunities, and consequences vary in different foreign investment forms. (UNCTC 1985, 1987; Young 1988). This will be discussed in detail in the next section.

6. Transfer barriers. Although highly desirable, particularly for host countries, technology flow between sender and receiver is not a easy process, and much knowledge cannot be transferred along with inward investment (Lall 1983, 1989; Rosenburg 1976, 1982, 1989; Dunning 1988). The difficulties resulting from various aspects consists of transfer barrier. The barriers vary in the regions, sectors, participants, and adopted channels, but it is usually caused by the following conflicts. First is the economic-price conflict. Foreign investors usually view technology as an expensive commodity with a very short commercial life. Therefore, it should be sold at a high price. While technology receivers treat it as a second-hand goods, and often want to put as low a ceiling as possible on the transfer process (Goulet 1990). Secondly, the conflict over the control of technology. Technology senders usually want to limit the scope of technology transfer by various measures, whereas the host country usually want to enlarge the results of every transaction or cooperation (Brown 1990). Thirdly, conflict between different backgrounds. Since technology is not only an entirely embodied equipment, and it cannot be transplanted totally from one culture to another (Lall 1977, 1983, 1989). When it is transferred, it would disturb other aspects of the host country such as social institutions, value systems and technology infrastructure. These disturbances will be amplified where there is a big difference

between the cultural or political background, and put restraints on the transfer process (Smali 1985, UNCTC 1987).

4.1.2 Factors Affecting Technology Transfer

Viewing from the above model, it is clear that the factors affecting foreign investment influence technology transfer through inward investment. However, the following factors in the standpoint of the technology receiver show more direct relationship with the process (Jegathesan 1990). Firstly, factors associated with the condition of physical facilities. Old, inefficient and poorly equipped production facilities, primarily involved in the production of industrial input materials and consumer products in developing countries, are some of the important problems that affect the ability to upgrade manufacturing technology and the speed with which this can be done. Furthermore, inadequate and outdated facilities for research and development provided by the public sector. Non-availability of infrastructure and uniform standards for process and quality control do not provide a conducive environment and the support necessary for the acquisition of inward technology.

Secondly, factors associated with human competence. The ability of the workers to absorb, adopt or adapt is a vital ingredient in the process of transfer of technology.

Thirdly, factors associated with the usefulness and cost of documented facts. An understanding of the value and role of information is vital in the assimilation of technology and learning effects. In many developing countries, inadequate appreciation of the importance of information for increasing knowledge is a problem, because most technology suppliers do not give their partners the latest information on their technology. The high cost involved in the purchase of technological information prevents many receivers from acquiring the information needed to add to their knowledge.

Fourthly, factors associated with the effectiveness of organizational frameworks. The lack of an integrated and interdisciplinary approach in the management of an organization due to the compartmentalized operation of key functional areas also prevents many FDI companies from obtaining full benefits from the resources available.

Fifthly, factors associated with supportiveness of the national technology climate. The development of a technology culture, a correct perception of technology transfer, and the appreciation of technology among the people in general will also determine the extent to which technology transfer succeeds in most foreign investment firms.

4.1.3 Possible Results of Technology Transfer

The impact of FDI on the host country's technology development has drawn the attention of many writers, such as Steuer (1973), Frank (1980), OECD (1981), Samli (1985), UNCTC (1985,1987), Roman (1986), and Blomstrom (1990). From the long list of benefits which host countries receive from FDI, we can divide them into following three categories: stimulating effect, short-cut effect, and spillover effect.

Stimulating role of FDI means that FDI forces indigenous existing firms to adopt more efficient methods, to increase their R & D, or to adopt some specific technology more quickly, either because previously the firm were not aware of the existence of the technology, or because it would not have been considered profitable for it to be acquired (Blomstrom 1990). The mechanism of stimulation can be observed through the following ways. (1) Stimulating domestic entrepreneurship through purchasing, subcontracting, or operational demonstration. (2) Initiating competition by bringing competitive pressures to a local monopolist.

Short-cut effects refers to the low cost of obtaining certain technology. Many researches such as Steuer (1973) and Young (1988) state that subsidiaries may draw on the research efforts of the parent organization, at low or zero explicit cost, therefore new products are made available at lower cost and are promoted more effectively. Besides that, because FDI is more concentrated in new technology or in technology intensive sectors, local firms can get more opportunity to acquire new technology through either the linkages of subsidiaries with their parent into R & D and technology resources, or the research and development activity undertaken by many subsidiaries themselves.

Spillover phenomenon is used to describe the externality brought about by FDI. In Samli's (1985) analysis, the better techniques are diffused mainly through mobility of personnel, contracts with suppliers and imitation through proximity. Some other studies such as UNCTC (1985, 1987) and Young (1988) also confirm that there are three channels of conducting technology diffusion into the indigenous sector from FDI: formation of spin-off enterprises; backward linkages through locally-procured inputs leading the emergence of an indigenous supplier industry; and forward linkage into product manufactures relation with the general scientific and business community. The consequences of these effects are mainly shown by improving the productivity and the competitiveness of host country's firms, at the same time revolutionlising production methods and management philosophy (Blomstrom 1990).

In view of the negative impact of FDI, the high cost of payments for technology;

technological dependence as well as inappropriate technology; and the restraints to local firms are the center of concerns in the previous studies. Regarding the high cost, FDI is also accounted for by two aspects. First royalty and other technology payments are too dear. Secondly, it leads to diseconomy of externality. For example, Frank (1980) states that the new technology introduced by MNCs may be highly capital-intensive and thus fail to utilize labour fully even where unemployment is already widespread. Aggarwal (1984) worries about all the scare local resources used excessively by the MNCs.

Technology dependence and inappropriate technology are explored by scholars from the following aspects. The first is the repeat construction caused by FDI. Aggarwal (1984) argues that because of the technology transfer through multinationals, certain parallel industry may be developed. The second is the creation of a "Halo effect". During the process of local industrial development, coping with MNCs easily leads local firms to adopt inappropriate methods. The third is helplessness or destroying the innovation capability in local firms. Dunning (1988), based on his investigation in the UK, points out that Japanese new establishments may fail to undertake research in host region, or may disband research organizations in cases of take-over. Therefore, the UK economy in a general sense becomes technologically dependent on foreign investment. Young(1988) states that many transfers of technology are concentrated on standard technology, assembly operations and mature sectors, which are helpless to promote local technological development.

The restraints of FDI on local firms are shown at two levels. At micro level, Dunning (1988) points out that through take-overs, FDI acquire property rights in the research achievements of local firms, and so gained the benefits of exploiting certain ideas. Frank (1980) argues that FDI, drawing on the vast technical and managerial resources of its parent company, may snuff out newly emerging local entrepreneurs. Far from encouraging competition, the foreign enterprise may itself become a monopolist in the local market. At macro level, Aggarwal (1984) worries that the MNCs drain out the local capital and other scarce resources such as trained manpower and raw material which can be used by local firms, and that may destroy the local "infant" industry.

It is apparent that previous studies have assessed the impact of FDI on the host country's technology development from both sides thoroughly. It is difficult to add new contents into the list of the possible aftermath of technology transfer through FDI. However, there is a problem remaining, e.g. the methods which can be used to measure these impacts are few. Some studies such as UNCTC (1984), OECD (1988), Yu (1990) and Young et al (1990) use royalty amounts to show the flow of technology. Some other studies such as Hood et al (1982), Young (1988) and OECD

(1989) use the level of involvement of FDI in certain host country sectors or activities to measure the technology transfer. Still other studies attempt to display the spin-offs of FDI by measuring the relations of inward investment with indigenous firms (Steuer 1973, Frank 1980, Turok 1993). None of them can show the all impacts against the technology development mechanism discussed in chapter 2.

4.2 Channels of Technology Transfer

There are many channels that can be used in FDI. These forms display different functions in conducting technology flow and technology transfer, and also show certain characteristics in employing them. Among these channels, wholly or majority owned, joint ventures and licensing are three important forms.

4.2.1 Wholly or Majority Owned Subsidiaries

The Wholly or majority owned subsidiary is an establishment of a company in a foreign country, over which the parent firm assumes effective control. Within this channel, the technology provided by the parent firm is characterized by:
(1) It is usually a complete package, which includes capital goods; industrial property rights in the form of patents, trade marks and brand names; secret unpatented know-how; and accumulated experience and skills in organization, management and marketing (UNCTCT 1987, Young 1988, Oman 1989).
(2) It is relatively new or/and highly firm specification. For example, UNCTC (1985) reveals that in chemical, semiconductor and pharmaceutical three sectors, 27% of total transferred technology within this channel is less five years old from 1960-1969, while in the period of 1969-1978, the ratio increased to 75%.

However, this channel is a typical "internalized" mode, by which the foreign investor dominated by the Multinational Companies (MNCs) retains absolute control over their technology-based advantage. Based on such control, the flow of technology in this channel shows the following two characteristics. First much technology flows through it. According to the study of UNCTC (1987), 4/5 technology transfer between America and developing countries is conducted by this form. In the case of Germany, intra-firm transactions of technology exceed 90%. Secondly, much technology cannot be transferred to local partners or indigenous firms. Except for "show how", it is difficult to show the importance of other learning mechanisms in this form.

The application of this form in foreign investment show two features. First it is often used in high or medium research intensive sectors such as electrical and non-

electrical machinery, transport equipment, chemicals and pharmaceutical industries. The reason for its preference of high technology sectors is that the MNCs in these industries have more bargaining power (Dunning 1981, Marton 1986). Secondly, it is often the target of the host country's government imposing restrictions. For instance, in India, Korea and several years' ago in China, there are many more restrictions for this form than any other forms (UNCTC 1985, 1987; Lee et al 1991). Oman (1989) points out that there is a trend to replace it by other new forms of investment in several sectors.

4.2.2 Joint ventures

A joint venture is a business association between foreign investors and local enterprises. It can be divided into two types. One is contractual joint venture, which is formed for a particular project of limited duration or for a long-term co-operative effort. Here the contractual relationship is commonly terminated once the project is complete. The other is equity joint ventures, that involve the sharing of assets, risks and profits and participation in the ownership of a particular enterprise. The relative equity stakes can vary under different situations (UNCTC 1987, Young 1988).

The sharing characteristic of joint ventures makes it offer greater opportunities for the effective transfer of technology to the host economy. In addition to learning by watching, local partners can use other methods to access or unbind inward technology, such as learning by training, learning by doing, and learning by sharing (UNCTC 1985, 1987; UNCTAD 1990). However, while joint ventures increases the opportunity to unbind technology, the sharing feature of it makes the flow of technology through this channel decrease, comparing with wholly or majority owned subsidiary. The surveys of UNCTC (1985) reveal that the technology from MNCs within this form is more mature, less firm-specific and not changing very much. Based on the experience of Russia, Hoyle (1990) reports that the level of technology in joint ventures may be sufficient to be attractive to the host consumers, but is unlikely to result in the export of their products.

The employment of this channel is often accompanied by the following phenomena. First, it is full of conflicts during operation. In the view of local partner, MNCs not only obtain benefits through production advantages such as supply equipment and technological know-how, which consists of the host country's direct cost, but it also erodes the joint ventures through their organizational advantages such as overprice the imports of intermediate products and equipment, which consists of the host country's indirect cost. (UNCTAD 1990; Michalet 1991). Secondly, it is usually used in standard technology sectors. Non-ferrous metal, plastic, textile

industrial chemicals, agricultural machinery and equipment, fertilizers, food and beverage processing are common fields where this channel is employed (UNCTC 1985, 1987). Thirdly, it often occurs that a great deal hinges on the specific terms and conditions of the joint venture agreement. MNCs may use tight licensing agreements to limit the local partner's access to the technology, and use other agreements such as management contract to limit the local partner just as a shareholder (UNCTC 1987).

4.2.3 Licensing

Licensing are the contracts in which the licensor provides licensees abroad with access to one or a set of technologies or know-how in return for financial compensation. It covers the broad spectrum of permits, and regardless of whether an equity relationship exists between the licensee and licensor. According to Kaynak (1985), the licensing may be divided into: (1) Patent licenses; (2) Know-how agreements--information that may be classified and thus difficult to obtain; (3) Technical assistance agreements; (4) Trademark and/or Copyright licenses; and (5) Miscellaneous agreements--includes franchising, sales, and service representations.

Licensing is characterized by a two way flow between licensee and licensor (Brown 1990). The flows from a licensor to a licensee can be summarized as: (1) Providing know-how for designing manufacturing test etc. (2) Granting the rights required to manufacture, apply, or sell the contract product (associated patents, trademark, copyright). (3) Training the host personnel at relevant facilities to master relevant know-how. (4) Providing experts to facilitate design, manufacture, etc. of the contract project. (5) Providing ongoing management advice & assistance if required. (6) Providing equipment required for design & manufacture of the contract project.

The flows from a licensee to a licensor usually include: (1) A lump sum on the initial transfer for technology. (2) Royalties on a continuing basis on a percentage value of the product manufactured service provided by licensor. (3) Fees for technical and other services. (4) "Gathering costs" associated with selection, production and delivery of technical documentation. (5) Payments associated with the sale or leasing of equipment purchased by licensee. (6) Ongoing or lump-sum payments for updates of technology or for improvements.

Separating with ownership, and possessing explicit two way exchanges makes licensing application show the following features: First it is highly flexible and can be used in a broad field. Many studies such as Marton (1986), Oman (1989) and Nunez (1990) have shown that licensing is welcomed by traditional sectors, but also plays an important role in high technology industry. Secondly, it transfers soft and medium

technology, and hard technology transaction does not show much importance in this channel (OECD 1990). Thirdly, when the licensor uses it, they often use terms of a licensing contract limiting the licensee's freedom to become a serious independent competitor of the licensor, and also create "locked-in" sources of "auxiliary business" for the licensor in the form of sales of components and further technology (UNCTC 1985, 1987; Young 1988; OECD 1990, 1991).

4.2.4 Comparison and Application of the Channels

In addition to the above discussions, there are some authors are interested in the comparison of these three channels and their application (Vernon et al. 1981, Stobaugh 1984, Cavusgil 1985, Kaynak 1985, Dunning 1986, Rapakko 1990, Grossman & Helpman 1991 and Casson 1992). Table 4-1 shows the differences of technology supply, transfer mechanism, access possibility and cost of local enterprise. Generally speaking, wholly or majority affiliate is a channel which conducts more technology flow than the other forms. For example, Rapakko (1990) compares the mean time lag of technology from introduction to transfer to abroad by different ways. He concludes that it is six years for wholly owned subsidiaries in developed countries, 10 years for such subsidiaries in developing countries, and it take 13 years to joint ventures or licensing to the developing countries' firms. However, in the view of technology transfer mechanism, wholly owned is the worst, while joint ventures and licensing show more learning methods and higher accessibility for local firms.

The evaluation of these three channels by the MNCs is displayed by Table 4-2. It is clear that wholly owned and licensing are the two ends of every criterion. The former needs more input, shows high uncertainty, and would contribute more to the parent company. The latter enjoys high stability and safety, but it worries the parent company in long run both in keeping control of the technology, and in generating future income. In the mind of MNCs, joint ventures is undoubtedly a trade-off between these two Channels. It does not make high sacrifices in any costs, nor does it generate high benefits.

The differences of the three channels make them not only show sectoral preference respectively, but also show a regional preference pattern. Table 4-3 exhibits the application of these channels in different regional context. From it we can see: Licensing is a dominant channel to transfer technology between developed countries, because it is specific and without difficulty for both sides to abide the contract. While in other contexts, three forms all show their importance, but joint ventures established by management contract only exists between two regions where there is a

Table 4-1 Comparison of Three Transfer Channels

Items	Wholly or Majority Owned	Joint Ventures	International Licensing
Technology Supply	***	**	*
Novelty of Technology	***	*	—
Transfer Mechanism	Technology Leak	Technology Share	Technology Trade
Learning Method	Learning by watching	Learning by watching doing	Learning by using, doing training
Used Field	High-tech	Mature-tech	no limit
Accessibility	*	**	***
Local Involvement	*	**	***
Direct Cost	*	**	***
Indirect Cost	***	**	*

* : low **: medium ***: high --: varied
Sources: Developed by author based on UNCTC (1985, 1987); Rapakko (1990);

Table 4-2 Cost and Benefits of Three Channels In the View of MNCs
(1 the lowest, 4 the highest)

	Licensing Contract	F-Local Joint	F-F Joint	Wholly Owned
Costs:				
Capital commitment	1	2	3	4
Management Commitment	1	2	3	4
Restraint on strategic and operational flexibility of other affiliates	4	3	2	1
Benefits:				
Amount of payment to parent	?	?	?	?
Stability of payment to parent	4	?	?	?
Political security for parent	4	3	2	1
Contribution to parent's store of knowledge	1	2	3	4
Contribution to value of parent's trademarks & trade name	1	2	3	4
Future availability of local outlet to parent	1	2	3	4

Source: Vernon et al (1981)

development gap.

Table 4-3 Channels Used in Different Context

Sender & Receiver's Countries	Channels Used in Transferring Technology
1. Advanced to Advanced	Licensing
2. Advanced to Developing	Wholly owned, Management contract R & D and Technical know-how Licensing
3. Newly Industrializing to Less Developed	Joint ventures/management Joint ventures/technical know-how
4. Less Developed to Less Developed	Wholly owned Licensing/ R & D Joint Venture/ technical know-how

Source: Cavusgil (1985)

4.3 Process of Technology Transfer Through FDI

4.3.1 Sending Process

The international product cycle theory sets a framework to trace the technology sending process (Vernon 1981, Dunning 1981). According to the theory, any technology development experiences the following stages: initiative; rapid growth; mature and decline. Along with the increase of technological maturity for any innovation, the return of investment into this technology is decreasing, but at the same time the opportunity to diffuse this technology is increasing. The uneven development of technology in different countries and the various methods of diffusing technology to make an innovation can be exploited multiply in the international context.

Many studies such as Vernon (1981), Marton (1986), Young (1988), Lall (1983, 1989) and Nakamoto(1992) points out that although technology can be exploited in different ways, the combination of these ways usually follows a certain order. First it is exploited initially through product exports. Then it is exploited by exporting technology to other industrialized countries. Finally, it is exploited by exporting both products and technology to developing countries. This technology exploiting

procedure suggests the technology sending order.

Based on this technology sending order, Hutton (1988) outlines the sending process through foreign investment. First is exporting. The activities of home companies are direct or indirect export. In this stage, technology sending is limited in embodied goods, and technology absorption is "guessing by using". Secondly, it is licensing. During this period, the involvement of the home country's company is concentrated tonlicensing agreement, which reflects the target of their know-how selling. Technology being sent in this stage is mainly in trade secret of production. Thirdly, the establishment of marketing branches or subsidiaries. Along with the establishment of sales offices or branches, the technology sending enlarges from embodied goods or single production know-how to both production and marketing know-how or the new combination. Fourthly, the multinational company stage; companies manufacturing their products abroad by both wholly owned or joint ventures. During this period, the management skills and corporate organizational technology are increased by a global approach. The technology being sent may increase from fragment know-how to a whole package, but the cost of technology sending also increases.

4.3.2 Assimilating Process

Assimilating or unpacking or unbinding imported, shared or leaked technology from the technology sender has been the crux of technology transfer through FDI, because it is proved to be a very difficult process by many studies (UNCTC 1985, 1987; Smali 1985; Stewart 1987; Enos and Park 1988; Young 1989; Habibie 1990).

There is not an agreeable division about the stages in the process of assimilating inward technology, although the two ends of the process is clear: encountering inward technology and increased local technological capability. Some authors such as Enos and Parks (1988) view this process by the activities involved in it, and mainly concern with design of plant and equipment; purchase of equipment and construction; installation and initial operation; and production and maintenance and minor technical change.

Some authors divide the process according to the increase of local technological capability. For example, Habilie (1990) divides assimilation into four stages based on the experience of Indonesia. They are: technology enters through licensed production; technology integration; technology development; and large-scale basic research to support the first three stages and to defend the technological superiority already attained. OECD (1990) treats the unbinding process as three steps. The first is access

to the technology from the investor's personnel and equipment. Secondly, is the absorption under the supervision of the investor. Thirdly, is the diversification of the technology.

Some writers scrutinize technology assimilating in view of human resource development. For instance, Stewart (1987) identifies three stages of technology unpackaging. First is the recruitment and training of local workers in the skills required to master and implement the technology used by the firm. Secondly, is the advancement of the workers thus trained to positions of greater responsibility as they gain experience, gradually replacing the expertise who are initially needed both to train them and to perform managerial and professional functions in the firm. Thirdly, is the turn-over of trained and experienced managerial and technical personal insofar as they employ their skills in starting new domestic enterprises or in modernizing domestic organizations.

It is apparent that between encountering inward technology and enlarging local technological capability, there can be varied links viewed from different angles. However, no matter how many links in it, a more important issue for technology receivers is to obtain expected results with less cost in each stage. UNCTC (1987) based on a series of studies of technology transfer, suggests a set of strategies to unbind technology carried by foreign investment.

The first strategy is the separation of the foreign investment package into its component parts, especially the separation of know-how and capital goods from ownership and management. The aim of this is to acquire foreign technology while retaining ownership and control over the investment process and the subsequent production operation. This allows greater scope for local decision-making in the initial choice of technology and greater local control over the activities concerned with the assimilation and adaptation of imported technology.

The second strategy is the separation of the technological package into its components, which involves distinguishing between "core" and "peripheral" technologies. The former is specific to the production process. The latter relates to the application of the core technology. By separating the two, the receiver can reduce peripheral technology import by sub-contracting it to local suppliers, which may either low foreign exchange expenditures, or provide learning chances for local firms.
require

The third one is to separate the pre-investment, investment, and operation activities from one another. The objective of this strategy is to maximize local involvement in the critical activities affecting the choice, assimilation and adaptation of imported

technology. The local involvement can result in the choice of more appropriate technology, and also can provide valuable learning opportunities to local designers, planners, engineers and technicians.

The combination of the sending process and assimilation processes affects the effectiveness of technology transfer. Kranzberg (1986) and Yankay (1987) identify two types of technology transfer. One is generative technology transfer, which does not only enable the utilization of the imported technology to satisfy certain needs, but also has the potential for the further generation of technology. The other is consumptive technology transfer, which cannot be applied to satisfy present and future needs without the technology itself being consumed or exhausted. They also find that consumptive technology transfer is 30-50% more expensive than generative technology transfer.

4.4 Technology Transfer In China

4.4.1 History of Technology Transfer To China

In the history of People's Republic of China since 1949, there are four important technology transfer stages. The first phase was during the 1950s. The Soviet Union and Eastern European countries were technology senders. This transfer ran the gamut from scientific and technological education to project design, and from production engineering to create a modern industrial organization, complete with planning, budgeting and management systems. During this period, as Conroy (1992) states, 400 imported projects were initiated at a cost of $2.7 billion. The majority was in the form of complete sets of equipment and turnkey plants (the whole factory is contracted for) for 156 complexes. At the same time, technical expertise and data were supplied and a large training programme was conducted.

The second phase was in the early 1970s. That was the first time China imported technology from Western countries. Technology transfer was mainly in ammonia plants, and complete sets of equipment predominated. The problem in this phase was the lack of feasibility studies of the imported projects. That led to many problems during and after implementation. This included those connected with energy and raw material supply and poor siting of projects away from markets and input sources (Lubman 1984).

The third period was in the late 1970s. This was a short-lived spree, again dominated by large turnkey projects such as the Baoshan iron and steel plant in Shanghai. This particular scheme involved one fifth of the total amount of funds

during that period. Most of 22 projects contracted for were metallurgical and petrochemical projects. This transfer was criticized not only for exacerbating the unbalanced growth of heavy industry at the expense of agriculture, light industry and services, but also for inappropriate technology (Conroy 1992).

Since the "open door" policy of late 1978, there has been a fourth wave of technology transfer. This phase is characterized by: (1) Fewer whole plants were likely to be contracted for. Emphasis was placed on rehabilitation and improving existing factories. (2) Technology transfer was not totally controlled by central government, and provinces and cities were allowed to have greater autonomy. China was experiencing a transformation from a highly controlled planned economy to a market economy. (3) Foreign investors were allowed and have been encouraged to invest in the economy. It is apparent that current technology transfer differs from the former not only in scope, method, but also in participants and channels.

4.4.2 Studies of the Current Situation in China

The rapid growth of China's economy and the pouring of FDI into her territory have became two outstanding characteristics in China of the last decade. Under this background, more and more writers are concerned about the increase of FDI in China (Moser 1984; Cannon et al 1990, Li et al 1991, Currey 1991,1993, and Zhang 1994). However, among these studies, the issue of technology transfer to China through FDI has received little attention.

1. Outside Studies. The studies outside China are mainly concentrated to the following aspects. Firstly, they are concerned with the behaviour of technology senders. One report from the Congress of the United States (Office of Technology Assessment 1988), based on the situation that China's technology progress is very uneven--some military industries have developed "pockets of excellence" that can compete in world markets. However, much of its civilian technology is out-of-date; it classifies the strategic technologies which could be transferred commercially into the following categories: (1) Can be transferred technologies, of which most are the technologies that are very difficult for China to master at present. (2) Cannot be transferred technologies. In this group, the technologies are not so complicated and their unbinding are easy for Chinese. Therefore, they are forbidden to be transferred to China. (3) May be transferred technologies. In this category, the unbinding process is usually futile. So, transfer is possible. It is clear that the technology which can be assimilated by China is strictly controlled by technology owner.

Another study (Casson et al 1992) reveals that five main motives lead foreign

investors to invest in China. According to their survey among 79 foreign partners who run "joint ventures" in China, the motivational structure of foreign investors is: 41% of foreign investors aim to access a large Chinese market; 15% of them aim to establish an export base; 22% aim to use cheap labour; 12% aim to access natural resources, and 11% of them aim to obtain tax incentives. When Ball et al (1993) undertake an investigation among 22 British exporters who export to China, they find that most British businessmen do not know the relationship between thousands Chinese research institutes and Chinese enterprises. Their survey also suggests that there is a over 20 years technological gap between British firms and Chinese firms.

Secondly, they check the involvement level of FDI in China's economy, Conroy (1992) points out that the share of foreign investment in total investment is low, which only accounted for 2.5% of total fixed assets by state-run enterprises at the end of 1988. In foreign investment the ratio of know-how to total stock is also low. The export share of FDI is also very low; only 1% of total exports in 1988. William (1993) reports that FDI firms produced 6% of China's total industrial output in 1992. In addition to tracing the increased trend of FDI's involvement in China's economy, Zhang's (1994) research reveals the uneven spatial distribution of FDI, based on the analysis of offical statistics in Guangdong, a booming southern province. He suggests that the difference in distance to HongKong, size of regional economy and policy status cannot explain this distribution to a large extent, because local government initiative plays an important role in the inflow of FDI.

Thirdly, they analyze technology transfer channels. Kosenko and Smali (1985) outline a procedure of technology transfer to China through joint ventures based on their theoretical framework. Oman (1989), through examining about a dozen contracts that have been signed by China and foreign firms in the automobile industry, concludes that equity joint ventures were regarded as a"Noble" among new forms of investment, and is more preferred by China than licensing, wholly owned, or sub-contracting etc. However, Conroy (1992) argues that this type of foreign investment only accounts for 27% of the total foreign investment stock before 1989. Beamish (1988) points out that foreign investors who take this form use the "fade-out" method--the duration of a project is about ten years, which is one of the factors distinguishing China from both developed and developing countries. Casson et al (1992) compare the operational characteristics of wholly owned and joint ventures in China, and finds that the former is manufacturing oriented, while the latter is services oriented. But the duration of joint ventures is shorter than wholly owned, while wholly owned is smaller than joint ventures in the average scale of investment.

2. Inside Studies. Compared with the discussions outside China, the

studies inside China which focus on technology transfer through FDI are few. The information connected with the issue is scattered in the following researches. First are the studies which concern about the role of FDI in the host region (Pi 1989; Xiu 1991; Yao 1992). For example, Xiu (1991) discusses the formation of new industrial structure in Southern China. He points out that there is a shift of industrial structure in Guangdon along with the inflow of FDI, and assumes that the technological gap between FDI and indigenous firms is the vital factor for advancing local industrial structure.

Secondly, it is associated with the researches which describe the changes of FDI in certain aspects and in certain regions (Hu 1990, Zhang 1991, Wang 1992, Xia 1992). For instance, based on the offical statistics of Xiamen, Zhang (1991) points out that the origins of foreign investors are changing over time and Taiwan investors overtook HongKong investors. Zhen (1991) states that there are five new trends of FDI inflow in the Pearl Delta: (1)Average investment scale is increasing. (2) There is a new investment model, in which many small projects are tied up with a large project and inflow together. (3) Foreign investors began to attract other foreign investors. (4) FDI is concentrated to certain industries, and (5) high-tech projects are increasing their portion in the all FDI projects.

Thirdly, it is connected with the studies which explore the relation between FDI and local economy. For example, Li's et al (1991) undertake a multiplier effects analysis of FDI inflow and China's economy based on the official statistics between 1979-1987. Their findings indicate: (1) FDI inflow, on one hand, increased the total investment scale; on the other hand, it caused the failure of macro economic control over the national economy. (2) FDI shows impacts both on exports and imports, but its impact on imports is much bigger than on exports. (3) FDI inflows create employment opportunities for China. Among three forms of FDI, wholly owned firms are the most effective to absorb surplus labour.

Finally, it can be observed from the discussions about various problems that have occurred in the local operation of FDI (Luo 1990, Yu 1991, Zhao 1991, Tao 1992, Qing 1992). The conflicts between foreign investors and local partners or local personnel, such as transferring the price, the cooperation in "grafting firms", and poor management of FDI firms have been the foci of concerns. Among them, Qing's (1992) investigation into about 50 joint ventures and cooperation firms in Shenzhen is interesting. Through his survey on the involvement level of Chinese partners in firms' abroad activities, shown as in Table 4-4, we can find that most Chinese partners in Shenzhen are channeling into the international market through their foreign partners.

Table 4-4 The Involvement Level of Chinese Partners in Abroad Activities (1991)

	Complete Involved		Half Involved		No Involved		Total	
	No.	%	No.	%	No.	%	No.	%
Equipment Purchase	36	73	4	8	9	19	49	100
Material Purchase	32	68	4	9	11	23	47	100
Products Sales	28	61	5	11	13	28	46	100

Source: Qing (1992)

Analyzing the previous studies both inside and outside China, it is clear that more concerns are being given to technology transfer through FDI, such as Qing (1992) and Ball et al (1993). But there are some difficulties which hinder the complete understanding of this issue. For the studies outside China, lack of necessary information is a handicap. As Beamish (1988) comments that many 'insights' offered by outside observers have been based on very small samples and they tell more about the observer than about the observed. Conroy (1992) also states that as no statistics are available for technology flows through FDI, there is no way to access its role as a channel for technology transfer. For the studies inside China, the following two handicaps are obvious. Firstly, the lack of a international comparison make the studies difficult to identify the characteristics of FDI's operation in China. Secondly, the lack of concerns on research methodology, which can be displayed by without a methodology section in most studies, make their analysis superficial and cannot explore the issue further.

Summary

Technology transfer through FDI is knowledge flow crossing national boundaries along with the overseas operations of foreign investors. Technology senders and receivers are the two ends of this process. They are connected by technology and its carrying channels. Government intervention and transfer barriers reflect the environment of international technology transfer. In terms of the technology receiver: physical facilities, human competence, appreciation of information, organization structure and technology development climate are the five factors affecting the effectiveness of the process. Stimulating, short-cut, and spillover effects are the positive aspects and high cost, technological dependence, and inappropriate technology are potential negative effects of technology transfer.

Among the three transfer channels, wholly or majority owned subsidiaries reflect the technology intra-flow, in which more or new knowledge flows, but few chances of learning or leakage exist. Joint ventures shows more learning mechanisms for the technology receiver, however the knowledge supply to this channel is limited. Licensing is purely technology flow, but it is based on a flow of royalties or fees from the receiver to the sender. No matter which channel is adopted, two sub-processes are included in technology transfer. The sending process is determined by the order of multiple exploitation of an innovation by technology owners: products exports, then technology exports, then FDI. The assimilating process varies from technology access to technology innovation. The results of unbinding the inward technology are affected by the circumstances and the technology level of technology receivers. Nonetheless, there are two levels of assimilating inward technology--first mastering it, then modifying it, and two steps of unpackaging--first separating it into components then combining them in the local situation.

There are few studies of technology transfer to China through FDI, although the literature on the increase of FDI to China is increasing. Compared with the three previous phases of technology transfers, current technology transfer is characterized by its wide scope, multi channels and FDI playing an important role. Among the studies which are concerned with this issue, Western commentators focus mainly on the supply side instead of the whole process, because of the lack of available data. Chinese scholars have done a series of scattered descriptive studies, because of the lack of international comparison and systematic analysis. The following parts of this thesis aim to bridge the gap by presenting a case study in China based on a systematic survey.

CHAPTER 5. RESEARCH METHODOLOGY

5.0 Introduction

Thus far, the discussion has mainly focused on conceptual or other empirical work. This chapter attempts to bridge the literature investigation and practical study by means of 'problem solving'. First of all, it clarifies the objectives of this study. After that, hypotheses which embody the objectives are set up. Then a framework used to test the hypotheses is designed by combining related theories and some empirical studies. Lastly, it discusses the data gathering and analysis.

5.1 Research Objectives and Hypotheses

5.1.1 Clarification of the Objectives of the Study

In the previous chapters a series of issues associated with the role of technology and its transferability to developing countries through FDI were reviewed. However, a general picture of technology transfer to China through FDI, and a suitable method used to measure the transferability of inward investment in current China do not emerge from the previous studies. This study aims to bridge these gaps by combining an empirical identification and associated method development under one umbrella.

Having outlined the study background, the main objective of the current research, through case study, is focused on analyzing and promoting technology transfer to China through FDI, both at overall level and at component level. This comprehensive objective can be divided into the following sub-objectives:

1. Identifying the impact of FDI on regional technology development. Since technology can be separated from trade and capital (OECD,1988), and foreign investment does not mean technology transfer, the effectiveness of FDI in conducting technology flow varies in regions and periods. So the first priority of this study is to systematically check the results of FDI on promoting technology progress in a host region, in order to show a picture of the contribution of FDI to China's current economic development from one angle.

2. Determining the variables which affect technology transfer. Based on the impacts measurement, the second task of this study is to expose the factors which affect the process of technology transfer through FDI. The scrutinizing of these factors and their combination aims not only to provide a further understanding of the process, but also to reveal the characteristics which make China

differ from other developing countries. This will help to view this process in a broader context.

3. Recommending some policies to enlarge the positive impact of FDI on transferring technology to the host region. The destination of many studies in social science connects with policy issues. This study is no exception. The existing barriers and the new problems raised from technology progress as well as FDI development call for appropriate policies to cope with these challenges and changes. Therefore, the third objective of the research is to analyze the effectiveness of previous policies, and recommend new policies or measures, so that the positive impact of FDI on transferring technology to indigenous firms could be enlarged and the negative ones could be diminished.

5.1.2 Formulation of Six Study Hypotheses

In order to realize the study objectives, six hypotheses are set up.

1. The technological level in FDI is higher than among domestic producers. Among different national origins, Western countries' investment has a higher technology value than other investors. This hypothesis stems from (1) Dunning's (1977) eclectic paradigm which emphasizes that a premium of foreign investment entering another country is its technology advantages over local enterprises, either in the production or organizational aspects; (2) empirical studies such as Frank (1980), Steward (1987), McCalman (1991) that the technology level and transferability of Western investors is usually higher than Japanese; (3) the analysis of Lall (1983, 1989) and OECD (1988, 1989, 1993) that outward investment from newly industrializing countries is mainly concentrated in labour intensive and land intensive activities. In most cases it is modified to lower labor skills in the host country.

2. Among different forms of foreign investment, joint ventures transfer more technology than other forms of FDI. This is based on (1) The technology transfer mechanism--technology sharing offers more opportunities than other channels (UN 1985, 1987; Young 1988). (2) Other countries' experience such as Korea (Yu 1990,) Taiwan, Singapore (OECD 1992, 1993), and Malaysia (Jomo 1992) which demonstrate that joint ventures are more effective to get outside technology than other forms. (3) The Chinese government prefers joint ventures and regards this form as a 'noble' one among all the forms of foreign investment (Oman 1989).

3. Among the foreign investors, manufacturing companies transfer more technology than trading companies and individual investors, and newly set up enterprises are less effective in transfer technology than 'grafting enterprises'. This hypothesis is formed from (1) The analysis of Oman (1989) that enterprise investment is more useful for getting technology than other forms. (2) The reports such as Ma (1990), Wang (1991) that Chinese partners in newly set up enterprises generally lack technological foundation, whereas in grafting enterprises there is a high absorption capability from the local end.

4. Organizational technology is just as difficult as production technology to transfer. Because (1) organizational technology is difficult to identify and is easily ignored by technology receivers, for the identification and appreciation of external technology needs similar circumstances (Rosenburg 1982), and needs internal expertise to be appreciated and absorbed (Mowery et al 1989); (2) the similarity of culture between the host region and overseas Chinese investors makes the involvement level of foreign management very low. (3) The dominance of small firms among FDI itself does not show much advantage in organizational aspects (Hu 1990).

5. Among the components of technology, hardware transplant is easier to conduct than skills and know-how transfer. The reasons for this hypothesis are: (1) The technology value of FDI in the beginning stage is low, and mainly in labor intensive and land intensive. Therefore, there is not much skill and know-how contained in it. Machinery is the main stake of investment (UN 1987, OECD 1993). (2) The absorption of skills and know-how needs a high quality work force pool, which takes quite a long time to build up (OECD 1988,1989,1992,1993). At the current stage, the level of technology in the host region is low and difficult to identify and absorb.

6. During the technology transfer, the open framework of host countries' investment climate plays a more important role than incentive measures alone. This hypothesis is based on the study of OECD (1988, 1993) which concludes that incentives play a minor role in the decision of foreign investors to invest abroad, and investors apply economic criteria only. OECD (1991) another research claims that abolishing or reducing discriminations in the host country is more attractive to FDI than offering incentives.

5.2 Design of the Analytical Framework

In order to test these hypotheses and carry out the research, a case study design is

developed, which is shown in Figure 5-1. In the framework, there are three dimensions: (1) impact measurement; (2) detailed analysis of the process of technology transfer; (3) comparison among different types of FDI firms. The policy issues are interwoven with the three dimensions.

5.2.1 Three Measuring Effects

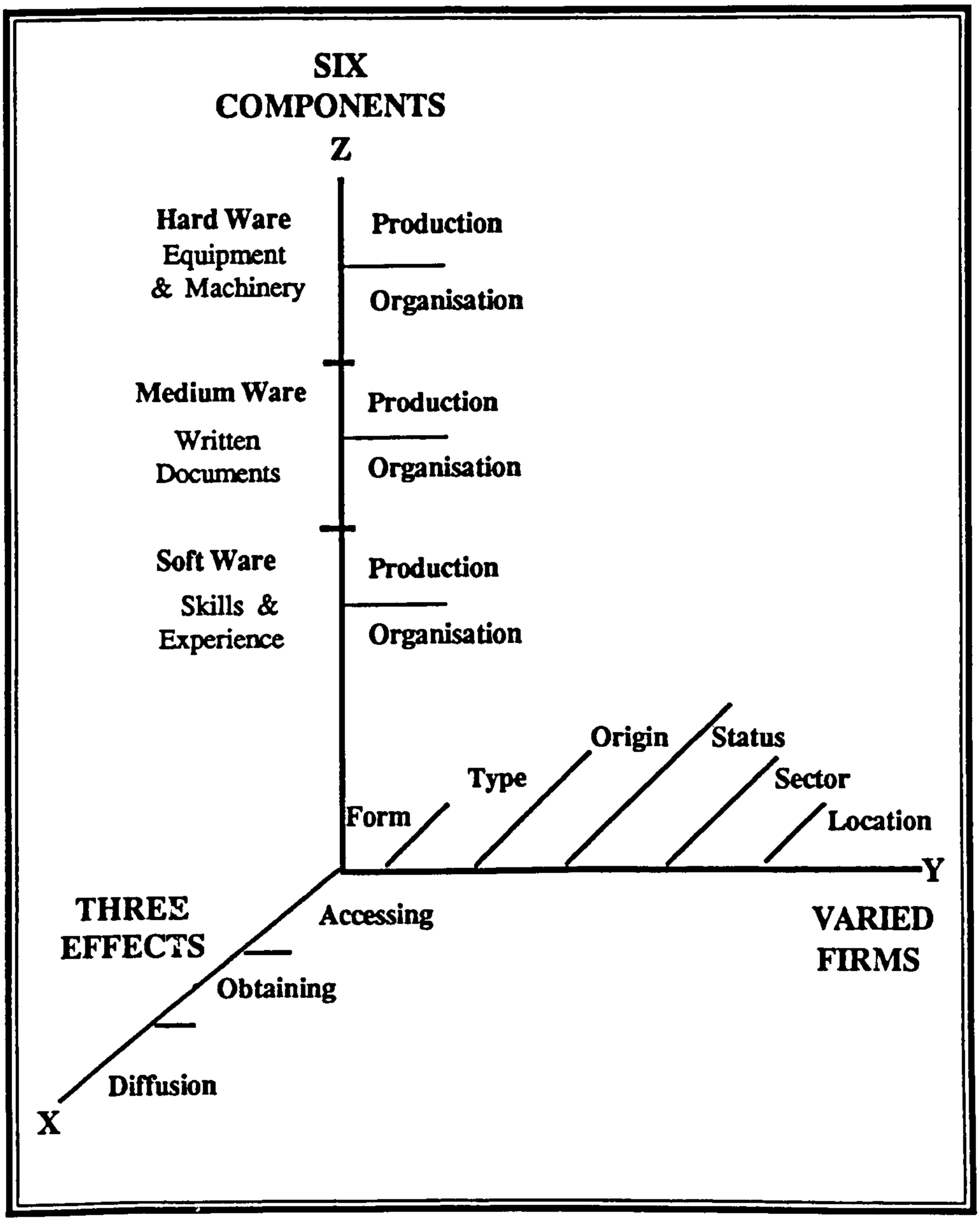
Since the focus of this study is the contribution of FDI to transfer technology to a host region through its local operation, the measurement is designed in terms of its relationship with local firms, and with local personnel. The three effects in the X-axis of Figure 5-1 are used to show this function. They are accessing effect which belongs to indirect measurement; obtaining effect which is a direct measurement; and diffusing effect which measures the associated technology transfer.

Accessing effects are based on the externalities model (TEP 1992) and Dunning's eclectic paradigm (1977). It means that the entry of foreign investment, which possesses certain technology advantages, offers some opportunities for the indigenous firms and personnel to make contact with it. Its local operation with these technology advantages cannot keep indigenous firms from acquiring them to some extent. The more opportunity and the better condition of contact between FDI and local firms, the more technology can be transferred to the host country. Under this idea, the previous measurement of FDI's involvement in the local economy, such as UNCTC/ESCAP (1984), OECD (1987) is used to show the accessing possibility of this contact; while the contact motivations, channels, objectives and fields are used to display the accessing environment. The combination of contact possibility and contact environment forges the accessibility of FDI, or overall potential for technology transfer through inward investment.

Obtaining effect refers to the direct acquisition of technology by local enterprises or local personnel from foreign investors within FDI firms, since most learning mechanisms are tied up with specific projects (Arrow 1962, Rosenburg 1982, Bell 1991). The potential, consequences and process of this acquisition are three foci of the measurement. Technological gap between foreign investors and local partners is chosen to show the technology value of inward investment or obtaining potential. Local partners' leap forward in production and/or in management is designed to show the direct transferability of FDI. The flow of technology at components level is employed to disclose the transfer process and evaluate various learning mechanisms.

Diffusion effect implies the spin-offs of inward technology outside FDI firms through the exchange of materials with indigenous firms or local markets and the

Figure 5-1 CASE STUDY DESIGN



outflow of local personnel. This measurement differs from the obtaining effect in its scope. It focuses on the knowledge trickling down beyond the boundaries of FDI firms. This assessment departs from accessing effect in its contents and method. It aims to assess the flow of technology based on some specific relations of FDI firms, which makes the measurement much more technology oriented and narrower than the indirect measurement of accessing effect. Under this design, previous analysis of forward, backward linkages of FDI (Steuer 1973, Frank 1980, Hobday 1991, Turok 1993), and the multiplier effect resulted from local staff movement (Germidis 1977, Smali 1985, Jegathesan 1990) are located in this associated measurement of technology flow.

5.2.2 Six Components of Technology

The Z-axis of the Figure 5-1 adopts the technological matrix developed in chapter two. In the case study, this matrix will be employed as a tool to explore the technology transfer in component level and test the hypotheses 4 and 5. From the discussion in chapter 2.1.3, we know that the matrix is combined by three knowledge forms: hardware, software, and medium ware; and two knowledge destinations: the application in production and organizational aspects. It is part of the technology ball and closely connected with other parts of technology. A concise explanation about each component is given as follows:

1. Hard production technology. This part is totally embedded knowledge, such as equipment and machinery which is used in production. Because it mainly appears as tools, its transplant can be directly accounted. The function and efficiency of tools are two key indicators to reflect the capability of human beings with his natural environment in certain field. The replacement of them shows the technology progress (Solow 1985). In the study production hardware will be used to measure the technology gap and the change of production capability in the host region.

2. Hard organization technology. As with production hardware, organization hardware is also totally embedded knowledge, and usually takes the form of equipment and facilities. Transport equipment, communication equipment, and other office machinery can be divided into this category. However, there are two points which differentiate it from the former. First it is mainly used for dealing with the non-production relations inside and outside enterprises, so it is common instead of special equipment. Secondly, some of them possess dual functions and can be used both in production and in organization. In the case study, we will use this component to show the change of technological infrastructure and the adoption of new organization forms in the host region.

3. Medium production technology. In this category, knowledge has to be embodied into documents but not yet embodied into machinery, so it exists in the form of "medium ware" such as designs, plans. Therefore, it can be transferred independently or associated with the other two knowledge forms. Because this component is the fruitful result of systematical exploration for natural secrets which aims to provide new products or new processor improve the existed ones, it serves as a door to enter a new production field, and becomes a key part of technology competition in current world. During the survey, this component is used, on the one hand, as the index to measure the transferability of technology; on the other hand, it is employed to show the characteristics of process of technology transfer. For the hard orientation of it can form tools to realize the special relation, and for the soft orientation of it can germinate innovation skills.

4. Medium organization technology. This part is also documents which result from the recognition of human relations, and result in the limitation of human behavior. It not only sets the pattern of human relation, but also determines the method to forge the pattern. Constitutions, charts, rules, regulations, agreements, etc. are under this heading. Organizations are also belong to the category, because the formation of any organization is the process of formulating associated documents. When you access or acquire these documents, undoubtedly, you get a passport and a visa to enter the structure. In the study, we aim to show the trend of organization technology transfer by this component.

5. Soft production technology. This is a kind of knowledge reserved within the human body and deals with the relations between the human and its natural environment, such as experience and skills accumulated in the process of production. It can be divided into two types. One is maintaining skills which handle routine problems including familiarity with the environment such as tools and quick response to them. The other is innovation skills which deals with the non-routine problems including exploring, testing, and formulating new relations between people and the natural environment. Different trades reflects different aspects. But formal training is the main channel to transfer this kind of knowledge.

6. Soft organization technology. This means experience and skills in dealing with human relations, such as management, public relations, marketing, finance. etc. This knowledge can also be divided into two types. One is daily working skills which reflect familiarity with necessary laws, charts, rules, and regulations, handling associated situation, and joining related activities. The other is the skill to recognize the new relations between human beings in changing backgrounds, and

designing new methods to cope with the change. Both formal training and informal personal contact will be checked in this category in the survey.

5.2.3 Six Comparative Angles

Along the Y-axis in Figure 5-1 there are several criteria chosen to compare the operational characteristics of FDI, especially in technology transfer. This dimension intends to show the deviation of FDI operation within the framework set up by X and Z axes, and most hypotheses formulated in the last section are contained in these fields. These criteria can be divided into three groups and six angles. In the group of FDI origination, national origin and investors' statues are used; in the group of FDI destination, sectoral distribution and spatial distribution are chosen; and in view of cooperation characteristics, ownership form and enterprise attribute are two indexes.

1. Ownership comparison. Recall the results obtained in chapter three that different ownership shows different technology transfer mechanisms (UN 1985,1987), and hypothesis 2 that joint ventures transfer more technology than other FDI forms. This comparison aims to identify the differences between different ownerships, and outlines the changing trend.

2. Firm attribute comparison. In addition to ownership, the attribute of FDI firm--newly set up firm or grafting firm--is also an important factor affecting the operation of FDI in China. This difference can be reflected in two opposite ways. One is the higher capability of absorbing production technology in grafting firms than in newly set-up firms, as stated in the hypothesis three. The other is that more barriers exist in grafting firms than in newly set-up firms, so for the latter it is easier to adopt foreign management style than the former (Lee 1991). So the deviation of capability of absorbing technology will be shown in this comparison.

3. Nationality comparison. The comparison of FDI national origins has been an interesting topic among the international business studies (Vernon 1981, Marton 1986, Lall 1983, Dunning 1988, Buckley & Casson 1991). Hypothesis one of this study presumes that there are significant differences between source countries. It will be checked not only in technology transfer but also in the other aspects of FDI in this study.

4. Investor's status comparison. The special situation in current China--that quite a few investors are not "real" ones--makes the status of investor an important factor affecting technology transfer, so it is chosen as a criterion to compare the origination of FDI, and to test hypothesis 4. The results of this analysis may

reveal the different behavior model among three main status: companies with manufacturing, trading companies and individuals.

5. Sectoral comparison of FDI. As Buckley & Clegg (1991) state the sectoral and industrial distribution of FDI into the local region is itself indicative of the state of economic and technology development. The examination of FDI among different industries in the host region, comparing with the discussion in Chapter 4 on high technology and standard technology industries, will expose the sectoral deviations of FDI in the host country.

6. Regional comparison of FDI. Although the case study intends to cover only one city, it aims to choose a reference region in which three types of investment areas can be included within its territory: newly set up economic development zone; old city center with a comparatively sound technological foundation; and comparative backward rural area. Comparing the distribution of FDI in these areas, on the one hand shows the spatial structure of FDI; on the other hand, it examines influence of various factors, especially the effectiveness of incentives. The latter, undoubtedly, lays down a foundation of formulating new policies and measures.

5.3 Gathering The Research Information اختيار المدينة للدراسة

Attempting to use this framework in China to check the current transferability of FDI, Dalian city was chosen as a reference region. It is one of 14 Chinese open coastal cities, and is located in Northeast China. Nearly a hundred years ago, inward investment from Russia and Japan launched its construction. The excellent harbour conditions combining with a huge hinterland of three provinces in Northeast China have facilitated its development in this century. At present, as one of the forerunners in adopting an openness policy and number one destination of Japanese investment, Dalian offers a good opportunity to check the transferability of FDI and its deviations among various national origins. The next chapter will give a more detailed description of Dalian's economic condition.

5.3.1. Secondary Information جمع البيانات

المجلات ، الكتب ، التقارير ، كتب غير مطبوعة / جهة اصدارها

1. Two sources of secondary information. There are two sources of secondary information in the case study: One is books, magazines, newspapers, and published books of statistics; the other is various reports and unpublished books of statistics. The former is public knowledge, and the latter is usually confidential.

Among the first category, there are only a few books about the reference region. One focuses on its geography. Some concern its history. The only one which gives a comprehensive introduction to its economy is "Dalian" published in 1989. The situation of magazines is better than books. In the reference city there are several magazines dealing with the problems of local economy. One is called 'Dalian Economic Study'. Another is 'Dalian Finance'. The third one is called 'Dalian Foreign Trade and Economy', but it did not survive more than a year when it was launched in 1987. Besides the local magazines, there are several national magazines in which technology transfer in the study area is discussed. The most important one is called 'International Economic Cooperation'. There are two newspapers in the reference region. One is 'Dalian Daily' with more than 40 years record. The other is a new one, and is called 'Paper of Development Zone'. It has evolved along with the development of the new town, and now is issued once a week. As with other regions, published books of statistics about the reference region are few. However, general data can be found in some national books of statistics, such as 'Chinese Statistics Yearbook', and the 'Chinese Urban Statistics Yearbook'. From the above sources, the context of Dalian's economy, the general trend of FDI inflow and some information about particular FDI projects can be obtained.

The second resource is more important for collecting research information than the first channel. It consists of various reports, such as surveys, annual reports, planning proposals and unpublished books of statistics. These documents come from government departments or enterprises, and are circulated among the different departments of government. They serve as references or regulations for making policy or implementing policy. The documents which are more connected with this study are those produced by (1) Center for Social and Economic Development; (2) Office of Policy Research; (3) Committee of Foreign Economic and Trade; (4) The Management Center for Foreign Funded Enterprises. The Statistics Bureau, as a data centre, produce more unpublished books of statistics than published ones. Among them the most popular one is called 'Dalian Statistics Yearbook'. However, accessing these documents is difficult in most circumstances.

2. Three functions of secondary information. The importance of secondary information to this study is shown in the following aspects: (1) It not only gives a general picture about the reference region, but also provides clues to understand the operating characteristics of FDI in the area. Through gathering and analyzing the secondary information, the physical conditions, development history, and economic structure, and investment environment of the reference region become more familar. At the same time, some explanations of its deviation from the Chinese

economy, especially in relating to FDI, such as dominant Japanese investment, high level FDI involvement, high export ratio, have also emerged. (2) It reveals some important facts which are helpful to refine the research focus. For example, examining the secondary information, especially various reports associated with foreign investment, the low level of high technology entry of FDI, and high ratio of loss makers among Japanese investment are emerged. The information suggested certain important lines of inquiry. (3) It provides some valuable data. In addition to the data appeared on published and unpublished statistic books, there is important information contained in articles or reports. These data, characterized by authority, are difficult or impossible to get by individual investigation. For instance, the changing of export structure (Table 7-7), the contribution of FDI to taxes and other aspects (Table 7-9 to 7-11) are produced from these data.

3. Four limitations of secondary data. There are also several limitations of secondary information. The first is that it is unsystematic. Secondary information embraces a wide range of sources. It has various origins. The different agencies, varied standpoints, nonstandard criteria and different orientations make secondary information scattered. Some data is incompatible. For example, there are two figures about the number of FDI projects until the end of 1991, one is 813 and the other is 770, both coming from official bodies, and it is difficult to explain the difference.

The second limitation of secondary information is the lack of focus on technology transfer. The reasons for limited information or research on technology transfer are: (1) Technology transfer itself is quite a new issue. As Ball et al (1993) said the term technology transfer is only widely known by Chinese in the recent years. Until now, there has been no an agency to deal with the issue. (2) Most enterprises have not recognized the importance of technology transfer through FDI, because the separation of production from technology development is the case for most Chinese firms (Under the planned economy, most enterprises obtain technology from associated research institutes instead of developing it by themselves). Therefore, many managers in the enterprises do not care about research and development. (3) The lack of international comparison keeps some researchers from systematically exploring the issue, although they have recognized the importance of this issue and carried out some studies, such as Liu (1988, 1989) and Ma (1990, 1992).

The third limitation comes from the quality of information itself. In China, official statistics, especially the statistics about FDI, as Walker (1993) comments, are invariably accompanied by highly optimistic official intepretation. Most information is positive, and few sources reveal negative aspects. Therefore, they may exaggerate the size of the capital inflow.

The fourth limitation results from the gathering of secondary information. Secrecy is another tradition of China. It is very difficult to access some basic data such as the total sales of enterprises. Foreign people and corporations are also very confidential about their information. That makes it very difficult to get satisfactory data to support this research.

5.3.2 Postal-Questionnaire

Since the secondary information was only sufficient to set up the context of the research, and provide partial data for analysis, collecting first hand information was called for. Two methods were undertaken to get primary data. One was postal questionnaires. The other was face-to-face interviews. The aim of the former was to get a general overall picture about the features of FDI in the reference area, and the transferability of technology through their operation. The objective of the latter was to obtain more detailed information about each component of technology transfer and the external relationships of FDI firms.

1. Scale. Firms in China have not got used to postal-questionnaires which are undertaken by academic persons, especially when the questionnaire is sent in the name of an individual or other unofficial organization. Under these circumstances, getting support from a higher authority is essential. Fortunately, I found one local authority which could offer some help (Confidentially not to mention it). However, the number of questions and the type of question in the questionnaire had to be limited, if the questionnaire was to be sent in its name. After re-designing the questionnaire, it was randomly sent to 500 FDI firms which are in manufacturing (or production firms in Chinese), according to a list of FDI firms compiled by Dalian Committee of Foreign Economy and Trade. 361 postal-questionnaires were sent back. This is a highly satisfactory rate of return (72%).

2. Contents. Within the limited space, the questionnaire was designed, following the idea of Y-axis in figure 5-1, to get the following information, as shown in appendix I: (1) The origin of FDI, eg. its nationality, and its status. (2) The destination of FDI, both in regional destination and sectoral destination. (3) The characteristics of FDI which include the scale of investment, the motivation of FDI, the market orientation, the operating situation, the cooperation years, etc. (4) The characteristics of the Chinese partners in the FDI firms. The origin of the Chinese partners, their motivations, and their capability to absorb technology. (5) The technological transferability through FDI, such as the technology gap, technology transfer level, and the contents of transfer. The answers to these questions are crucial

in measuring the direct transfer of technology.

3. Results. The biggest advantage of the survey by postal questionnaire is getting some information which is difficult to obtain or which has not been collected by others before. That makes this study specific and more focused on technology transfer. Another benefit of postal-questionnaire survey is the wide data range, because the questionnaire is large scale and high return, and the answers came back from the various types of firms. The third one is that the data is systematic and it is easier to carry out comparisons.

However, there are also some problems with the postal-questionnaire survey. First the number of questions in the questionnaire was limited, and 'the less the better' is the principle which had to be followed. Secondly, the sort of questions was also restrained. The questions involving quantitative answers could not be asked, except for the level of investment. The questions which the authority regarded as sensitive were also excluded.

5.3.3 Face-to-Face Interviews

In order to compensate for the shortcomings of the postal-questionnaire, face-to-face interviews with some FDI firms were undertaken.

1. Scale and structure of sample firms. Interviews are exciting and time consuming, so a trade-off between the desire for particular information and an acceptable level of time and money consumption was put forward. By the end, 36 FDI firms in manufacturing were interviewed, which are listed in Appendix II. The criterion for choosing the sample had a bias towards the firms with positive reports of technology transfer in the postal survey (high and medium transferability). At the same time, it also intended to include different types of FDI firms in the sample.

Following the two principles, the structure of sample firms, shown in Table 5-1, possesses two characteristics: First, for the criteria that technology transfer shows big differences, the emphasis of the interview is put on the firms with high technology transferability. For example, in terms of ownership, joint ventures were in the majority; in terms of investors status, manufacturing companies accounted for 67%; in terms of location, FDI firms in the old city ~~was~~ accounted for 58% of sample firms. Secondly, in other cases the samples are kept to show a more representative structure, such as in investors' origin, FDI firms setting up date, etc.

Table 5-1 Choice of Interview Samples

Choice \ Criteria \	Sample Firms Distribution No.(%)			
FDI Forms	Joint Ventures	Cooperation	Wholly Owned	
	27(75)	5(14)	4(11)	
FDI Origin	H.M.T*	Japanese	Western	
	14(39)	10(28)	12(33)	
Investors' Status	Co. with Manuf.	Trading Co.	Individual	
	24(67)	7(19)	5(14)	
Setting Date	<=1988	1989	1990	1991
	9(25)	9(25)	8(22)	10(28)
Attribute of Firm	Grafting Firm		Newly Setting Up Firm	
	15(42)		21(58)	
Sector	High Technology**		Standard Technology	
	15(42)		21(58)	
Location	Old City	New Town	Suburb	
	21(58)	12(33)	3(9)	
Technology Absorbing Capability	High	Medium	Low	
	21(66)	9(28)	2(6)	
Technology Transfer	High	Medium	Little	
	16(44)	16(44)	4(12)	

* H.M.T means Hong Kong, Macao and Taiwan

** High Tech Include Electronics & Electrical, Chemical, and Pharmaceutic. Other sector belongs to Standard Technology

2. Contents and Objectives. The interviews with FDI firms were designed to get information on the following three aspects: (1) How is technology transferred at component level? Under this title, the contents of every component; whether the technological gap existed and diminished in the cooperation; the stimulus of the transfer of this component to local firms and local personnel; the methods of transferring this component; the barriers to get or absorb this technology were enquired into. (2) How strong are the forward and backward linkages of FDI firms? In this category, the possible spin-offs of FDI firms; the structure of forward, backward linkages and staff movement; the contribution of outside relations of FDI enterprises to the host region; the problems among associated technology transfer are raised in the interview. (3) How effective are current policies? In this group, the challenges and opportunities in the cooperation; the complaints and demands; the

trends and suggestions were the topics of discussion.

Since the interviews covered specific topicsof technology transfer and a wide range of questions, the interview aimed to consult both general engineers and general managers of the firms, because the former were familiar with the issues of technology, and the latter were concerned with the whole situation and were more sensitive to the policy issues. However, in order to collect more information and get a thorough understanding of certain problems, sometimes an interview in a firm consisted of several discussions with different people.

3. **Advantages and limitations.** Based on the postal questionnaire, the interviews carried out in the FDI firms further enquired about the transferability of FDI into the reference region at the present stage, which reflects the following aspects. First, it provides more specific information for technology transfer through FDI. For example, the picture of transferability of inward technology at component level was outlined. Secondly, it connects technology transfer with other issues of FDI local operation, such as exports, local personnel movement. Thirdly, it checks the answers of postal questionnaire, and finds out if there are differences between the postal questionnaire and interview answers. For instance, the structure of transferability in the 36 interviewed firms was high 15 (43%), medium 12 (33%) and low 9 (24%), while in the answers of postal questionnaire was high 16 (44%), medium 16 (44%), and low 4 (12%). Because in over half cases the interviewee was not the person who filled the questionnaire, it is difficult to justify the difference.

There are also problems raised from the interviews. First many interviewees were reluctant to answer some questions especially in management aspects, because (1) there are some events in the firm connected with defective or unlawful behavior, such as corruption. (2) Competition between firms made them tend to keep secret about technological information, as well as other information. (3) They did not trust a student who at present is studying abroad. (4) They regarded the interview as useless for them, for they thought they could not get any benefit from it.

The second problem with the interviews was that some interviewees did not know the answers to questions. During the transition from a planned economy to market economy, the old order of social and economic system was broken. A new one has not yet been established. Everyone is looking for a new position in the transformation, no matter in state owned enterprises or in FDI enterprises. During the process, people tend to keep hold of anything they can occupy: power, relations, material and information. The current enterprise culture of China forged by this situation is one of the high monopoly of power, as well as information. Usually, only

a couple of people in the firm have access to the information we needed. Unfortunately, most of them belong to the category of reluctant speakers. So it was a paradox of the interviews: people who possessed the information did not want to talk, and people who were cooperative could not provide useful information. The lack of concern about technology transfer also made some interviews difficult to get useful results.

In addition to the interviews carried out in FDI firms, other face-to-face interviews were also undertaken in the case study. The interviewees included local officials, local scholars, local professionals and foreign bankers, as shown in Appendix III. The objectives of this type of interview were two. One is to obtain various secondary information which is scattered in various departments of local government. The other is to obtain ideas about the impact of FDI on Dalian's economic and social development from different angles.

5.3.4 Information Processing and Analysis

The information gathered in the field work shows four characteristics: First its wide scope. It is not limited to the category of technology, but involves economic and other aspects. The second is the novelty of some information, such as the technological gap, the usage of former imported machinery by FDI is neither listed in the books of statistics, nor tackled by other literature. The third is that qualitative data is dominant. Although there are some quantitative data such as investment, cooperation period, exports etc., it is not enough to carry on systematic quantitative analysis. The fourth is that some discrepancies in the information are difficult to justify. For instance, the technological transferability in postal-questionnaire is bigger than in the interviews, but an adjustment is difficult to make.

In the circumstances, this research is mainly based on qualitative analysis. The comparison between answers in different firms in the same category is used to reveal the differences in various situations. All the data analysis was done in Minitab, because this software is more convenient to put in data than SPSS, and is more effective than Lotus-123 in some operations. But it also raises a problem. Minitab is not good at analysing discontinous variables. So, it is difficult to do further statistic analysis.

Information collected from the two sources, after processing, is presented as following: Chapter 6, a concise introduction to the reference region, relies on the secondary data and other interviews. Through the various comparisons with national average levels, the features of this area are explored. The analysis of the involvement

of FDI in the reference region, which is the first half of chapter 7, is conducted by calculating unpublished statistics and data scattered in various reports. The revealing of the characteristics of FDI in Dalian, which is the other half of chapter 7, combines the analysis of the postal questionnaire and published & unpublished statistics. In chapter 8-9, the measurement of obtaining effect and diffusion effect analyses are based on two types of first hand data. The policy examination and suggestions in chapter 10 not only used the information gathered in the case study, but also used the information drawn from the literature review.

Summary

Measuring and enlarging the contribution of FDI on transferring technology to a host region are the objectives of this study.

The hypotheses of this study stem from two aspects. One is the recognition of differences between the technology supplier and receiver, between different foreign investors, between different FDI ownerships, and between different host region policies. The other is the identification of the contents of technology, which shows different structuresat various standpoints. However, knowledge forms and knowledge destinations are common in any field. The combination of them form a technology matrix.

The framework of the case study shows three dimensions. First, it consists of three measuring effects which attempt to evaluate technology transfer in three ways: direct measurement--knowledge flow within FDI firms; indirect measurement--overall technology transfer potential; and associated measurement--knowledge flow outside FDI firms. Secondly, it adopts the technology matrix developed in Chapter 2, by which the technology transfer will be analyzed at component level. Thirdly, it includes a series of comparisons. Therefore, the various variables which cause the deviations of FDI operation, especially in transferring technology, can be checked systematically.

The novel design calls for associated data. Two methods are employed to get specific information. The data gathered from large scale postal-questionnaire is used to show the overall transferability of FDI. While data collected from various face-to face interviews contribute to the detailed analysis of technology transfer. Dalian city, one of 14 Chinese open coastal cities, was chosen as a reference region, because it offers a good location to compare the technology transferability of FDI among different national origins and sectoral and spatial destinations. The next chapter will focus on the characteristics of this study area.

CHAPTER 6. DALIAN CITY

6.0 Introduction

This chapter outlines the natural and economic conditions as well as the investment environment of Dalian City--the reference region of this study. It consists of three parts. Section one is a brief introduction to the geography and history of Dalian. Section two aims to reveal the characteristics of Dalian in China's economy by comparing the main economic indicators between Dalian and the average level of China. Section three analyzes the current investment climate of Dalian.

6.1 Dalian Survey

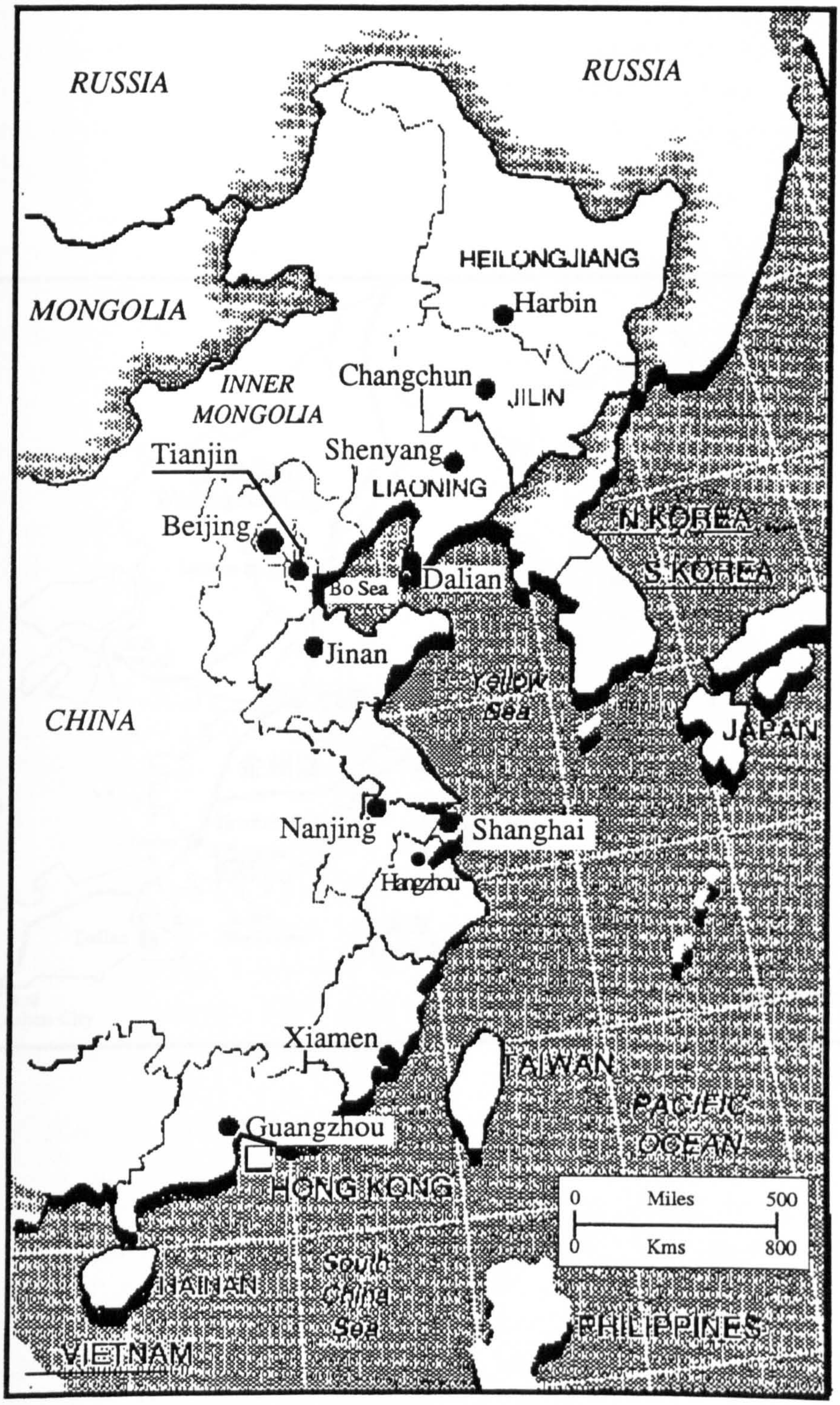
6.1.1 Location of Dalian

Dalian, as shown in Map 6-1, is located at the southern tip of Liaodong Peninsula between 30 43' and 40 10' north latitude, and between 120 58' and 123 31' east longitude. Dalian faces the Yellow Sea on the east and the Bo sea on the west. Opposite to the south is the Shandong Peninsula. Dalian is connected with northeast part of China in the north, and is a hub of sea transportation for three provinces in northeastern China and Inner Mongolia Autonomous Region to East China and South China as well as all over the world.

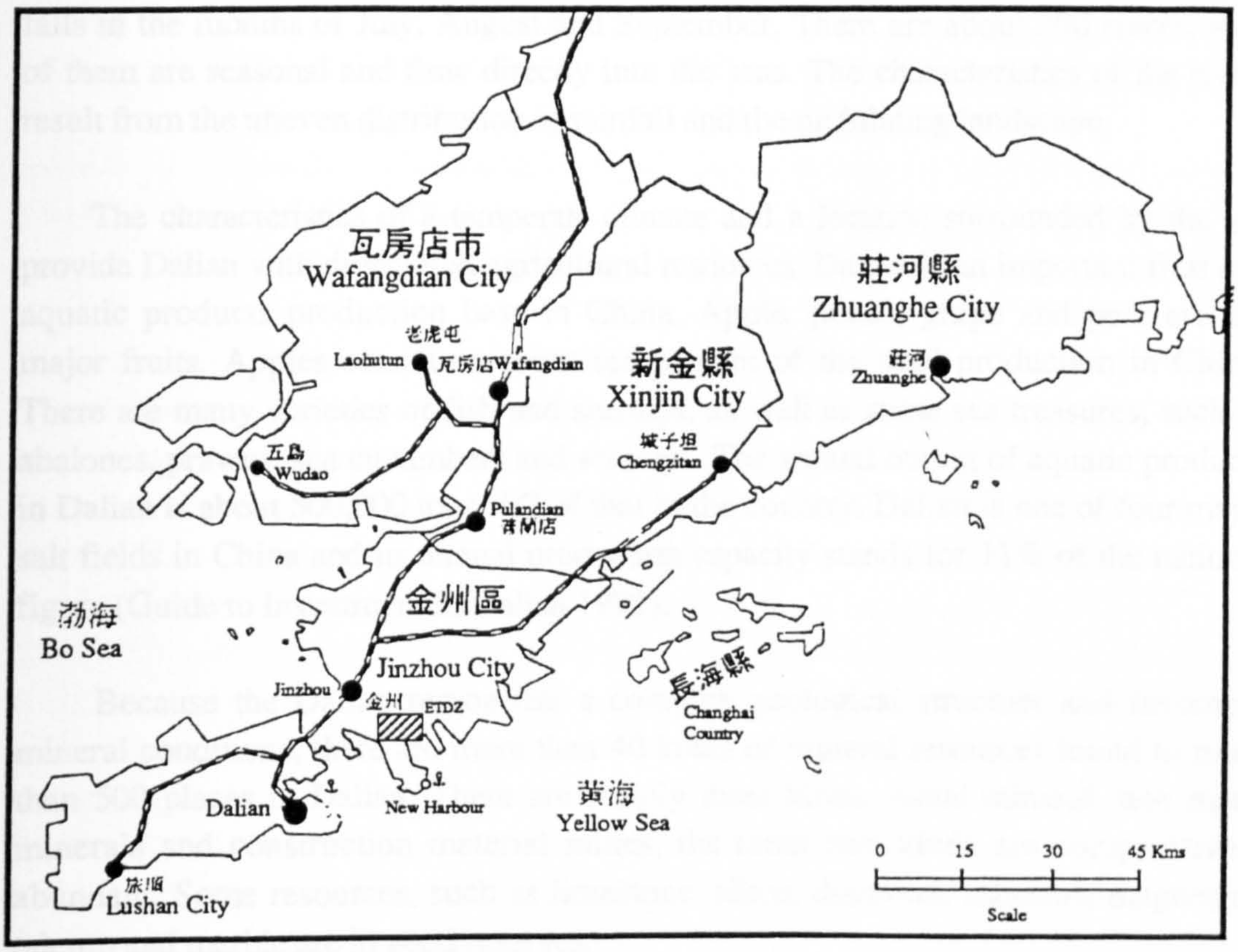
Dalian covers a total area of 12,574 square kilometers. Of this the urban region is 2,414 square kilometers. The major landform of Dalian are the hills of fifty meters above sea level and odd pieces of coastal plains. The shallow sea area (within 10 meters.) in Dalian region is 340,000 hectares. The coastline is 898 kilometers long and the sea beach area is about 600 square kilometers. There are 704 islands scattered in the Yellow sea and the Bo sea.

At present, Dalian has four districts, one county, one Economic and Technology Development Zone (ETDZ) or new town and five municipalities under its administration, as shown in Map-2. The population of Dalian at the end of 1991 was 5,199,500, of which 2,415,600 are urban population. The urbanization ratio in Dalian is 46%, which is nearly twice the national level (China Urban Statistics Yearbook 1991).

Map 1. Location of Dalian City - Case Study Area



Map 2. Map Of Dalian City



6.1.2 Natural Conditions and Resources

Dalian has a continental and oceanic climate in the north temperate zone. There are neither bitter cold days in winter nor extremely hot weather in summer. Dalian has four clearly distinguishable seasons and pleasant weather with an annual average temperature of 10 C and 180-210 frostless days. The annual average sunshine time is 27,000 hours.

The precipitation in Dalian is between 700-900 mm annually, and two thirds of it falls in the months of July, August and September. There are about 200 rivers, most of them are seasonal and flow directly into the seas. The characteristics of the rivers result from the uneven distribution of rainfall and the undulating landscape.

The characteristics of a temperate climate and a location surrounded by the sea provide Dalian with diversified agricultural resources. Dalian is an important fruit and aquatic products production base in China. Apple, peach, grape and pear are the major fruits. Apples constitute about ten percent of the total production in China. There are many varieties of fish and shrimps, as well as some sea treasures, such as abalones, prawns, sea cucumbers and scallops. The annual output of aquatic products in Dalian is about 500,000 tons, 1/7 of that in the country. Dalian is one of four major salt fields in China and its annual production capacity stands for 11% of the national figure (Guide to Investment In Dalian 1991).

Because the Dalian region has a complex geological structure and favorable mineral conditions, there are more than 40 kinds of mineral resources found in more than 500 places in Dalian. There are mainly three kinds: metal mineral, non metal minerals and construction material mines, the latter two kinds are comparatively abundant. Some resources, such as limestone, silica, diamond, asbestos, magnesite, talcum and marble are in good reserves.

6.1.3 Harbour and Hinterland

Dalian Port, is presently the second biggest seaport in China, with deep water and special operation areas, ice and silt free all year round. After more than 90 years construction especially in the last four decades, the annual handling capability is over 50,000,000 tons. Table 6-1 shows the increase of cargo and passengers handling capability from 1952 to 1991. It is apparent that within 40 years the capability increased more than 50 fold. By the end of 1991, there were 58 berths for crude oil, oil products, coal, timber, and sundry goods. Among them 28 berths are above 10,000-ton-class, and maximum 15,000-ton-class oil tankers can be berthed at the

crude oil terminal (Dalian Statistic Bureau 1991).

Table 6-1 Chronology of Dalian Port of Cargoes & Passengers Handled

Year	Cargoes (1,000) Ton	Passengers (1,000) Person	Year	Cargoes (1,000) Ton	Passengers (1,000) Person
1952	1060	300	1975	22880	1360
1957	5950	730	1980	32630	2170
1962	7900	1830	1985	43810	3340
1965	10670	650	1990	49520	3190
1970	15140	1050	1991	54720	3710

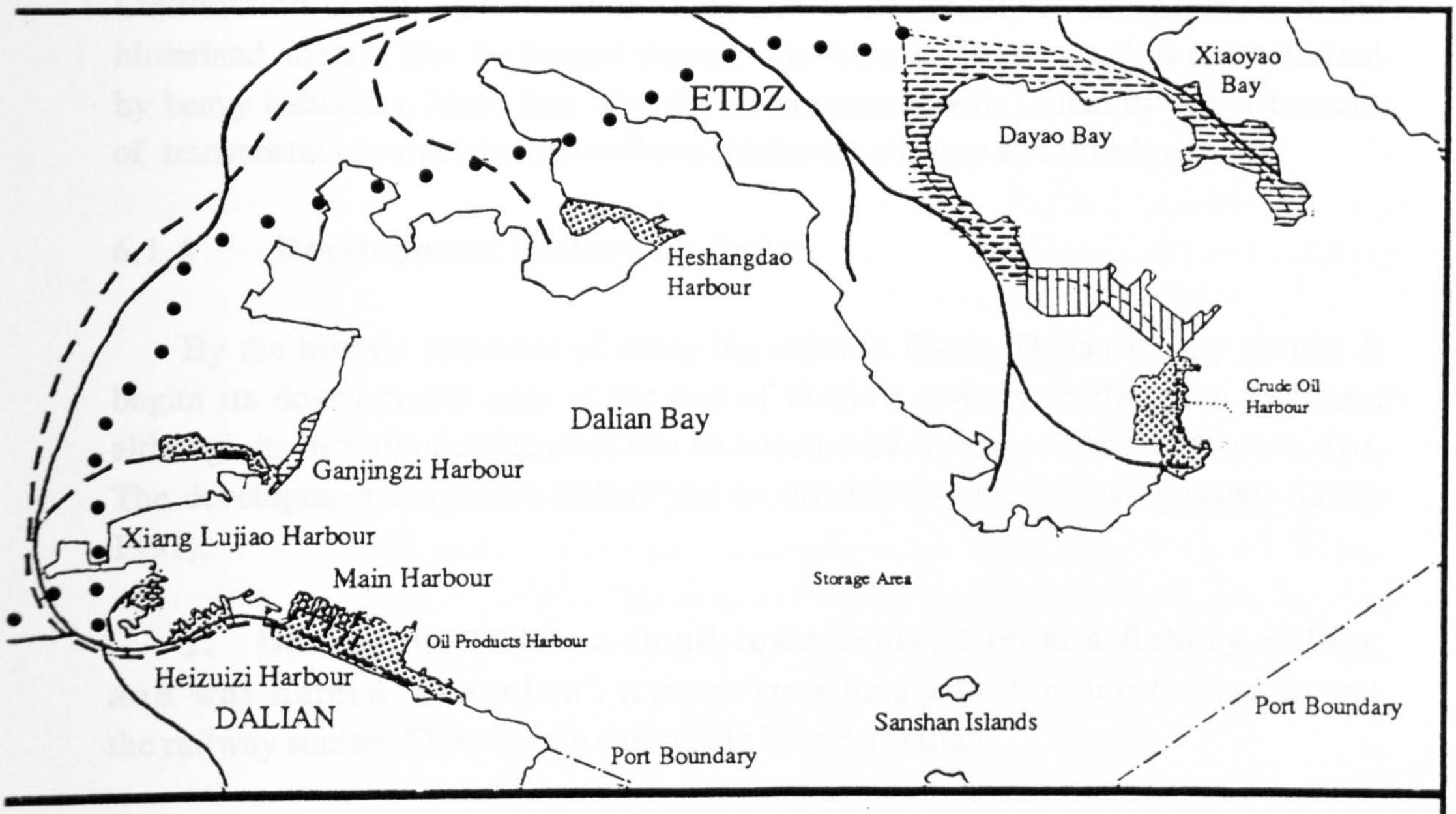
Sources: 1. Dalian Port 1899-1989.
2. Statistics of Dalian 1990, 1991.

Map-3 displays the structure of Dalian Port. It consists of two parts. One is around Dalian Bay. The other is around Dayao Bay. The former is an old harbour. Now it has 56 berths with an annual handling capacity over 40,000,000 tons. Da, Ganjinzi, Heizhuizi etc. are main harbors with 26 berths above 10,000-ton-class. The latter is a new harbour and most of it is under construction or plan. At present, only two berths are in operation. One is 50,000-ton-class, and the other is 100,000-ton-class, with a total annual handling capacity of 16,000,000 tons. Because of its natural condition, Dayao Bay harbour at present is designated by the State Council as a key project for an international deep water transfer port in the year 2000. According to the national plan, 91 berths will eventually be built with an annual handling capacity around 80,000,000 tons. The first phase of ten berths' construction of Dayao Bay is underway. Four of them (two above 30,000-ton-class container berths and two 25,000-ton-class multi-purpose berths) were put into operation by June,1993 with annual handling capacity increase of 16,000,000 tons (Planning Department of ETDZ 1992).

As the most important sea outlet of Northern China, Dalian Port has a huge hinterland. It either includes three provinces of Northeast China: Liaoning, Jilin and Heilongjiang, and covers the East part of Inter Mogolia (refer to Map 1). The total area of hinterland is about 1,241,000 square kilometers with a population of more than 100,000,000, which stands for over ten percent of China (Gong, 1991).

Within the hinterland, there is an abundance of natural resources. More than half of the oil resources in China is in the area. The resources of iron, coal, timber stands for

Map 3. MAP OF DALIAN PORT



about one fouth, one tenth, and half of China's storage respectively. The combination of rich natural resources and the long term development makes this region the most important heavy industrial base in China. At the end of the 1980s, its output accounted for 52% of national output in crude oil, 48% in timber, 35% in cement, 28% in motor cars, 17% in electricity, 17% in machine tools, and 16% in coal. It is also a production base for corn (maize), soybean, and sheep in China. The total output of the area was 13 % of China's total output in 1990 (Liaoning Province Commission of Foreign Economic Relations & Trade, 1991; Gong 1991). In the hinterland, there is also the biggest metropolitan zone in China, which is characterized by heavy industries. More than 60 cities are connected with Dalian by various means of transportation which include railway, highway, airways and tube lines.

6.1.4 Development History of Dalian

By the historic standards of many big cities in China, Dalian is very young. It began its development only at the end of the last century in the Qing Dynasty, although its history of civilization can be traced back to several thousands years ago. The development of modern Dalian can be divided into the following stages (Gong 1991):

1. **During the 1880's a small town evolved from a fishery village and was named 'Qingniwa'.** It means green mud pool. Now it is the area around the railway station. This was the embryonic Modern Dalian.

2. **Russian colony 1897-1905.** It was Russia that launched the large scale construction of Dalian. After a short occupation by Japan, in 1897 Russia set up a province called 'Guandong', which means east gate, in the Dalian area. In 1899, Russia began the construction of Dalian Port and the associated infrastructure of the city. In the same year they announced the port as being a free trade port and gave the city the name of Dalian. Under the free trade policy, Dalian Port and City grew very quickly. Until 1903, along with the completion of Dongqing Railway which connected Dalian with Russia, Dalian developed into a hub of land and sea transportation between Asia and Europe. In that time, Dalian port ranked No.1 in far East Asia.

3. **Japanese colony 1905-1945.** Japan occupied the area in 1905 and treated it as a state--'Guandong' following the defeated Russia in the war of Japan and Russia (from Feb. 1904 to May 1905). They divided the state into three districts: Dalian, Lushui and Jinzhou and carried on a strict colony ruling. During that time, Dalian Port was declared a free trade port for the second time, and Da harbour,

Heizhuizi harbour, Shiergou harbour were successively built. In 1940, the annual handling capacity of the port was 12,000,000 tons. At the same time industry developed along with the construction and extension of the harbour, railway and highway. The activities were mainly in mineral exploitation, machine repair, construction materials, chemical, textile and food processing etc. In 1943, there were 1800 firms in Dalian. Total output was 527,000,000 (RMB 1970 price), of which heavy industry was 69%.

4. 1945-1984 planned economy stage. Dalian has been treated as an important heavy industrial base and outward gateway of Mainland China since the surrender of Japan on August 15, 1945. Under the planned economy, although other infrastructures were ignored, harbour construction was emphasized. In addition to the repair and expansion of old harbors, Nianyuwan and New harbors were built and put into operation. Annual handling capacity increased 50 times in forty years.

Dalian industry experienced a rapid development in the 1950s. Most factories, science & technology institutes, as well as higher education in Dalian were formed during that time. By the end 1983, Dalian had about 2800 industrial enterprises employing 620,000 people. The total industrial output was nearly RMB 10 Billion. The main sectors were machine building, metallurgicals, petrochemical, and building material industries. (Dalian Commission of Foreign Economy & Trade 1986; Dalian Policy Research Office 1985).

5. Outward development period. Since 1984 Dalian has entered a totally new development stage. Although China adopted an 'open door' policy in 1979, it did not bring obvious changes to Dalian until 1984, because Dalian's economy was inward-oriented and closed before that time. Dalian Port was only an outlet of the national economy and did not connect with the local economy directly. In the spring of 1984, Dalian was designated by the state council as the first of 14 coastal cities opening to the outside world, and was permitted to set up an Economic & Technology Development Zone (ETDZ). After that, Dalian was granted a separate budget directly in the Central Planning Committee and enjoyed the power to do foreign trade independently. Since then, a series of devolution and "open door" policies have provided Dalian with more opportunities to contact with the outside world and transfer its economy into a market economy.

6.2 Characteristics of the Dalian Economy

6.2.1 The Weight of Dalian in China's Economy

Table 6-2 Ratio of Dalian To China In Main Indicators (1990)

Items	A.Dalian	B.467 Cities*	C.=A/B(%)
Land Area (km)	12574	2681891	0.47
Population (1,000)	5180	717260	0.72
Total Employees (1,000)	2650	370540	0.72
The Primary Sector	850	188930	0.45
The Secondary Sector	1110	104410	1.06
The Tertiary Sector	700	77190	0.91
The Self-employed	64	5530	1.16
GNP (RMB Bn.)	14.8	1141.3	1.30
Agriculture	2.7	325.7	0.83
Industries	8.7	584.0	1.49
Light Industry	3.3	271.7	1.22
Heavy Industry	5.4	312.2	1.73
Construction	1.0	68.3	1.46
Communication & Transportation	1.3	53.5	2.43
Retail & Wholesale	1.1	109.8	1.00
GDP (RMB Bn.)	17.9	13776.6	1.30
The Primary Sector	2.4	330.4	0.73
The Secondary Sector	9.9	674.5	1.47
The Tertiary Sector	5.6	371.6	1.51
Industrial Firms	3404	389001	0.88
Total Sales of Industry (Bn.)	30.0	2160.5	1.39
Total Profits (Bn.)	2.4	180.8	1.33
Fixed Capital (Bn.)	16.8	1282.6	1.31
Net Fixed Capital (Bn.)	10.8	910.7	1.19
1990 Fixed Capital Invest.(Bn.)	2.9	246.0	1.18
Non-production (Mn.)	671.2	66681.5	1.25
Housing Invet.(Mn.)	292.5	32115.4	0.91

* 467 Cities stand for about 90% of Chinese in most indexes except in Agriculture and rural population, which is about 70%

Source: China Urban Statistics Yearbook 1991.

The data in Table 6-2 shows us a picture of Dalian's position in China's economy. Several conclusions can be drawn from it: Firstly, the contribution of Dalian to China, generally speaking, is around 1% except with regard to agriculture. Keeping in mind

the fact that Dalian only possesses 0.47% of the land and 0.72% of the population among 467 cities, this 1% contribution to the national economy is significant.

Secondly, the contribution of Dalian to China, in terms of GDP, is different among three sectors. The tertiary sector shows the biggest contribution (1.51%), the secondary sector is in the middle (1.47%) and the primary sector ranks the last only (0.73%). The highest and lowest ratios in the table confirm this order. Communication and Transportation rank the first, which accounts for 2.43% in China. The employment of first sector ranks the last, and it is only one fifth of the highest one. It is clear that the greater importance of Dalian to China's economy is shown in the aspects of services and infrastructures.

Thirdly, the average size of Dalian industrial firms is much bigger than the national average. This can be seen from the comparison of the ratio of the number of firms and the ratio of fixed capital. The former is only 0.88% and it is below the average ratio of Dalian. While the latter is 1.31% and is above the Dalian average level.

Fourthly, Dalian's share in equipment is decreasing. The data shows that all the fixed capital of Dalian in China is 1.31%. However, the ratio in net fixed capital in 1990 was only 1.19. There is a gap of 0.12 percentage point. This may suggest that old equipment and facilities in Dalian have a higher percentage, and its pace to update its fixed capital is lagging behind the national level.

Fifthly, the comparatively high ratio of non-production fixed capital investment and its distribution show the diversity of Dalian's economy. Among the indexes of 1990 fixed capital investment, the ratio of Dalian to China in non- production fixed investment was 1.25%, which is 0.8 percentage points higher than total fixed capital ratio. However, among it, only 43% of non-production fixed investment in Dalian is distributed to housing investment, while on the national level, this ratio was about 50%. The gap suggests that more non-production investment is absorbed by public facilities and infrastructure in Dalian than the national level, which would be helpful to diversify the activities of Dalian economy.

6.2.2 The Comparison of Efficiency and Structure Between Dalian and China

Table 6-3 indicates that Dalian at present is at a high development level in China's economy, because among all the positive indexes, Dalian's are higher than the national level. The comparison of these data between Dalian and China reveals the following facts: (1) Output per capita no matter in Gross National Production (GNP),

Gross Domestic Production (GDP) or Total Output of Industry and Agriculture is very high. All of them are around 1.8 times higher than the national level. (2) Productivity of Dalian industry, although is also higher than the national level, is only one fourth above the national level. (3) The data which measures the efficiency of firms' management does not show a big difference between Dalian and China. For example, the three rows in the bottom of Table 6-3 indicate that there is only a small difference between Dalian and national average. The margin in the last one is nearly diminished. The deviation of differences among the three types of indexes, in addition to attributing to the difference of economic structure, may be explained by the following two points. One is that technology advance in Dalian is limited. Its output is mostly obtained from more injection of production resources (more in volume but similar in level/stage of technology). For example, unemployment in Dalian is lower than national average level. The other is that its economic reform has shown more active results and can channel more resources into economic activities. For instance, the self-employment ratio in Dalian is 60% higher than national level.

Table 6-3 Efficiency Level of Dalian and China (1990)

Items	A.Dalian	B.467 Cities	C.=A/B(%)
GNP per capita (RMB)	2868	1609	178
GDP per capita (RMB)	3464	1941	179
Total Production Output of Agriculture & Industry Per Capita (RMB)	6731	3772	179
Industrial Productivity (RMB)	34846.7	27245.6	128
Self-employment to total employment(%)	2.4	1.5	160
Unemployment(%)	0.8	0.9	89
Total Sales/100(RMB)	126.2	115.1	110
Profits/100(RMB)	14.4	12.9	112
Profits/100 Total Sales(RMB)	11.4	11.2	102

Sources: China Urban Statistics Yearbook 1991.

The weight of Dalian in China's economy and its efficiency deviation can be further understood by comparing the economic structures of Dalian and China. Figures 6-1, 6-2, 6-3 and 6-4 compare three structures. Figure 6-1 shows two differences: First China as a whole, in terms of employment, is still dominated by the primary sector, while in Dalian, the secondary sector employs the most people. It

Figure 6-1 Employment Structure Comparison Between Dalian and China,1991

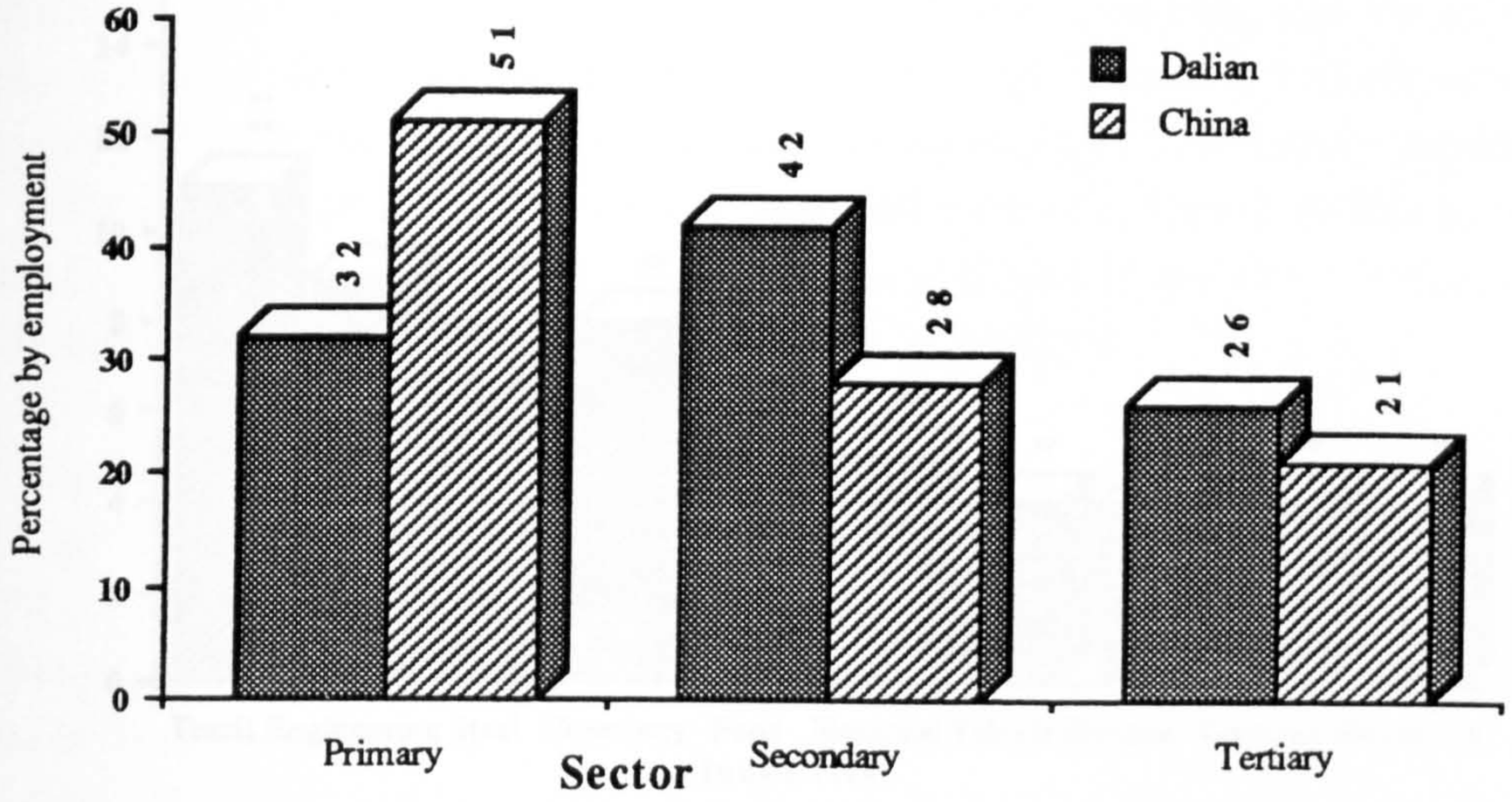


Figure 6-2 GNP Structure Comparison Between Dalian and China, 1991

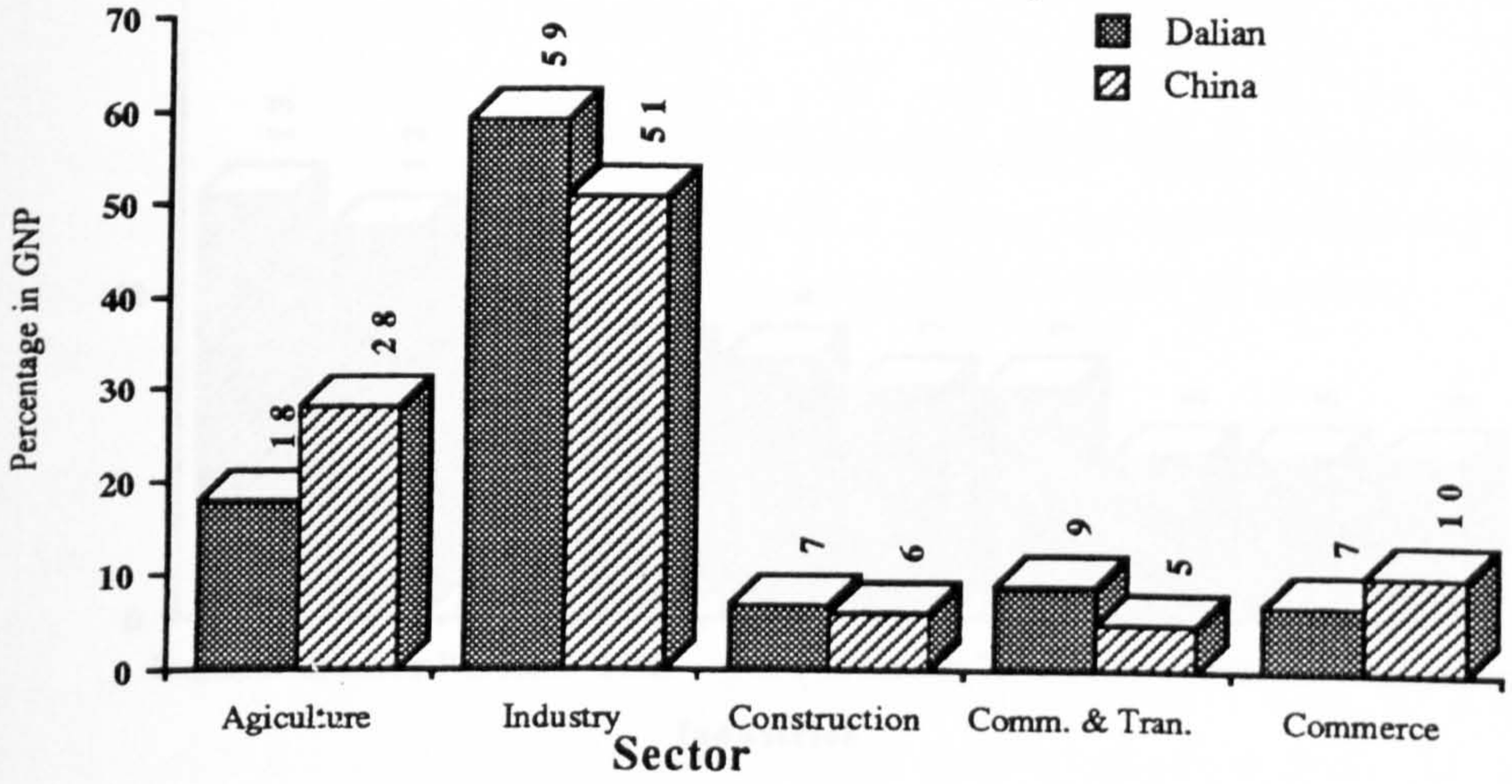


Figure 6-3
Dalian's Top Ten Industries, 1991

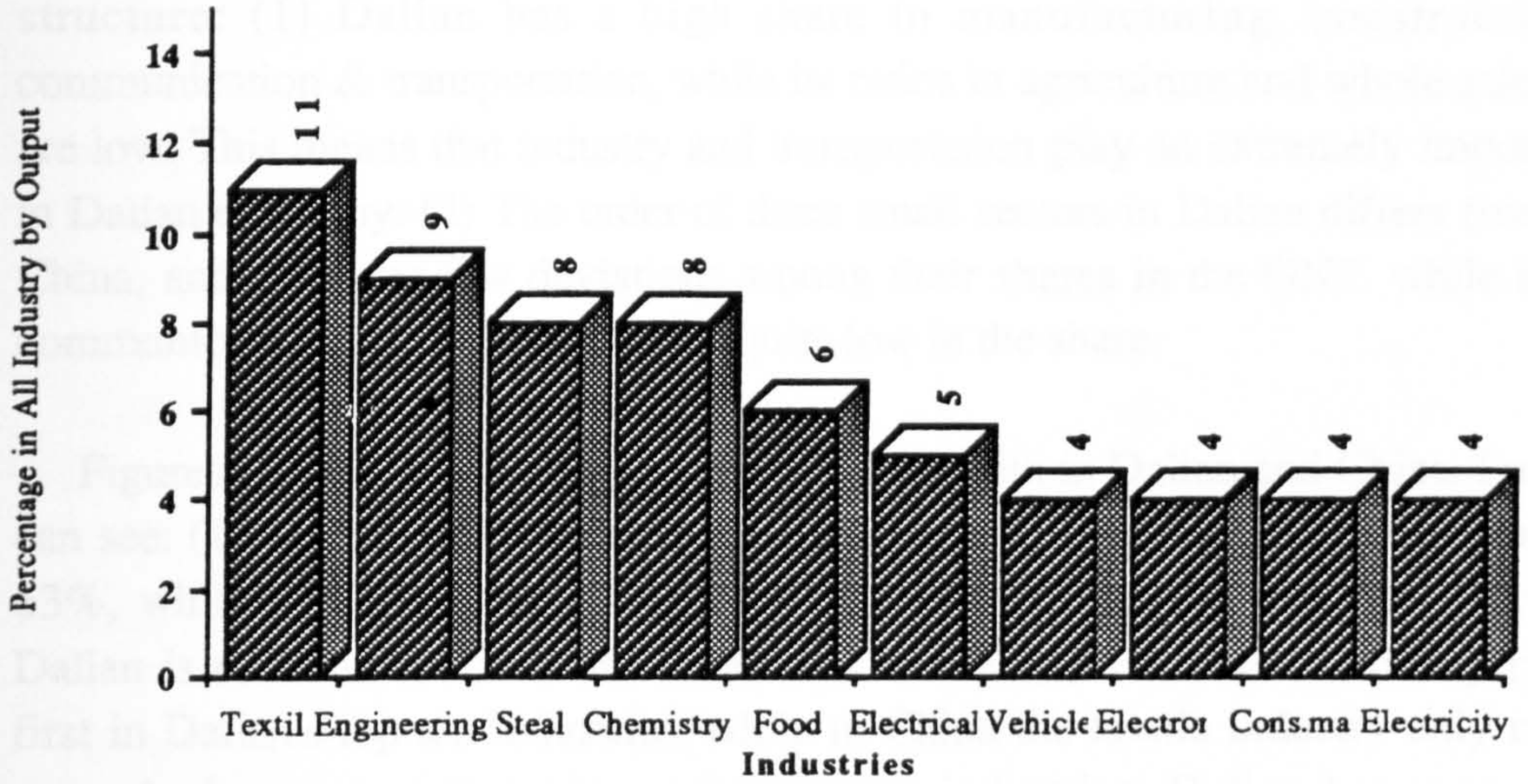
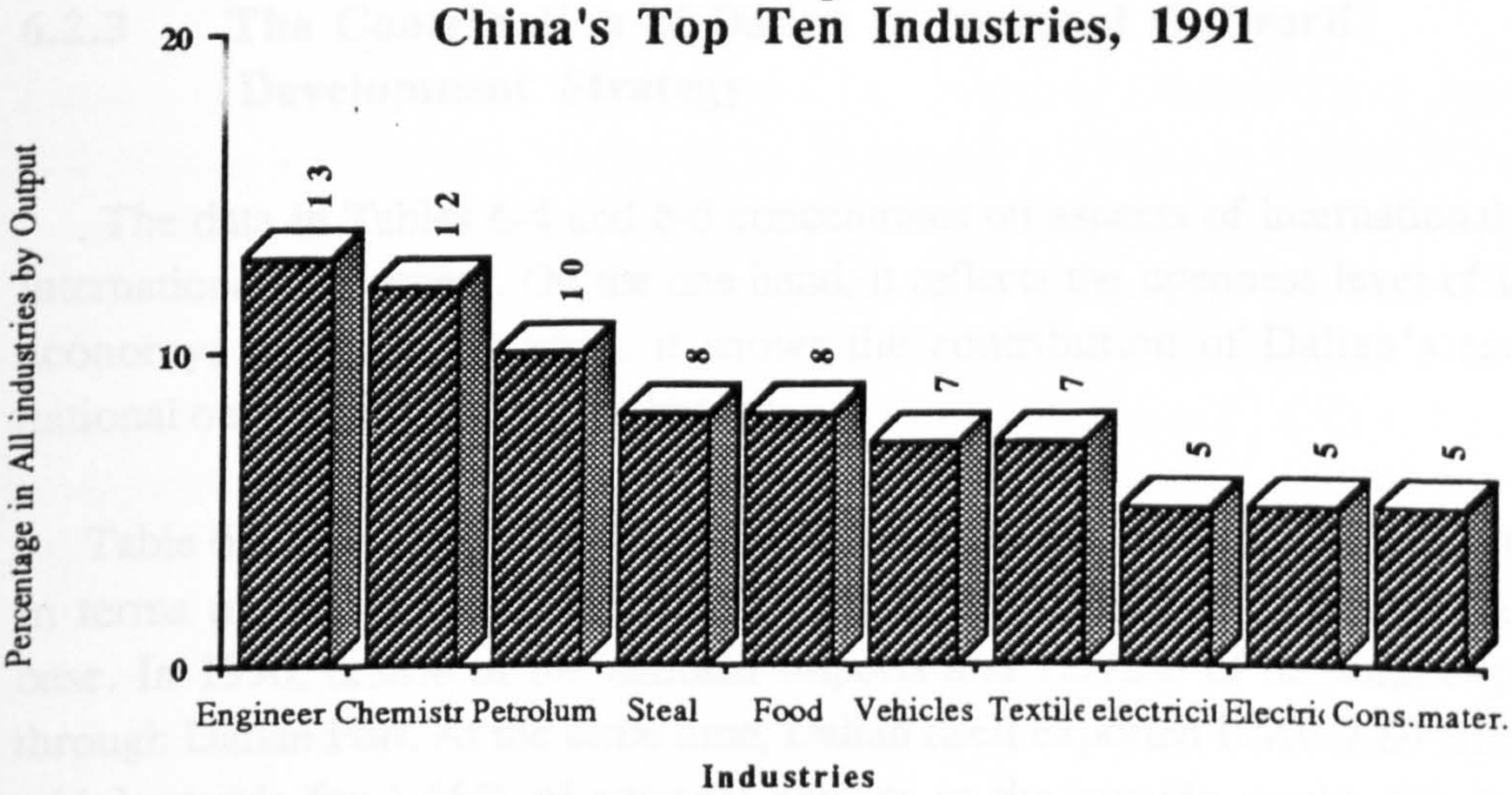


Figure 6-4
China's Top Ten Industries, 1991



suggests that Dalian is more advanced in the ladder of industrialization than China as a whole. Secondly, the sectoral structure of Dalian is more balanced than China's, while there is a big gap between the primary and tertiary sectors in China.

Figure 6-2 shows another two differences between Dalian and China in GNP structure: (1) Dalian has a high share in manufacturing, construction, and communication & transportation, while its ratios in agriculture and whole sale & retail are low. This means that industry and transportation play an extremely important role in Dalian economy. (2) The order of three small sectors in Dalian differs from that of China, and there are few deviations among their shares in the GNP. while in China, communication and transportation is quite low in the share.

Figures 6-3 and 6-4 list the top ten industries both in Dalian and China. From it we can see: (1) The share of the top ten industries in all manufacturing in Dalian is only 63%, while in China it is as high as 80%. This means the industrial activities in Dalian is more diversified than China as a whole. (2) The textile industry ranks the first in Dalian's top ten industries, while in China the textile industry only ranks the seventh. It suggests that among the top ten industries, Dalian has more balance between light and heavy industry than in China, although both have strong heavy industrial orientation. (3) The electronics industry is among the top ten in Dalian, while in China the petroleum industry takes the position of electronics industry. It indicates that new technology plays a more important role in Dalian manufacturing than at national level.

6.2.3 The Contribution of Dalian in National Outward Development Strategy

The data in Tables 6-4 and 6-5 concentrates on aspects of international trade and international investment. On the one hand, it reflects the openness level of the Dalian economy; on the other hand, it shows the contribution of Dalian's economy in national outward development strategy.

Table 6-4 shows the relations of Dalian with the outside world in three aspects: (1) In terms of foreign trade, Dalian is either an import-export gateway or an exports base. In 1990, 6.38% of the national imports and 12.72% of national exports went through Dalian Port. At the same time, Dalian itself exported RMB 2.69 Billion goods which stands for 1.65% of national exports to the outside world. (2) In terms of tourism, Dalian is a place which is attractive to foreigners rather than Overseas Chinese. The data shows that Dalian only shared 0.44% of the total tourists who came to China in 1990, which is much lower than the most economic indicators.

Table 6-4 Relations of Dalian with Outside World (1990)

Items	A.Dalian	B.467 Cities	C.=A/B(%)
International Trade			
Export Purchase(RMB Bn)	2.69	162.81	1.65
Harbour Import (US$ Bn)	2.92	45.78	6.38
Harbour Export (US$ Bn)	6.54	51.42	12.72
Tourism			
Total Tourist (1,000)	52	11950	0.44
Foreigner	36	3170	1.14
Overseas Chinese	0.087	270	0.03
H.M.T*	16	8500	0.19
Tourism Income (Foreign Exchange Certificate Bn)	0.19	10.67	1.78
Foreign Investment			
Projects of Utilizing Foreign Capital	213	7344	2.90
Projects of FDI	185	6957	2.66
Amount of Contracted Foreign Capital (US$ Bn)	0.71	7.74	9.17
Amount of FDI (US$ Bn)	0.57	6.32	9.02

* Hong Kong, Macao, and Taiwan

Sources: China Urban Statistics Yearbook 1991.

Among tourists, the accommodation for Overseas Chinese, and people from HongKong, Taiwan, and Macao shows an even lower share in Dalian. However, the accommodation for foreigners shows a high share, and the highest share appeared in tourism income share. This suggests that Dalian's tourist resources are underdeveloped, but current tourism activities are comparatively effective. (3) Regarding the FDI, Dalian is a very important destination of FDI. In 1990, about 3% of all foreign capital projects which includes direct investment, portfolio investment, and other investment projects were attracted into its territory. This ratio is three times most economic indices. In this group, FDI projects account for 87% of all foreign investment. In terms of investment amount, Dalian's role in hosting foreign investment is more prominent. Over 9% of foreign investment to China in that year went to Dalian. It is clear that Dalian not only accommodated many FDI projects, but also managed to accommodate larger sized FDI projects than elsewhere.

In order to carry out an export-oriented development strategy in coastal China, in 1984 the Chinese government granted the establishment of 14 Economic and Technology Development Zones (ETDZs). Dalian ETDZ was among them. Table 6-5 shows the share of Dalian ETDZ in the output of the 14 coastal ETDZs in 1989. From it, we can see the contribution of Dalian in conducting a national export-oriented development strategy. It is apparent that one fifth of the exports of the 14 ETDZs is from Dalian. The ratios in fiscal income & taxes gathered are also quite high, both over 10%. This suggests the effectiveness of the establishment of Dalian ETDZ from the standpoint of local government. However, the effectiveness at firm level in Dalian ETDZ was disappointing, because the two indexes which reflect the performance of the firms (total sales and profits of firms) were around or below the share it should be (at least 8%).

Table 6-5 The Output Share of Dalian ETDZ in 14 Chinese ETDZs (1989)

Items	A.Dalian	B.14 ETDZs	C.=A/B(%)
Total Sales (RMB Mn)	469	5699	8.23
Fiscal Income (RMB Mn)	77	648	11.88
Profits of Firms (RMB Mn)	33	718	4.6
Taxes (RMB Mn)	75	721	10.40
Export (US$ Mn)	101	514	19.65

Sources: (1) He(1991) (2) China Urban Statistics Yearbook 1991

6.3 Investment Environment of Dalian

Since 1984, Dalian has been implementing reform and open-door policies. In order to attract more foreign investment, Dalian has paid more attention to improving the investment climate. On the one hand, a lot of financial and human resources have been put into the construction of infrastructure and various facilities. On the other hand, many efforts have been made to establish a more open and effective framework. This section attempts to outline the investment environment from the following aspects:

6.3.1 Four Kinds of Infrastructure

In addition to the industrial foundation, infrastructure which displays the following features is another factor helping Dalian to attract FDI:

1. Convenient transportation & communication facilities. Besides the excellent sea port which has been mentioned in 6.1.3, Dalian's land and air transportation are also convenient. The railway connects with the network in Northeast China as well as North China. The railway cargo transportation was 28.95 million tons and passenger transport was 24.68 million people in 1990. There are 260 highways in Dalian region, with a total mileage of 4,000 kilometers. Both urban and rural areas are linked by a highway network extending in all directions. The 375 kilometers long Shenyang-Dalian expressway which is the first one in China has opened to traffic. Its transportation capacity was 13.75 million tons and 46.53 million people in 1990. Dalian airport now has 20 domestic and international air routes, connecting Dalian with 23 cities in 17 provinces, municipalities and autonomous regions. There are also three scheduled flights from Dalian to Tokyo and Fukuka in Japan and Hong Kong. Irregular chartered flights have been opened from Dalian to Japan, America, Canada, Holland, Romania and Switzerland. Along with a series of importing of programme controlled telephone exchanges, the total number of telephones is over 100,000. It is easy to dial directly to more than 180 cities in China, and over 170 countries and regions in the world (Gong 1991).

2. Quite stable electricity and water supply. The lack of energy is a problem in China's development, and lack of water is a common problem in North China. However, in Dalian these have been relieved to some extent. At the end of 1991, there were four power plants in Dalian. The operation of two sets of 350,000 KW units of the Huaneng Dalian Plant, which is also a joint venture, improved the energy supply. In 1991, the production of electricity was 6.2 million KWH, while the consumption was 5.9 million, and there was 0.3 million KWH surplus (Dalian Statistics Yearbook 1991). Along with the construction of the second phase of Huaneng Dalian two sets of 350,000 KW in the future, the energy supply will be improved further. There are 11 reservoirs with storage capacity of one billion tons in Dalian. There are also 8 water treatment and distribution plants in the city. The total water pipe length is nearly 3,000 kilometers. The daily water supply capacity is 520,000 tons. Another project which aims to bring the water from Biliu river to Dalian is at the planning stage (Planning Department of Dalian 1992).

3. Large skilled employee pool. As an old industrial base, the workers and staff in Dalian are of comparatively high quality. In the industrial enterprises, the technicians above middle level account for 2/5 of the total workforce. Besides these enterprises, Dalian city now has 239 scientific research institutes of all kinds and 108,000 technician and scientific personnel of various professions. As a higher education center of Northeast China, by the end of 1991, there were 11 universities with over 30,000 students every year being sent into society. (Dalian Statistic

Yearbook, 1991).

4. Attractive living environment & facilities. With hills behind and the sea in front, Dalian city not only has a comfortable climate, but also has beautiful scenery. There are 30 kilometers of long beaches with various scenery. Jinshitan, a famous national holiday campus with strange stone rocks is under large scale construction. Fujiazhuang is a wider sea beach. Near it a foreigner housing area with primary school for the foreign children and various facilities has been established. It has been proved that the development of these facilities is also an attraction for foreign investment (Commercial Department of British Embassy 1992).

6.3.2 Three Investment Places

At present, Dalian city offers three possible investment places for foreign investors: the old city center; the new town; and the suburbs (refer to Map 2). The old city center is the built-up area of Dalian city. It covers about 120 square kilometers with 1.6 million population. In 1990, it produced nearly 70% GNP of Dalian. This area surrounds Dalian Bay, and is the centre of administration, finance, industry, education, science & technology, communication & transportation. However, the limitation of land availability makes it difficult to accommodate land intensive projects.

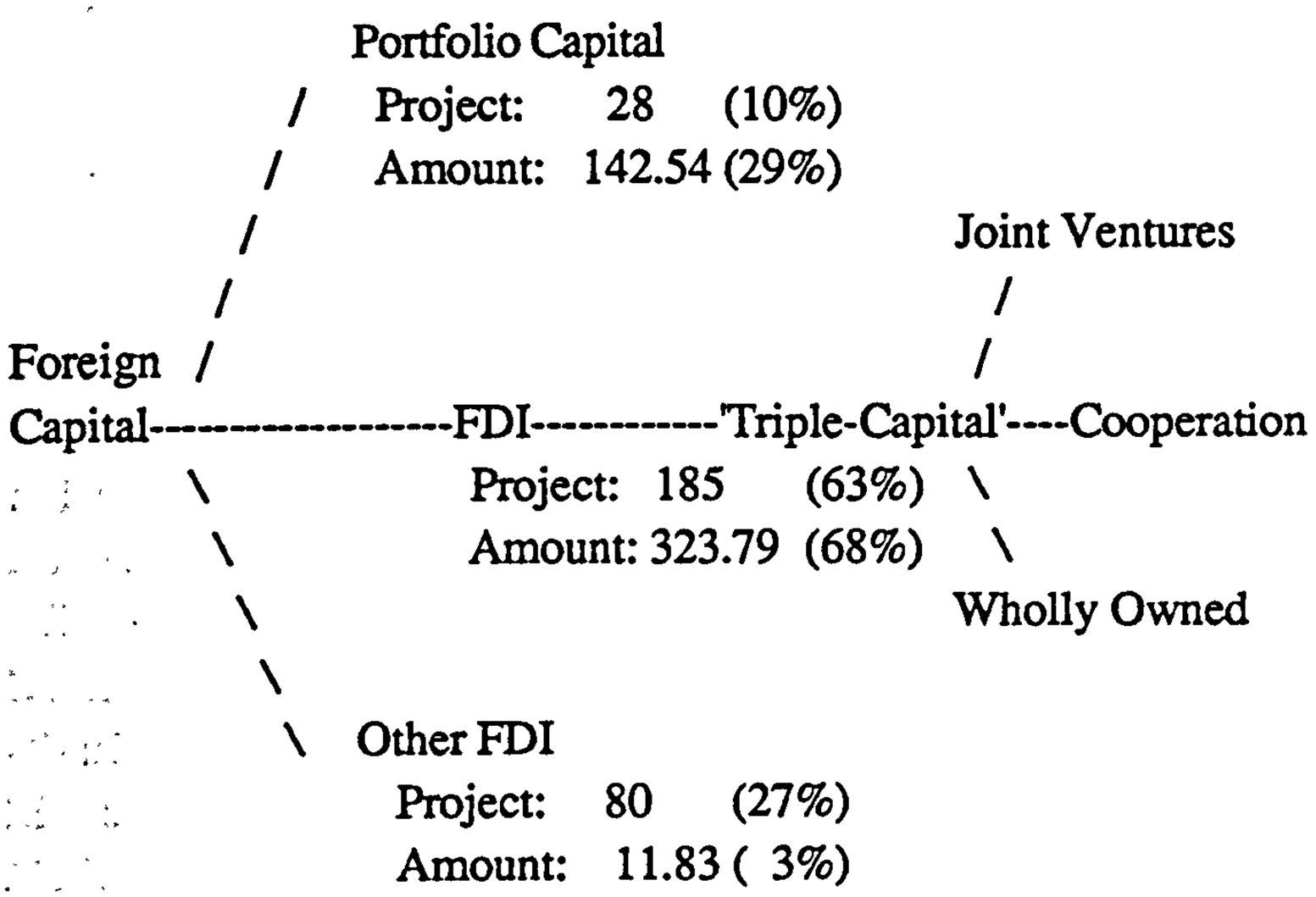
The new town is growing from Dalian ETDZ. When it was set up on August 15, 1984, Dalian ETDZ was designed as an export-processing zone with only 3 square kilometers. Along with the development, it has experienced several changes in its emphasis and its scope. Before the new version of a master plan launched in late 1992, its scope in the master plan reached 20 square kilometers. By the end of September 1992, it had completed the construction of ten square kilometers and opening the construction of another ten. Several hundred firms, among them FDI accounting for 81%, were established in this area (Economic Bureau of Dalian ETDZ 1992). Because of the booming economy, a new township has been authorized in the area. According to the new master plan, the new town will cover 191 square kilometers with 161 square kilometers built-up area and include Dayao Bay and Xiaoyao Bay in 20 years. The area of the present ETDZ will be only one of five districts of the new town (Planning Department of Dalian ETDZ 1992). By the end of 1992, several berths had operated within the new town; one tax free zone with 1.78 square kilometers was set up and more than 50 FDI enterprises were permitted to enter it; infrastructure and other facilities were also developed associated with the demand.

The suburb area accounts for 98% of 12, 574 square kilometers of Dalian. If the

old city center is characterized by access to infrastructure, other economic activities and skilled human resources, and the new town features various government incentives, the suburbs are prominent in abundant natural resources; low cost labor supply; and extremely high enthusiasm of the local people. Now, 12 small towns along the sea beach and transportation routines have been chosen as growth poles in rural area and opened to foreign investors.

6.3.3 Three Investment Forms

Table 6-6 Division of Foreign Investment In Dalian (1990)



Project: No. Investment Amount: $ Mn
Source: Dalian Statistics Yearbook 1991, DSB.

In terms of investment forms, there are some differences in Dalian as in other developing countries. The deviations come from two characteristics of China dealing with foreign investment. First, as in many other countries, China divides foreign capital into portfolio capital and direct investment. But there is an 'other direct investment' within the category of foreign investment. It usually includes 'Three coming and one compensation (coming of materials, design and sample, compensation trade)', 'Subcontracting' etc. Secondly, China sets up a special criterion--The method of setting up and operating foreign funded enterprises--to distinguish foreign direct investment (FDI), instead of using ownership as a unique criterion. Therefore, foreign investment in China can be divided into three types, and within FDI there are three forms: wholly owned; joint ventures and cooperation. Table

6-6 shows either the division of foreign investment in China or the distribution of foreign investment in Dalian.

Among the three forms of FDI, which are called "Triple-Capital" in China, a wholly owned firm differs from the other two forms by ownership, and a cooperation differs from a joint venture by means of establishing and managing the firm. A cooperation firm is set up and managed by an agreement signed by the foreign partner and the Chinese partner instead of by any other means. In a joint venture, every thing is determined by the shares of the investment held by the partners. The other differences among the three forms, especially between joint ventures and cooperation, are listed in Table 6-7, which can be summarized as:

Table 6-7 Main Differences Among Triple-Capital

Items	Joint Ventures	Cooperation	Wholly Owned
Minimum Foreign Investment (%)	25%	No	100%
Independent Legal Status	Necessary	Unnecessary	Necessary
Asset Evaluation Before Setting Up	Necessary	Unnecessary	Unnecessary
Decision of Ratio of Stock	By Value	By Contract	----
Division of Profits	By Value	By Contract	----
Limitation of Operating Years	>=10	No	No
Method of Getting Back Capital	Only by Profits Division	Many Methods	No Limits
Setting up Permit Getting From	Planning & Foreign Trade Committee	Only Foreign Trade Committee	Only Foreign Trade Committee
Management Method	Shared	By contract	----
Taxes Levy	One law	Two laws	One law

Source: Liu (1989 p1-4)

(1) In terms of organization, everything in joint ventures is shared by partners according to their stock in the project, while in cooperation, everything is determined by contract, and it does not connect with investment directly. (2) In terms of legal status, joint ventures and wholly owned FDI firm must have an independent law personality in China, while cooperation need not. (3) The difference in investment

method is that investment in joint ventures must be in money value. When equipment etc. is used as investment, it must be evaluated before setting up the enterprise. For cooperation, investment can be in any form according to the contract. (4) The difference is in the division of output. The division in joint ventures can only be profits, while in cooperation, division can be in different forms such as increasing depreciation rate, dividing products etc. (5) The difference is in disposing of the assets when the project is wound up. In joint ventures, a Chinese partner can only buy back the foreigner's stake, while in cooperation, the assets usually belong to the Chinese partner, because before winding up, foreigners can get assets back by other methods. (6) The difference in tax leviation. In joint venture and wholly owned firms, the levying of tax follows the tax law for foreign funded enterprises, while in cooperation, foreigners follow the law in their own country, and Chinese partner uses the law for Chinese firms. (7) The difference in management. Joint ventures must share management between partners. Its management is under the board of direction, and the chairman of the board must be a Chinese. Cooperation can freely choose its management style with or without board of directors.

6.3.4 Two Types of Enterprises

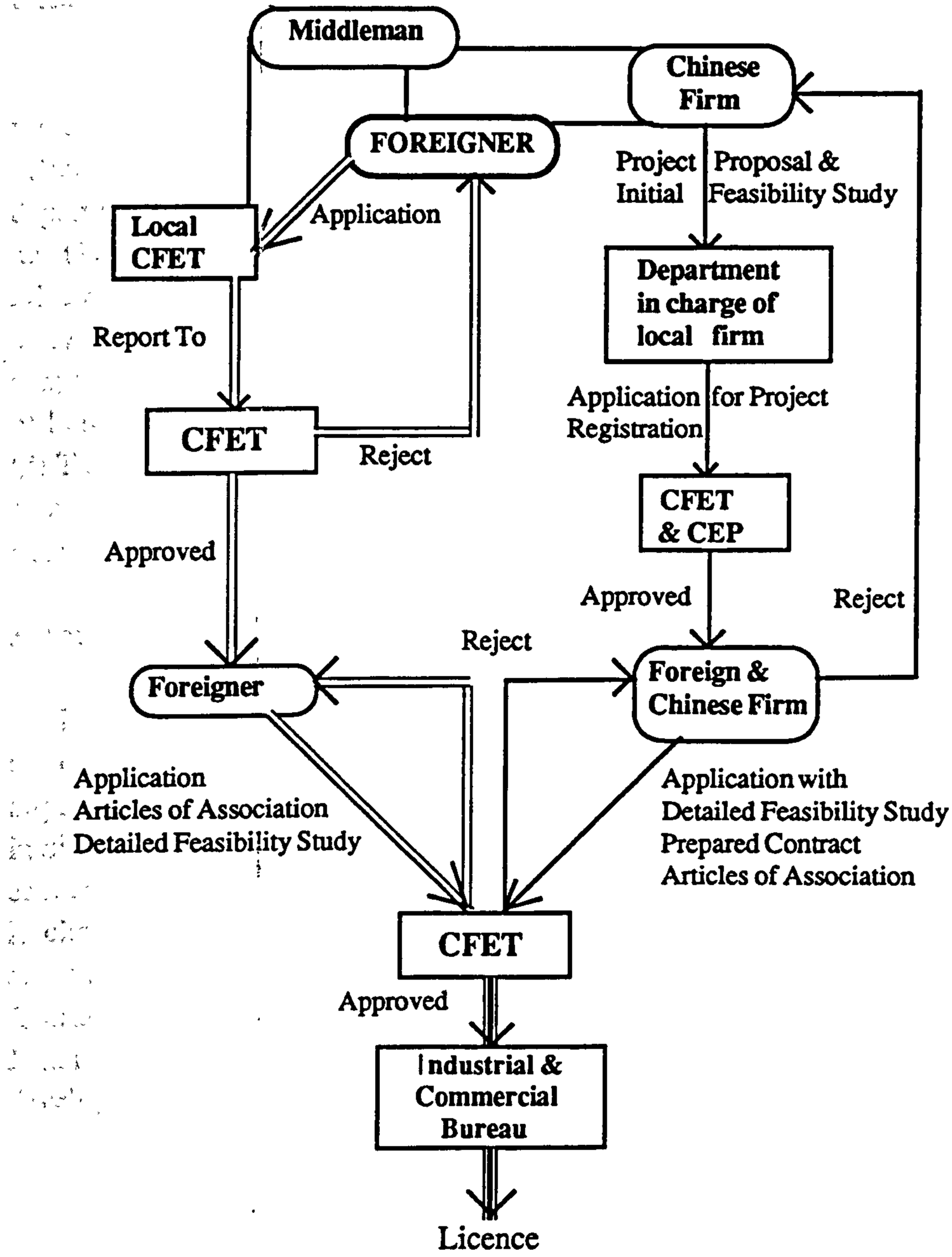
If joint ventures are chosen as the ownership form, there are two types of enterprises which can be set up under the form in Dalian: new firm and "grafting" firm. New firm means that the established enterprise is separated from the property of Chinese partner. The firm usually does not use the property, equipment or many employees of its Chinese parent firm. The reasons for foreign investors setting up a brand new firm are varied. For example, the old assets such as machinery or building are not suitable; it is easy to adopt a different management style, or a Chinese partner has no assets of this kind.

"Grafting" firms means that the established firm is based on using part or even the whole property, machinery and employees in the Chinese parent firm. This kind of FDI firm is usually located in the same place as its Chinese parent, at the same time it shows some characteristics such as bringing about new equipment, producing new products, exploiting new market, and adopting new management method. In Dalian, there are more large and medium-sized firms than the national level, and it offers more opportunities to use the old assets to form a grafting enterprise.

6.3.5 One Door Entry and Management System

While improving the hard investment environment, Dalian also makes an effort to improve the soft investment climate. A series of policies and measures relating to FDI

Figure 6-5 FDI Enterprise Setting Procedures



═══ For Wholly Owned ——— For Cooperation & Joint Ventures

CFET: Committee of Foreign Economy and Trade

CEP: Committee of Economic Planning

had been formulated and/or implemented, which is mainly reflected in the following aspects: First by offering investment incentives. The incentives are of two types. One is used in Dalian ETDZ, and the other is employed in other areas. The former shows more privileges than the latter. The contents of incentive are concentrated on taxation reduction, low land and various facilities use fees, low cost labor provision etc. The effectiveness of these measures will be discussed in detail in chapter 10.

Secondly, by simplifying FDI entry and management system. In order to promote the inward flow of FDI, Dalian has set up a high profile office entitled "Center of Foreign Economic and Technological Cooperation Management". All the departments of government which deal with FDI have a division in this center, and its head is the mayor of Dalian. The aim of setting up this center is to cut the red tape and raise the efficiency of document processing and management. Under the "one door entry" or "One dragon service" system, the procedures for setting up a FDI firm are simplified into the routine of Figure 6-5 in theory. From it we can see: (1) Committee of Foreign Economic and Trade is the key department in charge of the issue of FDI. (2) The establishment of a wholly owned firm is easier than setting up a joint venture or a cooperation firm. For the latter there are another two permits to be obtained before the firm is established.

Summary

Nearly a hundred years ago, inward investment from Russia and Japan launched the construction of modern Dalian. The deep and wide harbour combining with the huge hinterland of three provinces in Northeast China have facilitated its development in different stages in this century. At present, Dalian accounts for over 1% of national economy in most aspects, but enjoys a high share in foreign investment. Its economy is characterized by (1) rapid growth; (2) diversified industrial activities; (3) a comparatively advanced economic structure; (4) high export-oriented tendency; (5) a forerunner in adopting reform and openness policy; and (6) special relationship with Japan. All of these make Dalian a good case to check the impact of FDI on China's development at the current stage.

CHAPTER 7. ACCESSING EFFECTS MEASUREMENT

7.0 Introduction

This chapter presents the first part of the findings in the case study. It aims to assess the accessing effects of FDI. This measurement is based on the externality of technology development discussed in chapter 2 and Dunning's eclectic paradigm discussed in chapter 3, which demonstrate that the entry of foreign investment, which possesses certain technology advantages, offers some opportunities for the indigenous firms and personnel to make contact with it. FDI's local operation with these technology advantages cannot keep indigenous firms and local personnel from acquiring them to some extent. The more opportunity and the better the condition of contact between FDI and local firms, the more technology can be transferred to the host country. With this idea in mind, the first half of this chapter attempts to document the involvement of FDI in Dalian's economy, and through it, to display the possibility for indigenous enterprises and local personnel to make contact with inward investment. The other half of the chapter intends to expose the characteristics of FDI in Dalian, such as the origins and destinations of FDI. Through these analyses, it shows the contact environment between inward investment and the host region. The combination of contact possibility and contact environment determines the accessibility of FDI, or overall potential for technology transfer through inward investment, which constitutes an indirect measurement of technology transferability of FDI.

7.1 Accessibility--Involvement of FDI in Dalian's Economy

This section will treat FDI as a subsystem of Dalian's economy, and examine its contribution in the following aspects: investment, export, employment, balance of payments, and technology acquisition. It is assumed that the higher the involvement level of FDI, the more opportunity for the host region to make contact with inward technology (Young 1988). Therefore, there will be more technology transfer.

7.1.1 Investment Share of FDI in Dalian's Economy

1. The level of involvement of FDI in Dalian fixed capital investment. The first function of FDI, from the standpoint of host country, is to bring capital into the region (Koo 1985, Lall 1989). This role of FDI in Dalian is displayed in Table 7-1. Since we do not know what percentage of foreign investment falls into fixed capital investment (FCI), we assume that all FDI is in the category. This exaggeration may be compensated by the use of the official exchange rate in the

calculation, because the official rate had been much lower than swap market exchange rate before China abandoned two exchange systems at the beginning of 1994.

The data in Table 7-1 suggests the following: (1) The increase of foreign investment, as shown in row C, is much quicker than the growth of Dalian FCI shown as in row D. From 1985 to 1991, foreign investment increases nearly 17 times, while local FCI increases only 1.5 times. (2) The involvement level of FDI in Dalian economy at present is quite high. The average involvement ratio of foreign investment to Dalian FCI from 1990 to 1992 is 29%, while this ratio in 1985 was only 2%, and the average ratio from 1985-1989 was 7%. (3) FDI is not only an important capital source of Dalian, but also a guide to the new domestic investment, which can be observed from row H. It indicates that at least twice the amount of investment from Dalian has been absorbed into the FDI projects.

Table 7-1 Ratio of FDI to Dalian Fixed Capital Investment

Items	1985	1986	1987	1988	1989	1990	1991	1992
A. FDI Firms Total Investment ($Mn.)	217	103	135	246	421	568	518	382*
B. FDI Firms Registered Investment ($Mn.)	142	56	84	88	209	254	322	271*
C. FDI Firms Foreign Investment ($Mn.)	14	31	83	45	81	389	261	111*
D. Dalian Total Fixed Capital Investment (RMB Mn.)	2180	2442	2759	3035	3504	3960	5410	3850**
E. A/D*Rate(%)	28	13	18	30	56	67	50	55
F. B/D*Rate(%)	18	7	11	11	28	30	31	39
G. C/D*Rate(%)	2	4	11	5	11	46	25	16
H. A/C	15.5	3.3	1.6	5.5	5.2	1.5	2.0	3.4
Exchange Rate: 1$=RMB Yuan	2.8	3.2	3.7	3.7	4.7	4.7	5.2	5.5

* 1-6, 1992. ** 1-9, 1992

Notes: FDI Firm Total Investment means the total investment required by the project which consists of various capital sources.
FDI Firm Registered Investment means the assets possessed by the investors themselves.
FDI Firm Foreign Investment means the amount of capital out of foreign investors which shows the share of foreign capital in the firm.

Sources: 1. Dalian Statistic Bureau (DSB, 1991);
2. Dalian Statistic Yearbook, DSB 1985-1991;
3. Summary of Dalian Economy 1-9, 1992 and Forecasting. DSB, 1992.

2. The participation structure of FDI in the Dalian Economy. Table 7-2 provides a picture about the structure of FDI participation in the Dalian economy. From it we can see that FDI is highly concentrated on industry. In this field, FDI investment has overtaken the local FCI. In agriculture, although only a small fraction of FDI flows into this sector, it also plays a dominant role in financing the agricultural projects. Although FDI shows some importance in the property development, commerce and construction sectors, its role is much weaker compared with industry and agriculture.

Table 7-2 Involvement Structure of FDI In Dalian (1990)

Sectors	A. FDI $1,000	B. FDI Struct.(%)	C.Dalian FCI* RMB 1,000	D=A/C*Rate (%)
Agriculture	3,970	1.23	9,250	202
Industry	313,420	96.80	1,411,000	104
Construction	300	0.09	17,700	8
Transportation & Communication	310	0.10	539,170	0.3
Commerce	2,340	0.72	124,480	9
Property & Public Facilities	2,470	0.76	76,140	15
Other	980	0.30	474,840	1
Total	323,790	100.00	2,652,580	12

* Exclude FDI

Sources: 1. DSB, 1990 2. DCFET, 1991

Table 7-3 attempts to show the involvement of FDI in selective industries. Column A is the gross fixed capital in each industry accumulated to 1990. Column B is the foreign investment of 361 surveyed FDI firms in associated industries. Although Column B only covers one third of the total numbers of FDI firms, it includes the firms established in 1991, which is one more year than Column A. So the ratio in Column C could be compensated to some extent. The involvement level in selective industries shows obvious deviations. However, it is apparent that in the high technology industries, FDI involvement level is higher than in standard technology industries, which is exemplified by the situations in the electronics and pharmaceutical industries.

Combining the above discussion we can draw some conclusions about the

involvement of FDI in Dalian's investment. Firstly, the share of FDI in the Dalian economy increased very quickly, and inward investment has become an important capital supply of Dalian economy. Secondly, foreign investment in Dalian is "single minded" --mainly in industrial projects--and its participation in other activities is comparatively low. Thirdly, FDI's contribution to industry is not only reflected in the supply of funds, but also in the updating of the industrial structure, at least from initial inspection. Without FDI, the new and high technology industries in Dalian could not have developed so rapidly.

Table 7-3 Involvement of FDI In Selective Industries (1990)

Industries	A. Dalian Accumulate FCI* (RMB Mn.)	B. Foreign Invest. (US$ Mn.)	C. B/A*Rate %
Engineering	5041	87	8
Petrol & Chemicals	3184	168	25
Textile	1251	41	15
Construction Materials	1014	64	30
Electronics	362	74	96
Pharmaceutical	121	33	128

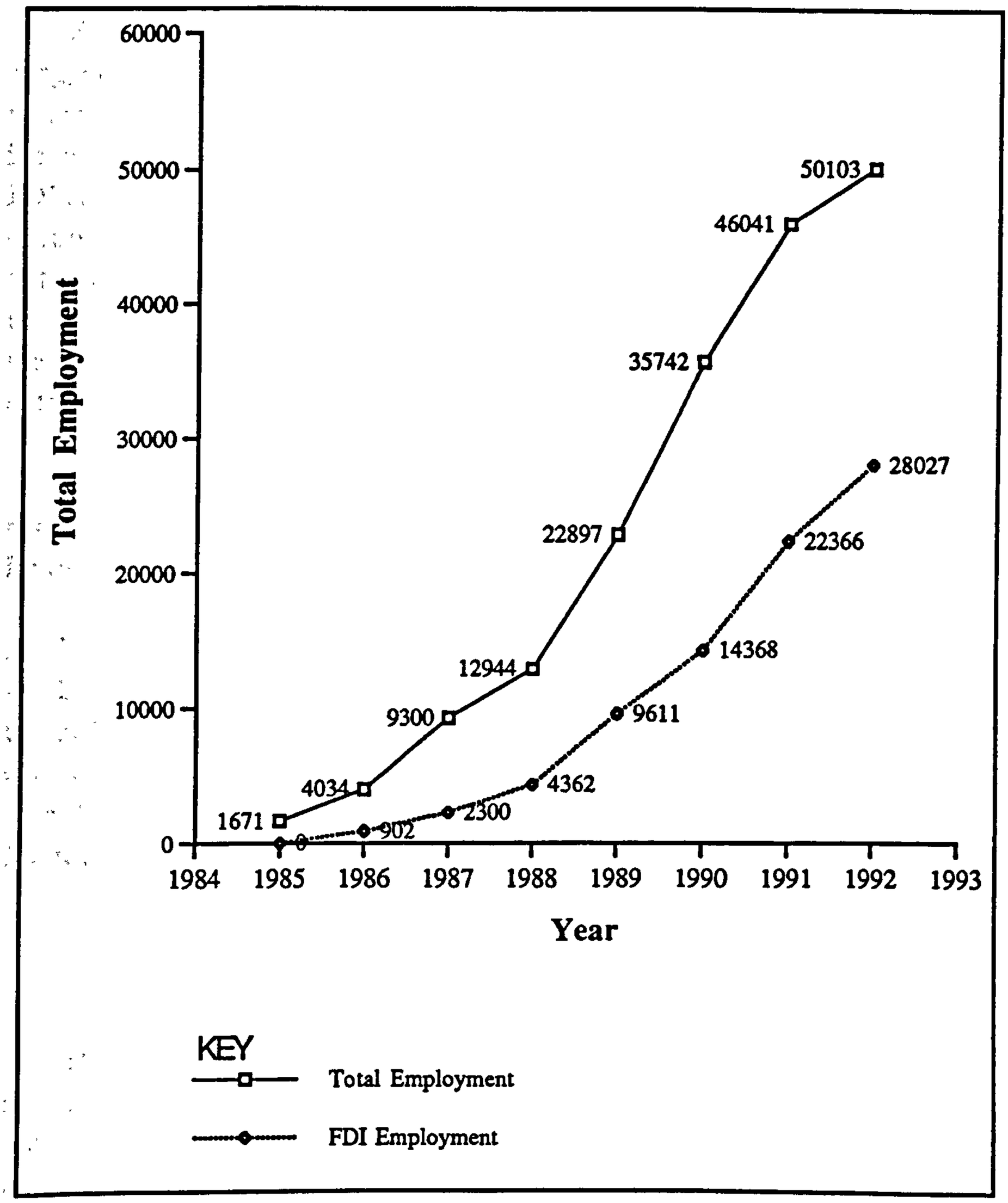
* Exclude FDI

Sources: 1. Dalian City. Chinese Planning Publish House.1991
2. Postal Questionnaire Analysis.

7.1.2 Employment Share of FDI

Recruitment has been described as one of the major contributions of FDI to a host region, because through FDI local operations it can enlarge the volume of employment, create various employment opportunities, and improve skill levels (Germidis 1977, Dunning 1981, UNCTC 1985, 1987). Table 7-4 shows the share of FDI employment in Dalian total work force and its change. Compared with other developing countries, especially with the levels of other Asian developing countries in the 1970s, when they began to host FDI on a large scale (refer to Table 3-5), the contribution of FDI to Dalian employment is not so obvious. At the end of September 1992, the total FDI employment is about 60,000, which is less than 5% of total work force in Dalian. It is easy to understand the situation, because China has the biggest labor pool in the world. The difference between investment share and employment share indicates that productivity in FDI firms is much higher than in local firms.

F7-1 Employment of FDI in DETDZ



There are three points to note about the FDI employment share. Firstly, the share of FDI in employment in Dalian has increased quickly. Within seven years, the ratio raised nearly nine times from 0.5% in 1985 to 2.8% in 1990, and to 4.4% in 1992.

Secondly, there are two problems with the FDI employment data. One is the exaggeration of employee numbers. It mainly results from some grafting enterprises, which are mostly located in the old city centre. When these firms change their identities by finding a foreign partner, they convert many or all of their employees to FDI employment. The other is the underestimation of employee numbers, which often occurs in suburb FDI enterprises. When they employ labor from rural area, they do not inform the labor bureau, so that they can waive the labor administration fee and other fees. In this case, the workers employed from the countryside fail to appear in the statistics. However, it is very difficult to estimate the difference due to the lack of data.

Table 7-4 Employment of FDI in Dalian (1,000)

Items	1985	1989	1990	1991	1992*
A. FDI	6.1	16.0	34.2	51.3	60.5
B. Dalian	1168.1	1198.5	1329.6	1363.4	1389.1
C. A/B (%)	0.5	1.3	2.6	3.8	4.4

* Up to September 1992

Sources: 1. Annual Report of DCFET, 1986, 1990-92.
2. Report of Dalian Center for Foreign Enterprise Management. 1992.
3. Dalian Development During 7.5 Plan. DSB, 1991.
4. Ma (1990)

Thirdly, FDI employment is concentrated in the new town. Figure 7-1 shows the increase of FDI employment in the new town since it was established. Comparing with other FDI locations, the data of employment in Dalian New town is more reliable. From it we can see that FDI employment in the new town is prominent. By the end of September 1992, workers employed by FDI firms constituted over half the work force of the new town. From 1986 to 1992, the rate increase in FDI employment is stable.

7.1.3 Exports Share of FDI

Like most Pacific Asian countries (OECD 1989, 1993), Dalian experienced a

parallel development between FDI inflow and exports increase. However, the special situation of foreign trade in China where most local firms do not have rights to conduct international trade makes the contribution of FDI on exports more prominent. It can be examined from two aspects: the increase in the volume of exports and the shift of exports structure.

1. Increase in the volume of exports. In terms of the change of exports volume, since 1985, when Dalian was granted rights to develop foreign trade on its own, exports have grown rapidly. Between 1985-1988 exports increased from $ 80 million to $416 million (DSB 1986, 1989). During this period, exports were mainly promoted by newly established local foreign trade companies and appointed export firms. Up to 1988, there were more than ten foreign trading firms which specialized in producing cereals, oil and foodstuff; native produce and animal by- products; chemical and mineral; machinery and textile products, and over 50 appointed export factories in Dalian (DCFET, 1989).

The situation has changed in recent years, and FDI has become the most important force for driving exports. Table 7-5 displays the structure of export goods production and its change over time, which reflects the supply capability of export goods in different firms, and is counted by domestic currency. From it we can see: (1) The share of FDI in export goods supply is quite high. It was 27% in 1991, which is 1.69 times the national level in the same year (Sun 1992). In 1992, the share was even higher, and over one third of export goods came out of FDI firms. (2) FDI has overtaken appointed export factories and bases as the number one producer among three types of firms within only three and half years. (3) The increased rate of export goods production is astonishing in FDI firms. From 1989 to 1991, foreign investment in Dalian only increased 1.6 times, while the growth in exports purchase was 4.7 times.

Table 7-5 Exports Purchase Share of FDI in Dalian (RMB Mn.)

Type of Firms	1989	1990	1991	1992*
A. FDI Firms	438.43	841.17	2074.93	2363.23
B. Deregulation Firms	145.12	168.13	451.96	
C. Appointed Export Bases	1591.46	1653.05	2016.81	
D. Total	4344.61	5189.44	7665.78	6874.18
E. A/D(%)	10	16	27	34
F. A:C	1:3.6	1:2.0	1:1.0	

* only 1-9, 1992

Sources: 1. DCFET, 1989-1992. 2.DSB, 1989-1992

Table 7-6 shows the structure of Dalian actual exports conducted by different exporters and its change in recent years, which is counted by US Dollars. Compared with the the structure of exports purchase, although the main rival of FDI is different--it is specialized foreign trading companies instead of production enterprises, the situation remains the same. However, the following aspects are noteworthy: First the share of FDI in conduct exports is higher than in supply export goods. From two of rows E in the tables we can see that the share of FDI in actual exports is higher than export goods supply in 1990 and 1991, although they show same ratio in 1989. In 1992, nearly half of actual exports is realized by FDI firms.

Table 7-6 Actual Exports Share of FDI in Dalian (US$ Mn.)

Type of Exporters	1989	1990	1991	1992*
A. FDI Firms	14	155	413	421
B. Trading Co.	119	416	454	
C. Local Firms	8	98	131	
D. Total	141	669	998	853
E. A/D (%)	10.0	23.2	41.4	49.4
F. A:B	1:8.5	1:2.7	1:1.1	

* only 1-9, 1992

Sources:
1. Annual Reports of DCFET 1989-1991.
2. A Working Paper of DCFET 1992.
3. Dalian Statistic Yearbook 1989-1991.
4. Summary of Dalian Economy 1-9, 1992 and Forecasting. DSB, 1992.

Secondly, the growth rate of FDI in actual exports is much higher than in export goods purchase. The data shows from 1989 to 1991, actual exports conducted by FDI firms increased about 30 times, which is five times higher than the growth of export purchase. This indicates that FDI shows more importance as an exporter than as a producer in Dalian.

Thirdly, the above two facts suggest that FDI is more effective than the local firms and specialized foreign trade companies. It only supplies one third of total exports goods, however, it can conduct half actual exports, while local firms which supply the two thirds of export goods, only realize half actual exports either by themselves or by specialized foreign trade companies. It undoubtedly suggests that the technology level of FDI, both in producing and in marketing, are higher than the local

partners.

Finally, while trading companies are losing their importance in actual exports, the importance of local firms is increasing, although the growth rate is only half of FDI firms. The fact that local firms have become important exporters, in addition to the deregulation brought by economic reform, could be explained partly by accessing FDI firms, because it reduces the resources requirement for a new producer to penetrate the overseas market (Bloom 1992).

2. Shift of exports structure. The contribution of FDI on exporting in Dalian is not only limited to the volume increase, but is also reflected in the advance of exports structure.

Table 7-7 Export Items Over $10 Million In Dalian Customs

1989	1990	1991
Soy Bean 38	Shrimp 52	Instrument 84
Shrimp 33	Steel 44	Dynamic machinery 63
Steel 30	Dynamic machinery 43	Soy bean 57
Non-cotton cloth 12	Soy bean 38	Steel 54
	Shell meat 22	Shrimp 46
	Oil products 20	Oil products 25
	Shila 18	Fabricate oil 24
	Cotton garments 13	Electronic equipment 16
	Cotton cloth 12	Cotton garments 15
	Heavy-burn Mg 11	Wool cloth 13
	Apple 10	Heavy-burn Mg 13
		Metal Products 13
		Iron 12
		Non-cotton cloth 12
		Shila 11
		Cotton cloth 11
		Plate Glass 11
Total 564	669	998

Sources: Dalian Customs 1989-1991.

Table 7-8 gives the evidence. It is a list of exports items of money value over $ 10 Million between 1989 and 1991. The change of contents within three years

reflects the impact of FDI in Dalian. It is apparent that there were only four items with export value over $10 million in 1989. The total value of these four export goods was $113 million, which only accounted for 20% of total exports in the year. Among them, agricultural products which include soy bean and shrimp accounted for 63% of the over $10 million exports; raw material e.g. steel accounts for about 27%, and manufacturing products non-cotton clothes only accounted for 10%, which shows an obvious bias towards to primary products. However, the situation changed within three years. In 1990, the structure of exports was agricultural products 43%, raw materials 19%, and manufacturing products 38%. The value of eleven items over $10 million accounted for 42% of total exports that year. In 1991, the structure of the three types of exports further changed to agricultural products 21%, raw materials 19%, and manufacturing products 60%. The value of 17 items over $10 million accounted for nearly half total exports that year.

Further investigation finds that the shift of exports structure is closely connected with the involvement of FDI in Dalian. For example, the number one item of exports in 1991 was instrument. It alone accounted for about one tenth of total exports value. The main component of the instrument is the black box of photo-copy machines made by Canon Dalian. Besides that, in electrical equipment, the mini motor made by Wanbaozhi dominated this category. In other items of manufacturing products, FDI firms also played an important role.

7.1.4 The Share of FDI in Dalian's Balance of Payments

The contribution of FDI in Dalian's balance of payments is another important aspect when considering the involvement of inward investment in Dalian's economy, because it reveals some other features of FDI operation. Table 7-8 shows us a general picture. First FDI constitutes a very important producer in Dalian, and its role is rising quickly. At present, there is about one fifth of total manufacturing output coming from FDI firms, compared with their share of 4% in manufacturing employment in Dalian, the high efficiency of FDI is obvious.

In addition to the effectiveness, the increase of FDI's output is much higher than Dalian as a whole. For example, in 1991, the total sales and profits of FDI firms increased 98% and 31% respectively, while Dalian as a whole only grew by 9% and 20%. It is clear that FDI does not appear only as a capital supplier, but also as a profit maker in Dalian. The double roles are increasing over time.

However, compared with the roles of FDI in investment and in exports, the share

Table 7-8 FDI in Dalian Total Sales and Profits (RMB Mn.)

Items	1989	1990	1991	1992*
A. Total sales of FDI	980	1878	3720	4070
B. Total sales of Dalian	23902	24644	26870	19740
C. A/B (%)	4.1	7.6	13.8	20.6
D. Profits of FDI	46	135	177	160
E. Profits of Dalian	655	922	1105	831
F. D/E (%)	7.0	14.6	16.0	19.3
G. Profits/Sales of FDI	4.7	7.2	4.8	3.9
H. Profits/Sales of Dalian	2.7	3.7	4.1	4.2
I. G/H	1.7	1.9	1.2	0.9

* 1-6, 1992

Sources: 1. DCFET, 1990-1992. 2. DSB, 1989-1992

of FDI in Dalian's output is still low. One reason for this may be the low operation ratio of FDI firms, resulting from learning process, or time lag between the FDI entry and its eventually operation. For instance, there were 262 FDI firms in operation in 1990 which is only 47% of the total registered FDI firms in that year. In 1991, 288 firms were in operation, which only accounted for 34%. The other reason is that the increase of profits per unit sales is much lower than its total sales growth. From rows of G-H in Table 7-8, we can see that the ratio of profits to total sales in FDI firms decreased from 1990 to 1992. Moreover, the ratio is lower than the local firms' in 1992, and it is only 54% of its own level in 1990. There are two explanations about the low increase in FDI firms.The first is the low profitable level of FDI firms, due to management problems and the learning process. For example, in 1990, among 262 operating enterprises, there were 118 profitable firms, which only accounted for 45% of operation firms. The remaining 55% were operating at a loss. The total amount of loss is RMB 96 million. Comparing with total profits of RMB 135 million, the balance is RMB 39 million. In 1991, there were 152 out of 288 operating firms profitable, and profits RMB 177 million. Although the loss ratio decreased 8 percentage points, the growth of loss amount kept the same pace with profits increase (DSB 1991). The second explanation is the erosion of taxes by hiding the profit or by transferring the profits to reduce taxes (Cheng 1991).

Table 7-9 Total Taxes Income From Foreign Investment*

Items	1985	1986	1987	1988	1989	1990	1991
No.of Levied Firms	40	97	158	164	347	520	681
Amount of Tax (RMB Mn.)	6.68	14.14	23.07	32.00	67.10	110.00	144.15

* Among it, about 50% comes from FDI and the ratio is raising.

Sources: 1. Wang (1992)
2. Dalian Center for Economic Research, 1992.

Table 7-10 Taxes Contribution of FDI in Dalian (RMB Mn)

Items	1985	1990	1991	1992*
A. FDI firms	3.23	50.43	75.23	72.00
B. All of Dalian		1487.60	1248.10	1198.18
C. A/B (%)		3.39	5.27	6.01

* 1-6, 1992

Sources: 1. Zhang (1991)
2. DSB, 1990-1992
3. Dalian Development During 7.5 Plan.

Table 7-11 Foreign Exchange Earn and Consumption ($. Mn)

Item	1986	1989	1990	1991	1992*
A. FDI Foreign Exchange Earnings	7	153	199	443	246
B. FDI Foreign Exchange Consumption			137	332	
C. Dalian Foreign Exchange Earnings	101	564	669	998	543
D. A/C (%)	7	27	30	44	46
F. A-B			62	111	

* Only 1-6 1992

Sources: 1. DCFET, 1998-1992 2. DSB, 1986-1992. 3. Guo (1987)
4. Dalian Development During 7.5 Plan. DSB 1991

The share of FDI in total sales and profits reflects the potential or indirect contribution of FDI to the balance of payments in Dalian. The taxes collected from FDI firms and the foreign exchange earned through their local operations constitute a direct contribution of FDI to the balance of payments of host region. For the former, it augments the income of local government; for the latter it relieves the restraint of foreign exchange shortage. Table 7-9 to 7-11 shows the increase of taxes collected from FDI firms in Dalian; its share in Dalian total taxes revenue; and its generation and consumption of foreign exchange in the local operation.The data indicates the following points: (1) The taxes collected from foreign firms increased very quickly, although there were various tax reductions. The rapid increase of foreign firms lays down the foundation of growth in taxes. (2) The share of FDI on all tax revenues is very low at present, only 6%, comparing with Shenzhen where the ratio is 17.5% in 1990. (Lin 1991). However, in contrast to the context that total tax revenues in Dalian are decreasing, the increase of FDI tax contributions is obvious. (3) Along with the rapid increase in exports of FDI firms, their role in foreign exchange earning is outstanding, which not only reflects the fast growth of international trade, but also large amount of profits.

7.1.5 Role of FDI In Technology Supply

There are two major ways for Dalian to make contact with outside technology. One is through technology imports e.g. buying technology abroad. The other is through utilizing foreign capital e.g. by various foreign investment. The analysis of these two types of capital flow, as shown in Table 7-12, outlines the role of FDI in supplying outside technology.

Before the mid 1980s, technology import was the dominant channel for Dalian to access outside technology. From 1979 to 1986, technology import accounted for over 80% of projects and over 60% investment of inward items, while FDI only conducted about one twentieth projects and one tenth investment into Dalian, which is only half of the level of portfolio investment in the same period. The importance of import technology was described as 229 firms imported advanced technology and equipment; 130 old firms were revamped; 4000 new products were developed; extra RMB 650 million output was created and US$ 70 million of foreign exchange was earned every year (DCFET, 1986).

However, the situation is changing, and FDI has emerged as the most important channel to contact outside technology in recent years. The data in the right hand three columns of Table 7-12 shows the opposite picture. FDI accounted for about 60%

inward projects, and about 70% inward investment. While portfolio investment is less than half of its level, and technology import only show less than 1/10 importance both in project and in investment. Although the cases of FDI inflow and technology import are not comparable for different technology transfer mechanisms behind them, the obvious decrease in technology import and increase in FDI undoubtedly indicates the dominant role of FDI as a channel to transfer outside technology into Dalian. In terms of management/organization technology transfer, technology import shows obvious disadvantages, because it is mainly concentrated in hard ware transplant. In Dalian, the figure is 94% in project and 95% in investment (DCFET, 1989-1991).

Table 7-12 Comparison of FDI Inflow and Technology Import

Items	1979-86	1989	1990	1991
A. Technology Import: Project	1212	30	25	32
Amount($ Mn.)	1080	36	20	26
B. Utilizing Foreign Capital				
Project	271	242	293	358
Amount ($ Mn.)	630	388	544	385
B-1. Among it Portfolio				
Project	177	99	108	107
Amount	430	178	155	64
B-2. Among it FDI				
Project	94	143	185	251
Amount ($ Mn.)	200	210	389	321
C. Total				
Project	1483	272	318	390
Amount ($ Mn.)	1710	424	564	411
D. A/C (%) Project	81.7	11.0	7.9	8.2
Investment	63.2	8.5	3.6	6.3
E. B-2/C Project	6.3	52.6	58.2	64.4
Investment	11.7	49.5	69.0	78.1
F. A/B (%) Project	447.2	12.4	8.5	8.9
Investment	171.4	9.3	3.7	6.8
G. A/B-2 (%) Project	1289.4	21.3	13.5	12.8
Investment	540.0	17.1	5.1	8.1
H. B-1/B-2 (%) Project	188.3	69.2	58.4	42.6
Investment	215.0	84.8	39.9	19.9

Sources: 1. Statistics of Dalian, 1986, 1989-91.
2. DCFET, 1985-1991.

Table 7-13 Involvement of FDI In Dalian High-Tech Park

Items	A. FDI	B.Hi-Tech Park	C. A/B(%)
a. Project	14	132	10.6
b. Investment (RMB Mn)	8.30	66.15	12.54
electronics	0.15	9.12	1.60
photo-electrical	6.90	21.85	31.6
material	1.05	14.64	7.1
other	0.20	11.96	1.70
c. Employee No.	515	4488	11.48
d. Technician No.	314	2817	11.15
e. c/d (%)	61	63	97

Source: Dalian Committee of Science & Technology (DCST), 1992.

The overall role of FDI as a technology supplier can also be observed from its share in Dalian High Technology Park (DHTP), which is located in the area of the university and research institute of the old city. Table 7-13 shows this involvement of FDI in this region. Two conclusions can be drawn from the data. First, the involvement level is about one tenth, whether in terms of project, investment, or skilled and unskilled employment. Secondly, among ten industries listed by DHTP, FDI only enters four, and shows importance only in the photo-electrical industry.

7.2 Accessing Conditions--Characteristics of FDI In Dalian

Unlike the last section in which FDI was treated as a part of Dalian's economy, this section will treat FDI in Dalian as a whole system, and examine its characteristics by dividing it into different subsystems. Through the analysis of FDI motivation feature; ownership pattern; national origin structure; investors' status; sectoral and regional destination, it attempts to reveal the contact "atmosphere" or environment between FDI and the host region. It is clear that the more favorable the contact condition, the higher the externalities that will result from inward investment.

7.2.1 Accessing Aims--Two Sides' Motives

It is the willingness of supplying and receiving technology that lays down the foundation of contact between foreign investor and local partner in international cooperation, in terms of technology transfer. The case study uses a postal questionnaire to investigate the motives of foreign investors and local partners at the same time. The answers are displayed in Table 7-14. The information not only shows

the common phenomena which appeared in other developing regions, but also reveals some characteristics in current Dalian.

Table 7-14 Motivation Breakdown of FDI Enterprises

Motives	Project		Total Invest.		Register Invest.		Foreign Invest.	
	No.	%	$Mn.	%	$Mn.	%	$Mn.	%
Foreigners:								
Accessing Chinese Market	92	26	764	70	451	70	305	58
Getting Low Cost	178	49	225	21	138	22	151	29
Getting Favorable Policies	61	17	43	4	12	2	30	6
Getting Natural Resources	30	8	56	5	40	6	39	7
Total	361	100	1088	100	641	100	525	100
Local Partners:								
Getting Favorable Policies	98	34	121	12	60	12	74	17
Getting Capital	72	25	572	59	371	73	212	50
Getting Production Know-how	46	16	133	14	31	6	60	14
Getting Organization Know-how	46	16	48	5	13	3	32	7
Capital & Production Know-how	19	6	94	10	34	7	57	13
Getting Two types of Technology	10	3	9	1	2	0	7	2
Total Answer	291	100	977	100	510	100	442	100

Note: Total Investment means the all investment required by the FDI project;
Registered Investment means the assets possessed by the investors themselves.
Foreign Investment means the amount invested by foreign investors

Source: Postal Questionnaire Analysis

From the point of foreign investors, motive structure is characterized by: (1) Quite a big difference between project structure and investment structure. According to the number of FDI firms, low cost of production is the most attractive point for foreign investors, followed by market lure, incentive policies, and natural resources exploitation. In terms of the amount of committed foreign investment, accessing the

Chinese market is the main target of foreign investment. Low cost, natural resources, and incentive policies are ranked after market accessing. (2) Among the four types of motivations, market access and low cost are the dominant. 75 percent of FDI firms in Dalian are in these two categories. In terms of investment, their share is as high as 87%. (3) Incentives pursuers show importance in projects, but lost their importance in investment. The data shows that nearly one fifth of FDI enterprises in Dalian are set up by the influence of favorable policies. But their share in foreign investment is the lowest, only about 1/20. (4) Accessing natural resources is only a small number of FDI in Dalian, however, it is the most balanced in terms of its share in projects and in investment. This, on the one hand, reflects the fact that the attractiveness of natural resources is limited; on the other hand, reflects the situation that resources orientation is quite stable.

In terms of local partners, the situation is very surprising. Firstly, more than one third of the local partners do not aim to get anything from foreigners by setting up an international cooperation project, but aim to get something within China--getting favorable policies offered by the Chinese government. It sounds strange that the incentive policies have more influence on Chinese enterprises rather than on foreign firms. However, if the current situation that China is being transformed from a planned economy to a market economy is taken into account, the puzzle is easily understood. In current China, a firm possessing a status of FDI enterprise can get a lot of benefits. For example, taxation levied on the firm will be reduced to half of the average level; it can enjoy the rights to do the business of imports and exports; it may change management style; and it can easily get loans from banks. If a firm cannot get a status of FDI firm, during the campaign to attract foreign investment, there will be a high pressure on the managers of local enterprises. Keeping this in mind, it is also easy to understand why only about one sixth of foreign investment falls into this category, because the Chinese partners are not so serious in getting capital and other benefits, but only in obtaining a FDI enterprise identity.

Secondly, thirst for capital is another important factor which drives the local partners to embrace FDI. Among the 291 answers from local partners, a quarter aim to get funding from foreigners. And they have managed to absorb more than half of the foreign investment into their projects. In the category of registered investment, its share is as high as 73%. If accounts the another 13% foreign investment in the group of getting capital and production technology, the share of capital pursuing could be nearly one third in project and two thirds in committed foreign investment.

Table 7-15 Changes in the Two Sides' Motivation Over Time (Project)

Motives	--1988		1989		1990		1991	
	No.	%	No.	%	No.	%	No.	%
Foreigners:								
Accessing Chinese Market	18	46	21	22	23	21	30	25
Getting Low Cost	16	41	47	50	58	54	57	48
Getting Favorable Policies	2	5	16	17	20	19	23	19
Getting Natural Resources	3	8	10	11	7	6	10	8
Total	39	100	94	100	108	100	120	100
Local Partners:								
Getting Favorable Policies	9	22	17	23	31	39	48	46
Getting Capital	18	44	19	25	19	24	16	15
Getting Production Know-how	6	15	17	23	10	13	13	13
Getting Organization Know-how	3	7	17	23	13	17	13	13
Capital & Production Know-how	3	7	2	3	6	7	8	8
Getting Two types of Technology	2	5	2	3	0	0	6	5
Total	41	100	74	100	79	100	104	100

Source: Postal Questionnaire Analysis

Thirdly, getting technology from outside China is also a main motivation, but only limited foreign capital (one fourth) falls into this category. Among local partners whose orientation is technology, half of them aim to obtain production know-how, while the other half attempts to get organizational know-how. The difference between them is that the former is closely connected with capital acquiring or equipment imports, and the latter is not so keen to get capital, so that the latter's share in foreign investment is only the half of the one in the former.

Resulting from the above discussion, it is clear that access motives of the two sides do not set a favorable environment for transferring technology. Many foreign investors come to Dalian aiming to reap the advantage of low cost production and access to the market, while many local partners are thirsty for deregulation and incentives.

The survey also finds that the structure of motives of foreign investors and their

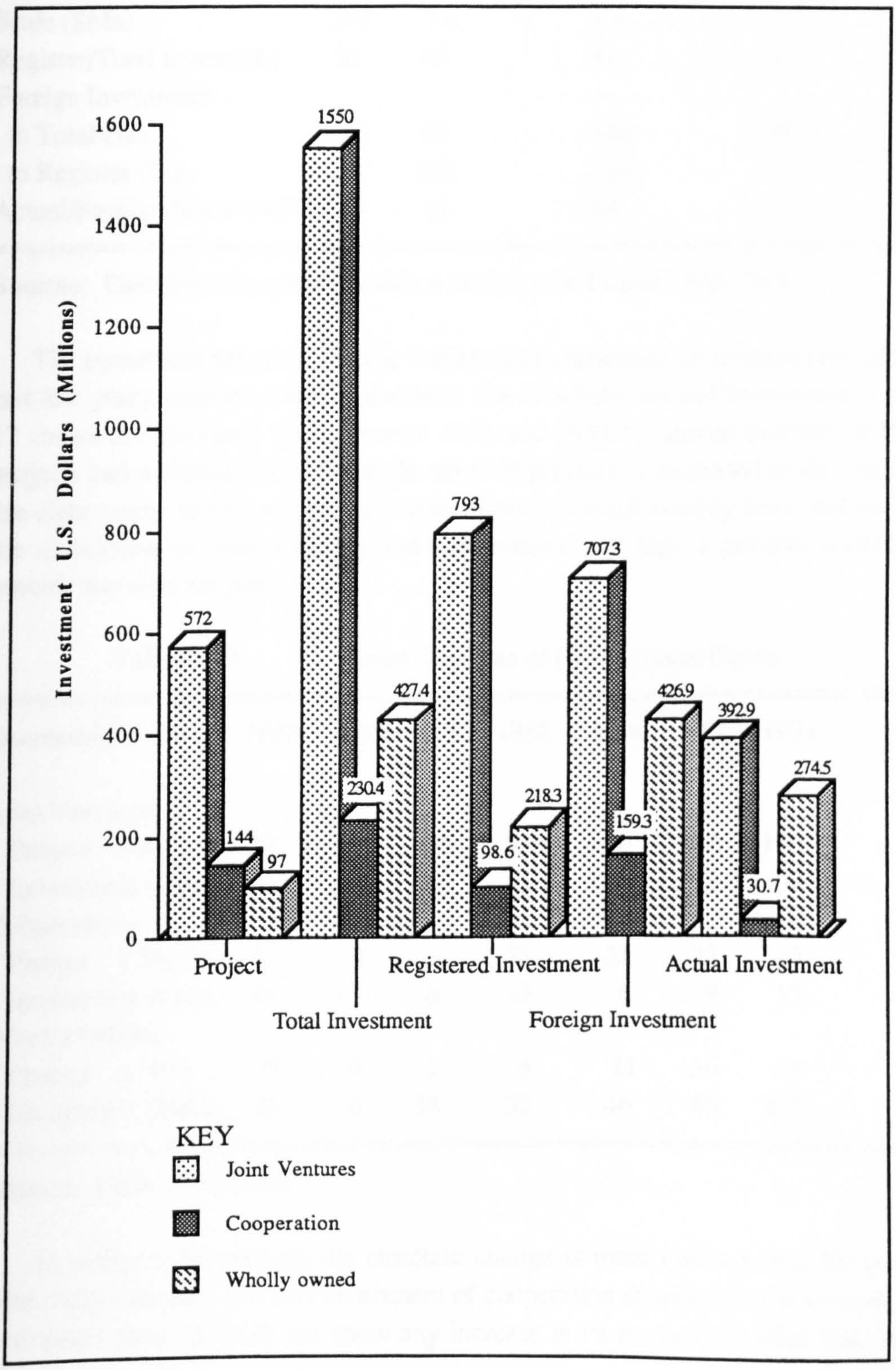
local partners do not show a favorable change over the last few years. Table 7-15 shows the distribution of FDI projects in different motives over the time. It is clear that incentives pursuers both in foreign and local partners do not decrease, and the share of local partners who aim to obtain production technology does not increase.

7.2.2 Accessing Channel--Ownership Pattern of FDI

It was seen in chapter six that FDI in Dalian can take three forms: Joint ventures, Cooperation and Wholly owned firms. Different investment forms shows various technology transfer mechanisms, as discussed in chapter 4. Therefore, the ownership pattern can be used as another variable to check the accessing condition. From Figure 7-2, which shows the form structure of FDI in Dalian, we can see that joint ventures is the dominant form of FDI, both in project and in investment, while wholly owned firms show more importance in investment amount and cooperation only shows some importance in project numbers. Since the mechanism of transfer technology in joint ventures is mainly in learning by sharing, this ownership structure is good for local firms to access inward technology. However, analyzing the relations between five indexes in the figure 7-2, of which "actual foreign investment" means the amount of foreign investment which has been utilized by Dalian based on contracts, some characteristics emerge from Table 7-16.

Firstly, the share of foreign investment in joint ventures is lower than the other two forms. The ratios of foreign investment to total investment and to registered investment in joint ventures are quite low. In the first ratio, it is only two thirds of cooperation and a half of wholly owned. In the last is further lower, only a half of cooperation and 40% of wholly owned. These data show that although joint ventures is now a main component of FDI in Dalian, it is not so effective as other forms in increasing the share of foreign investment in projects. Secondly, the scale of investment in joint ventures is only half that of wholly owned, although it is much bigger than cooperation. It is clear that wholly owned firms are more capital-intensive than joint ventures and cooperation firms. Thirdly, cooperation not only shows the highest debt ratio, the smallest investment scale, but also the lowest foreign investment utilization, which is only one third of joint ventures and one fourth of wholly owned subsidaries. It suggests that its financial resources rely more on loans or local partners.

F 7-2 Ownership Structure of FDI



PAGE NUMBERING AS ORIGINAL

Table 7-16 Investment Features of Three Forms

Items	Joint	Cooperat.	Wholly	Average
Scale ($Mn)	2.7	1.6	4.4	2.7
Register/Total Invest.(%)	51	43	51	50
Foreign Investment				
to Total (%)	46	69	100	59
to Register (%)	89	162	196	117
Actual/Foreign Invest.(%)	56	19	64	54

Sources: Calculated by author based on Statistics of Dalian 1985-1991.

The ownership pattern of FDI in Dalian has experienced an obvious change in the last few years, characterized by the rapid rise of wholly owned investment. Table 7-17 shows the changing trend between 1985 and 1991 by annual increase of FDI in projects and in foreign investment. In terms of projects, it increased in all forms over the eight years. However, wholly owned firms, although coming later, did not show the undulation of joint ventures and cooperation, and kept a positive accelerating growth rate over the period.

Table 7-17 Annual Increase of FDI In Three Forms

Ownership \ Year	1985	1986	1987	1988	1989	1990	1991
Joint Ventures							
Project (No.)	37	20	19	99	110	127	160
Investment ($Mn.)	49	43	48	44	156	297	89
Cooperation							
Project (No.)	13	6	7	22	22	22	43
Investment ($Mn.)	94	13	6	15	6	9	17
Wholly Owned							
Project (No.)	0	0	1	6	11	36	48
Investment ($Mn.)	0	0	33	30	46	83	235

Sources: DSB, 1985-1991.

In terms of investment, the structure change is more obvious than for projects. After only one year, the new investment of cooperation dropped to one seventh of the first year's level, and did not show any increase in its importance after that. Wholly

owned investment keep the same trend as in project change, but at a much higher growth rate. It overtook cooperation in 1987 only one year after entering Dalian. In 1991 it surpassed joint ventures and became the main stock of new foreign investment. It is worthy noting the huge fluctuation in joint ventures since 1989. The data shows in 1989, 1990 and 1991 the annual increase of foreign investment in Dalian was $156.7, $295.5 and $89 million respectively. 1990 was nearly double that of 1989 and it fell dramatically to only a quarter of 1990's level in 1991. However, if we deduct the 60% of investment in 1990, which comes from the foreign branches of Chinese companies instead from foreigners (Dalian Statistic Bureau 1991), the fluctuation is not so huge, and the downturn point of joint ventures should be one year earlier. It not only suggests that joint ventures are more sensitive to the political stability--it was very affected by 1989's Tiananmen event, but also indicates that wholly owned investment had overtaken joint ventures in 1990. The rising of importance of wholly owned firms in ownership structure signals the worsening of accessing atmosphere from one angle.

7.2.3 Accessing Objective--National Origin of FDI

One characteristic of foreign investment in Dalian is the variety of national origins. By the end of September 1992, there were over 15 countries and regions' investors came to Dalian. All foreign investors, according to their national origin, can be divided into three types: (1) Hong Kong, Macau and Taiwan investors. They are all Chinese, but outside mainland China. (2) Japan investors, and (3) Other investors which are dominated by the Western countries. Table 7-18 shows the breakdown of these three types of investment.

Table 7-18 Breakdown of FDI National Origins

		HMT*	Japan	Western	Total
Project	(No.)	405	244	184	813
	(%)	50	30	20	100
Foreign Investment	($Mn)	475.1	563.1	248.2	1286.4
	(%)	37	44	19	100

* Hong Kong, Macao and Taiwan.

Sources: DSB, 1985-1991

It is apparent that outside Chinese investment is dominant in the number of projects. It accounts for about half FDI projects, and the other half is shared by Japan and Western investors. However, in terms of the amount of investment, Japan ranks the first. Its share in all foreign investment is over 40%. Hong Kong, Macao and Taiwan dropped to the second with a share of over one third. The investment ratio of Western investors concords with their share in project, about one fifth.

Table 7-19 Differences of FDI National Origins

Items	H.M.T	Japan	Western
FDI Enterprises' Distribution (%)			
Ownership Form			
Joint ventures	78	41	64
Cooperation	14	23	16
Wholly owned	8	36	20
Sector Distribution			
Hi-tech Sector	37	20	39
Traditional Sector	63	80	71
Technology Sending Capability*			
High	24	55	47
Medium	66	38	52
Low	10	7	1
Market Orientation			
Domestic	48	32	57
Outward	52	68	43
Foreign Motivation			
Market	20	15	54
Low cost	47	64	34
Policy	23	15	7
Natural Resources	10	6	5
Average Investment Scale ($1,000)			
Total Investment	2925	3135	3034
Registered Investment	1784	2192	1128
Foreign Investment	1229	1603	1737

* Measured by the technological distance between foreign investors and local partners or local same trade

Source: Postal Questionnaire Analysis

The main differences among the three national origins of FDI are listed in Table 7-19, based on the answers of FDI firms in different categories. There are three scenarios emerging from it. Overseas Chinese prefer to take joint ventures and hardly use wholly-owned; they seems to be show quite high technology sector-oriented. However, their technology sending capability is much lower; they do not show a propensity for market penetration, and domestic and international market is nearly half and half.

Japanese investment is characterized by being more likely to set up wholly-owned subsidiaries; most projects belong to traditional activities and using standard technology. However, their technology level is comparatively high. Japanese investment shows the lowest market entry temptation, because it focuses on exploiting the low costs, and 70% of Japanese projects are international market oriented. The average scale of Japanese investment is the largest among all the investors.

Western investors, although they use joint ventures as the main channel, also have a high tendency to adopt wholly-owned firms. They show the highest high technology sector distribution and highest technology sending capability. At the same time, western investment shows the highest domestic market penetration, and most of them aim to access the Chinese market.

Table 7-20 Annual Increase of FDI in the Three Origins

National Origin \ Year	1985	1986	1987	1988	1989	1990	1991
Hong Kong, Macao & Taiwan							
Project (No.)	29	12	15	71	74	98	108
Investment ($Mn.)	81	36	23	111	32	41	41
Japan							
Project (No.)	16	5	7	35	49	49	83
Investment ($Mn.)	29	25	38	107	142	80	141
Western							
Project (No.)	5	9	9	21	20	38	62
Investment ($Mn.)	6	41	74	28	35	25	40

Sources: DSB, 1985-1991.

Comparing the three scenarios, we can conclude the following: (1) Western investment offers more favorable opportunities for local firms to access inward

technology. (2) Domestic market penetration and high technology entry seems to have a close positive relation. The more domestic-oriented the market, the more favorable technology accessing environment.

The change in the national origins of FDI over time, as shown in Table 7-20, displays three patterns. Firstly, HMT has shown the largest annual increase projects, however it lost its importance in investment. During 1986-87 there was an obvious slow down, both in project and investment. That agreed with the national situation, during that time central government tried to cool the inflated economy. It suggests that overseas Chinese are more sensitive to the policy changes. In 1988, investment and projects both had a rapid increase. That, on the one hand, was a result of booming of economy, on the other hand resulted from the large entry of Taiwan investors. Before 1988, the investment of Overseas Chinese was dominated by Hong Kong and Macao. Since 1988 investment from Taiwan has been over 20%.

Secondly, Western and other investments shows a steady increase in projects, however, investment since 1987 has been stagnant. The reason for this is the wane of Western investment was compensated by the rise of other investment such as from Korea.

Thirdly, Japanese investment has increased very quickly, both in project and investment. For projects, the increase was without any hesitation. The gap with HTM diminished in 1991. For investment, it was nearly equal to HMT in 1988, and overtook it in 1989. Although there was a sharp drop in 1990, it was still the main stock of that year's investment. In 1991 the dominant role of Japan investment is prominent. It is greater than the sum of all other investment.

7.2.4 Accessing Objective--Investors' Status of FDI

Status here means the identity of investors. It is also an important variable to determine the behavior of investors in current China, since in the last decade the investment climate in China is very complicated, and the investors entering the territory are heterogeneous. In the survey, we concentrated on comparing the following three types of investors: (1) the companies with manufacturing or manufacturing companies; (2) trading companies; (3) individuals and other investors.

Table 7-21 displays the status structure both in project and in investment. Same as the above breakdowns, the differences between them are obvious. In terms of the project number, trading companies are dominant among all investors. Nearly 60% of projects were set up by them. Manufacturing companies rank the second with a share

of 30%. Individual and other investors are the smallest portion are only account for over 10%. As for investment, the situation is different. Companies with manufacturing are dominant overall. In contrast to it, the role of trading companies is dramatically decreased, and individual's investment is also much smaller than its project share.

Table 7-21 Investors' Status Structure of FDI

Items	Company With Manu.	Trading Company	Individual & others	Total
Project (No.)	109	206	46	361
(%)	30	57	13	100
Total Investment				
($ Mn)	817	243	29	1089
(%)	75	22	3	100
Register Investment				
($ Mn)	543	89	9	641
(%)	85	14	1	100
Foreign Investment				
($ Mn)	355	149	20	524
(%)	68	28	4	100

Source: Postal Questionnaire Analysis

There are several reasons to explain this structure. Firstly, after long isolation, when China began to embrace FDI, trading companies were pioneer investors, because the risks involved in their entry were quite low. In many cases the investment they put in was the goods they were selling. Secondly, Dalian is quite far from Hong Kong and near Japan, so the main investors who aimed to exploit the low cost come from Japan instead of from Hong Kong. That makes the investment scale of manufacturing companies comparatively large. Thirdly, a lot of overseas Chinese who combine cultural heritage and business opportunities consist of the main stake of individual investment, which differs from MNCs overseas operation.

Further analysis reveals that there are several differences among the three status. (1) Most trading companies come from HMT; nearly half of the manufacturing companies come from Japan, and the number of individual investors is in proportion to the distance from China, HMT the first, Japan the second and the West the third. (2) Individual investors prefer to cooperate with local firms, especially in joint

ventures, while manufacturing companies enjoy setting up wholly owned enterprises. Trading companies are reluctant to cooperate with old factories to set up grafting enterprises, although they show the highest tendency to adopt various FDI forms. (3) Companies with manufacturing have high technology sending capability, and prefer to choose a partner with a sound technological foundation; while in the other two, technology sending capabilities are quite low, and FDI seems not to care about the technology level of their local partners.

The above comparison reveals a dilemma: manufacturing companies are ideal carriers of technology, however, they are isolated by taking wholly owned forms of FDI. In addition to that, the share of manufacturing companies in annual FDI decreased from 44% before and in 1988 to 26% in 1991, in terms of projects. Individual investors and trading companies increased respectively.

7.2.5 Accessing Field--Regional Distribution of FDI

In chapter 6.4 that the three main investment locations for foreign investors in Dalian were discussed. Table 7-22 shows the spatial distribution of FDI in these areas between 1985-1992. It is apparent that three areas share the FDI projects, but the new town or ETDZ is more prominent in hosting FDI investment, and nearly 60% of investment is attracted into this area. The high concentration of FDI in the new town's differentiates Dalian from many other coastal cities (Cheng 1992, Zhang 1994).

Table 7-22 Breakdown of FDI Spatial Distribution

Items	Old City	New Town	Suburb	Total
Project (No.)	261	271	281	813
(%)	32	33	35	100
Invest. (RMB Mn.)	703	1251	262	2116
(%)	33	59	13	100

Source: DETDZ, 1992.

The survey finds that FDI located in different areas shows the following operation characteristics: (1) FDI located in the old city center usually takes the form of joint ventures; projects located in the new town are more likely to be wholly owned, while in the suburb, cooperation shows the highest tendency to be adopted. (2) The firms operated in the new town display the lowest profitable level, while the suburb firms show the highest profitability. (3) Foreign investors in the new town shows the

highest technology level. 45% FDI projects in the new town are with high technology sending capability, while in the old city and the suburb, the ratio is only 37% and 19% respectively. (4) In terms of the technology absorptive capability of local partners, FDI firms located in the old city center rank at the top, while FDI firms in the new town rank at the bottom.

Summarizing the above differences, it is still difficult to evaluate the role of FDI in offering accessing opportunities for local firms, when they are located in the new town. In terms of attracting FDI, the new town is successful. Within 7 years, it developed from a stretch of agricultural land to a skeleton of modern city with a population of 1,000,000. Without this new town, it would have been difficult to attract high technology level projects into Dalian. However, in terms of contact between foreign investment and local firms, the new town is dominated by wholly owned firms, and these FDI firms are in a more isolated environment. It is difficult for indigenous firms to access them. The lump development of new town such as the establishment of Taiwan industrial park and Japan industrial park in the new town (Dalian Daily October 30 1992) may further this isolation.

7.2.6 Accessing Field--Sectoral Distribution of FDI

The intra-industrial structure of FDI, according to the customs of local statistics, is displayed in Table 7-23. It is apparent that: (1) engineering attracts the most FDI projects, but chemical, rubber & plastic absorb most investment among the ten industries, no matter which criteria are measured. The reason for concentrated investment in this industry is that the biggest project in Dalian falls into this industry. Western Pacific Oil Refinery Co. is a joint venture between China, Hong Kong and France. It is designed to refine 5 million tons oil annually with total investment nearly 300 million, which accounts for about 70% of this industry and nearly 30% of total investment. (2) Electrical, engineering, textile, chemicals and construction materials are five industries which account for 70% FDI projects, and over 80% foreign investment. The investment is more concentrated than projects among FDI. (3) High technology industries which include electrical, chemicals and pharmaceutical accounts for only one third of projects, but stands for half of investment. It indicates that high technology projects are large scale and/or capital intensive.

The current sectoral structure of FDI in Dalian can be examined through the following three dynamics. (1) The foundation of previous industry plays an important role in attracting the same trade to enter Dalian. Engineering and textile industries are examples. (2) The hub location and huge hinterland are also conditions which show

advantages for attracting new activities. For example, the huge Western Pacific Oil Refinery Co. which aims to import crude oil and export oil products after processing. RiQing, a food processing enterprises, intends to use the abundant soybean resources within the hinterland. (3) The big technology gap between local firms and FDI leads foreign investors to enter that field. Most projects in electronics industry belong to this category.

Table 7-23 Industrial Structure of FDI

Industries	Project		T-Invest.		R-Invest.		F-Invest	
	No.	%	$Mn.	%	$Mn.	%	$Mn.	%
1. Electrical & Electronics	57	16	130	12	81	13	74	14
2. Engineering	71	20	157	14	81	13	87	17
3. Textile	49	14	65	6	35	5	41	8
4. Chemical, Rubber & Plastic	47	13	437	40	298	46	169	32
5. Food Processing	44	12	30	3	17	3	23	4
6. Leather & Products	10	3	22	2	12	2	16	3
7. Pharmaceutical	11	3	34	3	18	3	33	6
8. Hand Crafting	28	8	9	1	3	1	7	1
9. Construction Materials	20	6	187	17	91	14	64	12
10. Others	24	7	18	2	6	1	12	2
Total	361	100	1,089	100	642	100	526	100

Source: Postal Questionnaire Analysis

In addition to the investment share, there are some other differences among the ten industries. First the access motives of both sides in FDI enterprises vary with industries. As shown in Table 7-24, foreigners who enter the high technology industries show a high tendency to exploit the market, and they are more concerned with saving when they enter standard industries. The local partners, in high technology industries, pay more attention to production technology; in high competition traditional industries such as engineering, they are concerned with organizational technology, while in low competition standard industries, they mainly aim to get favorable policies.

Table 7-24 A Comparison of the First Two Motives Among Ten Industries

Items	1	2	3	4	5	6	7	8	9	10
FDI Enterprises' Distribution (%)										
Foreigners Motivation										
Market	46	28	8	47					25	
Cost	33	59	90	34	27	80	36	61		54
Policy							27	21	60	25
Resource					34	20				
Local Partners Motivation										
Policy	33	28			41	22	22	48	68	42
Capital		22	47	27		33	33		21	
Production tech.	30			27	27					21
Orgnisation tech.			31					29		

Source: Postal Questionnaire Analysis

Table 7-25 Investors' National Origin and Ownership Form Differences Among Ten Industries (%)

Items \Sectors	1	2	3	4	5	6	7	8	9	10
FDI Enterprises' Distribution (%)										
FDI Form										
Joint	68	56	59	72	52	80	82	54	75	71
Coope.	7	18	14	15	32	0	0	21	20	29
Wholly	25	26	27	13	16	20	18	25	5	0
National Origin of FDI										
HMT	49	41	69	60	66	90	27	71	65	54
Japan	44	50	20	36	25	0	36	4	25	25
Western	7	9	11	4	9	10	37	25	10	21

Source: Postal Questionnaire Analysis

Secondly, although HMT are major investors in all industries, their dominance is less in high technology industries, while Japanese and Western investors are higher in these fields. Contrasting with this situation, ownership differences among the ten industries show a different picture. Joint ventures are the most popular form among the three ownership forms, and their dominance is more obvious in high technology industries than in standard sectors, as shown in Table 7-25.

Thirdly, in standard industries, old property and equipment can be an advantage to attract FDI, but in high technology industries, these conditions are hardly seen as advantages. For example, in textile, food processing, leather products and construction materials industries, FDI not only tend to set cooperation firms with local partner, but also tend to use the old factory as the production place. In these industries, joint ventures and cooperation generally account for over 80%. Among them the grafting enterprises account for over 30%. However, in pharmaceuticals and electronics, although cooperation with a local partner is also common, the grafting enterprises account for a very low ratio, only 7% in the former and 18% in the latter. In another group of high technology industry--chemical, rubber and plastic--the ratio is as high as 28%, but it is mainly accredited to the low technology plastic products production, which is a big stake in this industry. Along with this deviation, most projects of standard industries prefer to locate in the old city, while high technology projects enjoy being located in the new town. It is clear that activities which are resources-oriented tend to locate in the suburb. For example, in construction materials and food processing nearly half and one third of firms respectively are located in the suburb. Table 7-26 displays these differences.

Table 7-26 Differences of FDI Firms Type and Location Among Ten Industries

Items	1	2	3	4	5	6	7	8	9	10
FDI Enterprises' Distribution (%)										
Attribute of FDI Firm Type										
Grafting	18	27	37	28	41	40	9	18	30	21
Newly set up	82	73	63	72	59	60	91	82	70	79
Location of FDI										
Old city	61	46	51	56	50	70	46	76	35	69
New town	33	34	29	33	22	20	45	16	20	12
Suburb	6	20	20	11	28	10	9	8	45	19

Source: Postal Questionnaire Analysis

Fourthly, as shown in Table 7-27, there are three types of combination between technology sending capability and absorbing capability. One is high sending and high receiving combination, which only shows in the engineering industry. The second is high sending capability, low receiving ability, which is reflected in high technology industries. The third type is that technology sending capability is low, while local partners receiving capability is comparatively higher. The other industries all belong to this category.

Finally, it is a fact that the share of the high technology sector, measured by electrical & electronics, chemicals, rubber & plastic and pharmaceuticals, do not show an increasing trend in the FDI industrial distribution, as indicated by Table 7-28. In the electrical & electronics industry, 23% of projects were distributed to this field before 1989, and only 18% in 1991. In the chemical, rubber & plastic industry, although 1990 experienced a raise in the share, other years are below the 1988 and before's level, and 1991 dropped to the lowest point. In pharmaceuticals there is no obvious decreasing, nor increasing trend, the figure keeps about 3%. But as a whole the share of high technology industries drops from 44% in 1988 and before, to 29% in 1991. Another fact shown by Table 7-28 is that engineering and textile industries are two traditional industries which show a clear increasing trend. The difference between them is that the textile industry increased smoothly and did not show any fluctuation; while engineering increased rapidly but shows a fluctuation.

Table 7-27 Sectoral Differences of Two Sides' Technological Capability

Items \Sectors	1	2	3	4	5	6	7	8	9	10
FDI Enterprises' Distribution (%)										
Technology Sending Capability In FDI Firms*										
High	57	51	31	40	20	20	45	21	15	29
Medium	30	42	41	57	73	65	36	71	60	63
Low	13	7	28	3	7	15	19	8	25	8
Technology Receive Capability In FDI Firms										
High	35	48	48	45	53	44	40	46	42	42
Medium	33	16	18	21	28	22	30	25	42	33
Poor	32	36	34	34	19	34	30	29	16	25

* Measured by the technological distance between foreign investors and local partners or same local trade

Source: Postal Questionnaire Analysis

The change of FDI industrial distribution pattern can be attributed to many factors, however, the previous industrial structure can be used in explaining the differences. The three high technology industries which show a decreasing trend in the share of total FDI are comparatively weak in their technological foundation in Dalian. Engineering and textile, which show clear increase trend over time, possess a strong industrial foundation locally. It suggests that the structure of FDI industrial distribution is affected by previous investment to some extent.

Table 7-28 Change of FDI Sectoral Structure Over Time

Items	--1988		1989		1990		1991	
	No.	%	No.	%	No.	%	No.	%
Electrical & Electronics	9	23	17	18	9	8	22	18
Engineering	4	10	17	18	26	24	24	20
Textile	4	10	12	13	15	15	18	15
Chemical,Rubber & Plastic	7	18	11	12	20	19	9	8
Food Process	6	15	8	9	13	12	17	14
Leather & Products	0	0	4	4	3	3	3	2
Pharmaceuticals	1	3	4	4	2	2	4	3
Hand Crafting	3	8	10	11	8	7	7	6
Construction Materials	2	5	6	6	3	3	9	8
Others	3	8	5	5	9	8	7	6
Sum	39	100	94	100	108	100	120	100

Source: Postal Questionnaire Analysis

Summary

The rapid increase in inward investment has given FDI an important role in Dalian's economy. It not only offers an additional capital source, but also a profit maker in the local economy. It serves either as an export engine, or a main channel to bring in outside technology. At present, new FDI accounts for about 25% of Dalian's annual fixed capital investment. In certain high technology industries, inward investment has become the dominant source of capital. In terms of output, about 20% of Dalian manufacturing total sales and profits are made by FDI firms; nearly half of its exports and foreign exchange is through or earned by them. Besides this, 5% of Dalian's total work force is employed by FDI firms, and 70% of opportunities to contact outside technology are through FDI. The high involvement of FDI in Dalian's economy provides local firms with good possibilities to access inward technology both in production and management aspects, through manufacturing or exporting activities.

However, further analysis reveals that the environment for local firms to access inward technology is not so favorable. Firstly, the distorted contact motives, especially on the local side, fail to let participants focus on technology transfer.

Secondly, the high ratio of low-technology carriers among foreign investors, which is characterized by high share of trading companies and Hong Kong and Taiwan investment, lowers the technology value among the contact. Thirdly, the dilemma in contact channels--high technology carriers are more isolated by adopting wholly owned forms, while enthusiastic cooperative foreign partners lack the required technology--limits the use of various learning mechanisms. Fourthly, the distribution of FDI reinforces the difficulties for local firms to access inward technology. Because, on the one hand, the share of high technology industries shows a decreasing trend, although FDI showed a favorable sectoral structure at the beginning; on the other hand, the concentration of high-tech projects in the new town worsens the unbinding possibility of local firms. In short, the accessibility of local firms to inward technology shows a high potential for substantial involvement of FDI in Dalian's economy. However, it is over shadowed by poor contact conditions.

CHAPTER 8. OBTAINING EFFECTS OF TECHNOLOGY TRANSFER BY FDI

8.0 Introduction

This chapter presents the second part of the survey findings. It aims to directly measure the technology transfer to Dalian through FDI by checking the obtaining effects. These have been defined in Chapter 5 as the acquisition of technology by local enterprises or local personnel from foreign investors within the FDI firms. 'Technology Ball' synthesized in chapter 2 and technology transfer model displayed in chapter 4 are the theoretical foundation of this measurement.

In order to obtain a complete understanding of this effect, section one of this chapter displays the acquiring potential or the technology value of foreign investment through measuring the technological gap between foreign investors and local partners or local same trades. Section two checks the acquiring result or technology transferability of FDI by examining the diminishment of the technological distance between foreign investors and local partners or local firms. At the same time, the factors which affect the transferability of FDI are analysed from three aspects. Section three scrutinizes the acquiring process, in which technology transfer is divided into the flows of six components of technology. Among the three sections, the first two are macro analyses, which treat technology transfer as a whole and identify the overall technological value and technology transferability of FDI. The final section is a micro analysis. It not only deals with technology transfer at component level, but also breaks down the current spectrum of transferability of FDI into several conducting models.

8.1 Acquiring Potential--Technology Value of FDI

It has been mentioned in chapter 4 that the quantitative increase of FDI in China has been widely discussed, while the qualitative aspect of FDI had received little attention, and there is not a suitable method for measuring technological value of FDI in current China, because the data of value added is impossible and R & D activity is low. In the case study, we chose another replacement--technological gap between foreign investor and local partner or local same trade evaluated by FDI firms as an index to reflect the technology value of FDI in Dalian. The potential of direct technology transfer can be viewed from analyzing the width and structure of this gap.

8.1.1 Width of the Technological Gap

The precondition of technology flow between FDI and the host region is the difference of technology development level between home and host region (Smali 1985, NEDC 1989). The distance between the two ends determines the potential of technology transfer. The larger the gap, the more knowledge could be obtained from inward investment. In the survey, we ask FDI firms to estimate this gap between foreign investor and local partner or with local same trade, in terms of production and organization know-how. Two measures were suggested: (1) How many years is it for the technology developer to develop the technology brought by foreign investor, based on the technology previously used by local firms? For example, the time gap of color TV displacing white and black TV technology. (2) How many years are needed for local firms to overcome this gap by themselves, based on their technology capability before FDI came?

Table 8-1 Perceived Technology Gap Between FDI and the Host Region

Items	No.	Total	Percentage
Much Higher (>15 Years)	44	361	12
Quite high (10-15 Years)	96	361	27
Some High (0-9 Years)	195	361	54
Lower (< 0 Years)	26	361	7

Source: Postal Questionnaire Analysis

The answers, which are listed in Table 8-1, testify to the first hypothesis we set up in chapter 5 that the technology level in most FDI enterprises is higher than the local partner's or local same trade's. 93% of the firms thought that there was a technological gap between the two sides. Although this figure may be exaggerated, as discussed in chapter 5.3.3, it does prove that possessing technology advantage is a precondition for most foreign investors to enter China. Secondly, they show the gap between foreign investors and local firms or same trades is not big. The majority of FDI firms only show a couple of years' technological advance, and a 0-10 years technology gap stands for more than 50% of all answers. Compared with an estimation that the technological gap between China and Western countries is over 20 years (Ball et al 1993), this technology margin seems narrow. Compared with other Chinese cities such as Tianjing where 40% of FDI shows obvious advantages in technology (Wu 1989)--which may be compared with our over ten years technology gap categories, the technology gap in Dalian is not big. Thirdly, they reveal that there

are speculative investments in Dalian, e.g. foreign investors invest in Dalian with even lower technology level than local firms'. The following two facts should be borne in mind: (1) This figure may be higher than the answers; and (2) There are about 8-9% FDI projects which are cancelled before they set up (Ma 1992), so this situation may be more serious than first appears.

If the technology gap can be used as a major index to measure the technology value of FDI, the deviations of this technology gap among various FDI firms reveals the relation between FDI technology value and different variables, as shown in Table 8-2. The most obvious phenomenon is that the motivations of FDI show an obvious impact on the technology gap of inward investment. Data shows that domestic market oriented investment has the highest technology value. Although cost saving investment is the main stake of FDI projects, most show a narrow technological gap. Policy pursuing investment shows the lowest technology value. Among the category of negative gap, it accounts for 62%, and only a few projects can bring over 15 years technology. Natural resources oriented investment, although accounting for a very small fraction of capital flow, is characterized by neither high level technology, nor low level technology.

The deviations of FDI in technology value among three FDI ownerships do not coincide exactly with the situations in other countries discussed in chapter 4.2 (Vernon et al. 1981, Stobaugh 1984, Cavusgil 1985, Kaynak 1985, Dunning 1986, Rapakko 1990, Grossman & Helpman 1991 and Casson 1992) that wholly owned firms possess the highest technology value, and joint ventures are worried about technology supply. The case in Dalian shows the following features: (1) There are two wholly owned firms falling in the category of negative technological gap and quite high a ratio (about 30%) of wholly owned firms only show a very narrow technological gap. The explanations about low technology supply in wholly owned firms can be explained from two aspects. One is the problem of data, because wholly owned firms are quite secretive, the estimation no matter inside or outside is difficult, and may not reflect the real situation. The other is some speculative investors from HMT also take the form of wholly owned. They do not possess high level technology. (2) Although joint ventures are dominated by low technology value FDI, they are also the main stake in the categories of 10 to 15 years and over 15 years technology gap. The importance of joint ventures at various technology levels may be ascribed to the underdevelopment of licensing and the huge differences of home countries and host regions. (3) The difference of technology value in cooperation is very small. The reason that neither high technology level investors, nor many speculators chose this channel is the export processing characteristic of this form (Germidis 1977, Young 1988).

Table 8-2 Differences of Technology Gap Among FDI

Items	>15 Years	10-15 Years	0-9 Years	<0 Years
FDI Motives				
Market	27	33	31	1
Cost	12	48	109	9
Policy	3	8	34	16
Resources	2	7	21	0
FDI Forms				
Joint Ventures	24	57	127	21
Cooperation	0	11	48	3
Wholly	20	28	20	2
FDI Investor				
HMT	9	33	113	17
Japan	15	48	44	8
Western	20	15	38	1
FDI Status				
Manufacturing	34	50	24	1
Trading	8	39	143	16
Individual	2	7	28	9
FDI Location				
Old City	10	37	70	10
New Town	23	57	82	5
Suburb	1	12	43	11
FDI Sector				
High tech	28	34	48	5
Standard	15	63	147	21

Sources: Postal Questionnaire Analysis

The differences of FDI technology value in national origin show a picture which harmonizes with the second half of hypothesis 1 of this study that outward investment from newly industrializing countries are of low technology value (Lall 1983, 1989; OECD 1988, 1989, 1993), and the technology level of Western investors is usually higher than Japanese (Frank 1980, Stewart 1987, McCalman 1991). In Dalian, the data shows that the quality of HMT investment is the poorest, although they are dominant in the FDI projects. Most of them (66%) possess the narrowest technology edge, and they are also the main component of the negative category. Western countries' and Japanese investment both show high technology value, but there are

differences between these two main groups. For example, the share of Western investment in the over 15 years category is the highest while the share of Japanese investment in the group of 10 to 15 years is the highest. In terms of technological gap structure, Western investment shows higher technology value than Japanese investment.

The status of foreign investors shows an obvious impact on the technology value of FDI. It is clear that manufacturing companies are a good channel to bring technology into Dalian. This type of investment not only has the highest and overall dominant share in the group of big technology gap, but also shows low ratios in the categories of lower or negative technology gap. It is understandable that trading companies and individuals do not show importance in high technology value investment, because of their characteristics of middle man in transfer technology. It is also understandable that trading companies dominate speculative investment.

The relation between FDI technology value and FDI destinations in Dalian shows two obvious trends: (1) High technology value investment is likely to be located in the new town, while little high technology value investment goes to the suburbs. FDI in the old city is characterized by a more balanced structure among various technology gaps. The spatial deviation of FDI technology value can be explained by firstly, green field new town is more attractive to high technology activities and it is dominated by wholly owned firms; secondly, the metropolitan area can accommodate most types of investment for its diversity. (2) FDI which invests in high technology sector shows much higher technology value than that in the traditional sector. The data shows that high technology projects account for 19% in the negative technology gap group, while it is 65% in the over 15 years category. It is clear that there is a proportional relationship between high technology sector and technology value.

8.1.2 The Structure of the Technology Gap

The technology distance between foreign investors and the host region implies that there is something missing for local firms, compared with inward investment. In the discussion of technology ball in chapter 2, it was pointed out that production know-how and organization know-how are two basic types of technology, so they could be the common ingredients of the missing. Based on this division of technology, we ask the FDI firms in the questionnaire to identify the contents of the technology gap, e.g. what or in which aspect they consider their technology is backward or advanced. We assume that the co-existence of production and organization gap is the best situation, because it allows more opportunities for transfer technology. Besides this, production technology is divided into two parts: product and equipment.

The structure of technology gap identified by the answers of the questionnaire is shown at Table 8-3. Three features can be drawn from the table. Firstly, the cases of co-existence of production and organisational advantages in FDI projects only account for about one fifth of the total FDI firms. Nearly 80% FDI projects in Dalian only show their advantage in production or in organisation aspect. This suggests that the technological threshold for foreign investors to enter Dalian is low.

Table 8-3 The Structure of Technology Gap

Items	Firm No.	Total Answer	Percentage
1. No Answer	26	361	7
2. Product only	34	361 (335)	9 (10)
3. Equipment Only	27	361 (335)	7 (8)
4. Product & Equipment	105	361 (335)	29 (31)
5. Organizational Only	92	361 (335)	26 (28)
6. 4+5	77	361 (335)	21 (23)

Source: Postal Questionnaire Analysis

Secondly, production technology advantage is the main ingredient of the technology gap. 72% of the positive gap consisted of this type of know-how. Although product and equipment advantages are bound together into Dalian in most cases, there are also 18% investors entering Dalian only by introducing products or bringing some equipment. Among them products advantage is slightly more attractive to the host region than process advantage.

Thirdly, over half the answers identify organization know-how as the contents of technology gap. However, over 25% of foreign investors came to Dalian only rely on this type technology may be too high, although it is common for newly industrializing countries to invest in a less developed country using management skills as a tool (Cavusgil 1985). This may suggest the low technology value of current FDI in Dalian from another angle.

The data in Table 8-4 displays the differences in structure of the technology gap among FDI. The following conclusions can be drawn from the data. (1) The structure of the technology gap in market oriented FDI differs from those of other motives. The data shows that the structure in market entry not only shows a high ratio of comprehensive technology advantage, but also shows a very low ratio in the category of equipment only. In contrast to it, the technological gap in the other three types of

motives, especially in policy purchasing, are dominated by single advantage. This difference may suggest that in order to occupy the domestic market, foreign investors must possess advanced products as well as a comprehensive technology package. While for other purposes, the threshold of technology is comparatively low.

Table 8-4 Differences of Technology Gap Structure Among FDI

Items	1. Product.	2. Equip.	3. 1+2	4. Organ.	5 3+4
Distribution of FDI Firms					
FDI Motives					
Market	10	3	32	12	34
Cost	13	14	55	54	32
Policy	9	8	13	11	5
Resources	2	2	5	15	6
FDI Forms					
Joint Ventures	17	19	65	67	41
Cooperation	6	6	18	19	10
Wholly	11	2	22	6	26
FDI Investor					
HMT	16	11	49	63	17
Japan	11	12	30	13	41
Western	7	4	26	16	19
FDI Status					
Manufacturing	3	7	37	10	51
Trading	23	19	57	70	21
Individual	8	1	11	12	5
FDI Location					
Old City	12	9	38	29	30
New Town	16	9	51	44	41
Suburb	6	9	16	19	6
FDI Sector					
High tech	13	2	35	24	37
Standard	21	25	70	68	40

Sources: Postal Questionnaire Analysis

(2) Among the three ownership forms, technology in joint ventures and cooperation is more fragmented than in wholly owned firms, and joint ventures show the most importance in attracting organization technology.

(3) The package of technology in Japanese and Western investment is more complete than in HMT investment, because the latter is dominant in the categories of single advantage, especially in organization technology aspect.

(4) Manufacturing companies again show the highest technology transfer potential among all the foreign investors. It does not enjoy the highest share of comprehensive technology advantage, but shows the lowest ratio of single technology advantage. In contrast with it, individual investors hardly possess two types of knowledge, and the trading companies are also single minded.

(5) Unlike the technology gap, the contents of a technology package do not show obvious differences between the old city and new town. The reason that the new town shows bigger technology gap but does not show favorable structure of technology package may be explained by the different orientation of FDI in the two locations. FDI located in the old city shows a high tendency to occupy the domestic market, while the new town's FDI aims more to international market. (6) As with the technology gap, the structure of technology package in high technology sectors is much better than that in standard technology. So the high technology investment of FDI not only shows the advance of technology, but also shows the complete package of technology. However, the extremely low ratio of equipment advantage in high technology sectors may suggest that it is difficult or reluctant for foreign investors to transfer the process technology to high technology sectors.

8.2 Acquiring Results--Transferability of FDI As a Whole

Since the consequence of technology transfer is bringing the technology receiver gradually to the similar level of the technology supplier by overcoming the technology gap between them (OECD 1981, Rosenburg 1982), the core of obtaining effects analysis is to measure the diminishment of technology distance between foreign investors and local partners and local personnel. This narrowing of the technology gap shows both the advance of the technology receiver through FDI operation and the transferability of FDI.

8.2.1 Diminished Technology Gap And Change Trend

It is very difficult to define and measure the technology gap. It is even more difficult to define and measure the gap diminished by inward investment, because technology development is interactive, and technology transfer is multiple, which cannot be limited in certain channels (Rosenburg 1982, NEDC 1983, Meissner 1988, OECD 1988, TEP 1992). In order to obtain a general picture about technology

transferability and make it comparable with the technology gap, the diminished gap is divided into the following three categories in the survey.

High technology transferability or over ten-year diminished technological gap. This category refers to a lot technologies or obvious know-how flows between the two ends, so that over a ten-year period technology gap can be overcome. The suggested evidence in this group includes: obviously upgraded products; the obtaining of advanced key equipment; mastering of new processes; the development of new product(s); the obtaining of important trade secrets; entering certain world networks; access to important information channel; dramatic reform of management; and the arrival of advanced international practice or criteria.

Medium technology transferability or under ten years technological gap reduced. Because there is only a moderate know-how flow within the FDI firms, the following criteria could be used to identify this progress of technology development: the improvement of products quality; the improvement of the management; the enlarging of the export channel; the use of other trade marks, especially for exports; the improvement of the appearance of product; familiarity with outside world; the use of certain training beyond only operation training; the obtaining of some advanced equipment; the adoption of international standard or criteria.

Low/little technology transferability or no diminishing of technology gap. Since this category indicates little or no technology flow between the two ends, local partner and local personnel find it difficult to get benefits from the operation of FDI enterprises. The following cases are listed in this group: no technology supply or the technological level of foreign investors' is lower than the local's; only simple operation training; foreign partner only as a seller of equipment which is not difficult to get; foreign partner only as a buyer of the product; foreign partner only as a lender of capital; little involvement of foreign investors in the operation.

Table 8-5 Overall Technology Transferability of FDI

Items	Firm No.	Total Answer	Percentage
High transferability	95	361	26
Medium Transferability	173	361	48
Low or No Transferability	93	361	26

Source: Postal Questionnaire Analysis

The answers which are displayed in Table 8-5 can be analysed from three aspects. Firstly, the scope of technology transfer through FDI is wide in Dalian. There are more than one fourth of FDI firms with high technology transferability. High and medium level technology transfer account for 60% of surveyed FDI firms. This means Dalian has started to update or develop its technology by FDI, which is a brand new channel to get outside technology.

Secondly, the amount of technology transfer is limited, because nearly half the firms indicate that the transfer within their firms is in the medium category, which suggests that the technology gap diminished in Dalian is under 10 years. During the 1950s, China was a backward country and most of its civil technology was obtained by the large scale transfer from the former Soviet Union and Eastern European countries (Lubman 1984, Conroy 1992). After that China's technology development has in fact stagnated for at least fifteen years, owing to the "Cultural Revolution" and long term isolation. Against this background, ten years' gap diminishing does not mean much progress. Measuring by an empirical study (Rapakko 1990) that the mean time lag of technology from introduction to transfer abroad from developed country to the developing countries' firms by joint ventures is about 10 years, this technology advance is also too moderate.

Table 8-6 Technology Transferability Change Trend

Items	>=10 Years Proj. (%)	0-9 Years Proj. (%)	<0 Years Proj. %	Total Proj. %
Technology Gap:				
-1988	24 (61)	14 (36)	1 (3)	39 (100)
1989	38 (40)	46 (50)	10 (10)	94 (100)
1990	35 (32)	62 (57)	11 (11)	108 (100)
1991	43 (36)	74 (61)	4 (3)	120 (100)
Technology Transferability:				
-1988	22 (56)	15 (38)	2 (6)	39 (100)
1989	20 (21)	51 (54)	23 (25)	94 (100)
1990	20 (19)	50 (46)	38 (35)	108 (100)
1991	33 (28)	57 (48)	30 (24)	120 (100)

Source: Postal Questionnaire Analysis

Thirdly, the effectiveness of technology transfer which may be viewed from the comparison of the technology gap and technology transferability is not so high. It is reasonable and understandable that there are differences between the technology gap

and technology transferability because of the problems of data and various transfer barriers. However, the distance between them is noteworthy. Compared with Table 8-1, it is apparent that in the over 10 years category, the technology gap is 13 percentage points higher than transferability; in the medium level it is 6 percentage points higher, and in the low group it is as high as 19 percentage points. This not only suggests that one fourth of FDI firms can not exert positive impact on local technology development, but also indicates that another 20% of FDI firms which possess the capability of supply technology can not conduct technology transfer fully.

In terms of the transferability change over time, it is difficult to state that there is an obvious increasing or decreasing trend, because there are serious fluctuations among the different levels, as shown in Table 8-6, which is characterized by the big gap before and after 1989; the "U" shape change in the category of high level transfer and the opposite trend in the other two categories; and the increase share of the medium group. This situation indicates that technology transfer in Dalian is severely affected by the general investment climate.

8.2.2 Transferability and Supply Side Factors

Technology transferability within FDI enterprises, as with the technological gap, varies with the FDI motives, national origins and investors' status. Table 8-7 displays the deviations. Comparing it with Table 8-2 and 8-4, we can not only see the different roles of various suppliers in technology transfer, but also see their characteristics in supplying technology.

With regard to FDI motivation, the data in the table confirms the previous analysis that domestic market oriented projects show the highest tendency of transfer technology to local partners. More than 50% of them conduct high level technology transfer, which account for nearly half in the group of high transferability. Although there are also projects which fall in the low level category, its share is only half of the medium level, and one third of the high level. It is clear that market oriented investment not only has the capability to supply technology but also shows willingness to do so. The other motives show another scenario, in which medium transfer is dominant and the ratio of them in low level transfer is much higher than in high level transfer. It suggests that FDI with other motives lack the enthusiasm to supply technology.

The relationship between technology transferability and the national origin of FDI differs from the relationship between the technology gap and FDI national origin, in two aspects. First Western investment shows a much higher transferability than

Japanese investment, although Western and Japanese investment both show high technology value in their projects. For example, among 35 projects of Western investment with over 10-year technology gap, 29 (83%) indicate that there is over a 10-year diminishing technology gap; while among 63 Japanese projects in the same criteria, only 32 (51%) report the same result. This means that about half Japanese firms in this type cannot conduct associated technology transfer. The same situation can be seen from the other categories.

Table 8-7 Transferability and Technology Suppliers

Items	High TT No. (%)	Medium TT No. (%)	Low TT No. (%)	Total No.
FDI Motives				
Market	47 (51)	30 (33)	15 (16)	92
Low cost	36 (20)	90 (51)	52 (29)	178
Policy	10 (16)	30 (49)	21 (35)	61
Natural Resources	2 (7)	23 (77)	5 (16)	30
FDI National Origin				
HMT	34 (20)	96 (56)	42 (24)	172
Japan	32 (28)	47 (41)	36 (31)	115
Western	29 (39)	30 (41)	15 (20)	74
FDI Status				
Manufacture Co.	47 (43)	38 (35)	24 (22)	109
Trading Co.	39 (19)	112 (54)	55 (27)	206
Individual	9 (20)	23 (50)	14 (30)	46

Source: Postal Questionnaire Analysis

Secondly, HMT investment shows more importance in technology transfer than in technology gap. In all the projects with over a 10-year technology gap, HMT projects accounts for only 30%, whereas in all projects with high transferability, they account for 36%. Besides that, the share of low transfer projects in HMT is 7 percentage points lower than Japan's ratio. These deviations outline three behavior models among FDI national origins. Japanese investors possess the capability of supplying technology, but they are unwilling to do so. They transfer far less technology than they control. HMT show an opposite situation. Although their ability to supply technology is weak, their enthusiasm to send technology is high, and constitutes the main basis of current technology transfer. Western investors possess both capability and willingness to send technology to Dalian.

The deviations in investors' status are not so obvious as in the technological gap, although there is still a difference. It is clear that manufacturing companies possess the best structure of technology transfer compared with the other two types of investors. The higher the level of technology transfer, the more projects are distributed into that category. While trading companies and individual investors are dominated by medium level transfer, they are also the main basis of low or little technology transfer. However, it is noteworthy that the enthusiasm of the last two types of investors to unbind technology to Dalian is high. Again comparing the technology gap and technology transferability, the shares of trading companies and individual investors in the over 10-year technology gap are 34% and 6% respectively, while their shares in high level transfer are 41% and 10% respectively. The ready willingness to send technology by them can be explained by a lesser concern about the loss of technology secrets.

8.2.3 Transferability and Receiving Side Factors

It has been repeatedly mentioned by literature that the receiving side also plays an important role in the technology transfer (Rosenburg 1982, Samli 1985, Enos and Park 1988, Mowery et al 1989, Hull 1990). In the survey, we pay more attention to three factors: local partners' motives, local partners' absorption capability, and the origins of local partners. Table 8-8 shows the relation between these factors and technology gap as well as transferability.

Compared with the analysis of supply side factors, the prominent feature in receiving side factors is the small difference between the technology gap and technology transfer. This narrow gap may result from the problem of data, for most questionnaire are answered by local partners, and they may exaggerate the problems of technology suppliers and lessen the problems on their side. But this narrow gap may also confirm the general trend that technology transfer is concentrated on the supply side (Stewart 1987).

However, the huge differences within each category also offer an opportunity to view the impact of receiver side factors on technology transfer from the following aspects. Firstly, a ready willingness of receiving technology leads to a high level technology transfer, and obtains the best transfer result. A low enthusiasm to acquire imported technology gets the worst transfer results. However, there are two points that are noteworthy: One is that organization technology oriented projects show the same situation as policy purchasing oriented projects. The other seemed that the transferability in the no answer group which is wholly owned firms, is much worse than policy purchasing oriented.

Table 8-8 Transferability and Technology Receivers

Items	Technology Gap			Transfer Level			
	>=10	0-9	<0	High	Medium	Few	Total
Local Motives							
Prod. Tech.	30	16	0	31	14	1	46
Two Types Tech	16	13	0	14	14	1	29
Capital	22	42	8	20	40	12	72
Orga. Tech.	8	36	2	8	29	9	46
Policy	16	68	14	19	59	20	98
No Answer	48	20	2	3	17	50	70
Absorb Capability							
Strong	60	70	9	71	55	13	139
Some	25	46	5	14	48	14	76
Weak or No	26	71	11	9	62	37	108
No answer	29	8	1	1	8	29	36
Local Origin							
Dalian	77	135	19	78	117	36	231
Other Areas	15	40	5	14	39	7	60
No Answer	48	20	2	3	17	50	70

Source: Postal Questionnaire Analysis

Secondly, the technological receiving capability is in proportion to technology transfer. In the survey technology receiving ability was divided into three categories: (1) Strong absorption capability which could be shown as: possessing the capability to manufacture the same, or a related product; a full understanding of the technology and has associated R & D capability to open the imported technology, although did not have the required manufacture capability; has mastered the upstream or downstream technologies of the imported technology;
(2) Some absorption capability which includes: possessing certain manufacturing capability but not familiar with the import technology; possessing certain adaption ability but lacks understanding of imported technology and lacks manufacturing foundation;
(3) Weak absorption capability covers other situations and is characterized by no manufacturing capability before and a lack of required skilled human resources and other resources. It is clear that different levels of technology absorptive capability lead to different types of technology transfer. For high capability receivers, there are 60 projects with an over 10-year technology gap, but there are 71 answers falling in the category of high level transfer. The differences between them, on the one hand, may

indicate the incomparability of the two indexes; on the other hand, may suggest that a local partner with strong absorbing capability can get a high level transfer under a comparatively small technology gap. It is a different picture for low capability receivers, in which there is about 65% of firms with an over 10-year technology gap which can not conduct associated technology transfer.

Thirdly, the Dalian firms show better transfer results than other regions' firms. In the survey we use the origins of local partners to display the differences between Dalian and its hinterland. The data shows us two pictures. One is the dominant role of Dalian firms. No matter in which group, the enterprises originating from Dalian are about 80%, and the inward hinterland firms only account for 20%. The other is the low technology transferability of FDI in hinterland's firms. It may be explained by Dalian failing to attract high technology value hinterland investment, because most hinterland firms come to Dalian only for contact with outside world.

8.2.4 Transferability and Operational Characteristics of FDI Firms

In addition to the factors on the supply and receiving sides, the characteristics of FDI local operations also affect technology transfer. Table 8-9 exhibits the differences of technology gap and technology transferability among FDI ownership, enterprise attributes, management situation, investment scale, intended project duration, and spatial location. Table 8-10 displays the deviations among ten industrial sectors.

The technology gap and transferability of FDI among three FDI ownership in Dalian confirms the findings of other studies (Vernon et al. 1981, Stobaugh 1984, Cavusgil 1985, Kaynak 1985, Dunning 1986, Rapakko 1990, Grossman & Helpman 1991 and Casson 1992), and also partly prove hypothesis 2 of this study--wholly owned firms have a bigger technology gap than other channels, but joint ventures show better transfer results than other forms of ownership. However, there are two characteristics in the case of Dalian. (1) Cooperation shows a similar picture with joint ventures in conducting technology flow. (2) Most transfer is conducted by joint ventures. Wholly owned firms show little importance in the direct measurement.

Among all the FDI enterprises, grafting enterprises--using the assets of an old factory located in the local partner's property--show much higher efficiency than non-grafting firms to transfer technology, although the difference between them in the technology gap is not so big. Firstly, grafting enterprises can conduct high level transfer in cases where the technology gap is not so big. In contrast with it, less than 50% of non-grafting can get high level transfer when they face a big technology gap.

Secondly, very few grafting firms cannot transfer technology, if there is a technology gap. While in non- grafting firms there are more than one fourth of them which cannot conduct technology transfer when there is a technology gap. However, the technology gaps in grafting firms are not as wide as in non-grafting firms, especially in the over ten years group. It seems that foreign investors with high technology levels are unwilling to set up a grafting firm with old indigenous factories, because of their concern about technology control, and the more complicated procedures for setting up a grafting firm.

Table 8-9 Transferability And Operational Factors

Items	Technology Gap			Transfer Level			
	>=10	0-9	<0	High	Medium	Few	Total
	140	195	26	95	173	93	361
Investment Forms							
Joint Ventures	81	127	21	79	117	33	229
Cooperation	11	48	3	13	39	10	62
Wholly Owned	48	20	2	3	17	50	70
Attribute of Firm							
Grafting	36	55	8	44	44	11	99
Non Grafting	104	140	18	51	129	82	262
Project Location							
Old City	47	70	10	39	58	30	117
New Town	80	82	5	42	83	42	167
Suburb	13	43	11	14	32	21	67
Management Situation							
Profitable	71	103	11	57	83	45	185
Loss	36	72	14	21	68	33	122
Non-production	33	20	1	17	22	15	54
Average Project Scale ($ 1,000)							
	6152	1105	439	7088	1754	1197	3044
Mean Project Duration (Year)							
	20.9	14.7	14.5	15.9	16.0	20.3	17.1

Source: Postal Questionnaire Analysis

Unlike the relations between transferability and the investment scale, in which the bigger the investment, the better the technology transfer within the FDI firms, there is not a clear relation between the management situation of FDI firms and technology transferability. Profitable firms are main stake of all categories of

transferability, and loss-making firms also conduct technology transfer. The lack of a positive feedback between profit earnt and technology transfer may be explained by (1) Competition in China is still incomplete, and the role of technology is limited. (2) The co-operation between two partners is not so close. (3) The profit figure is hidden or underestimated.

Table 8-10 Transferability of FDI in Different Industries

Items	Technology Gap			Transfer Level			
	>=10	0-9	<0	High	Medium	Little	Total
	140	195	26	95	173	93	361
Electrical	38	17	2	25	21	11	57
Engineering	36	30	5	25	26	20	71
Textiles	15	30	4	9	24	16	49
Chemical, Rubber & Plastics	19	27	1	13	27	7	47
Food & Drink	9	32	3	5	27	12	44
Leather & Product	2	8	0	2	5	3	10
Pharmaceuticals	5	4	2	1	6	4	11
Hand Crafting	6	20	2	5	14	9	28
Construct Materials	3	12	5	4	10	6	20
Other	7	15	2	6	13	5	24

Source: Postal Questionnaire Analysis

With regard to the industrial differences, technology transfer in Dalian, as shown in Table 8-10, shows the following characteristics: (1) Technology transfer mainly occurrs in the standard sectors, and high technology sectors which include electrical, chemical and pharmaceutical only account for 35% in high and medium transfer two categories. If account is taken of the fact that the division of high technology here is too wide--in electrical, and chemical, rubber & plastic industry, there are many firms which only produce low value added plastic products or assemble some consumer electronic products, the actual ratio will be much lower than the figure.

(2) High technology industries are much better than standard technology industries in accessing high level inward technology and conduct high level transfer, although its share is low. For example, the share of high technology industries in all sectors is 41% in high level transfer, 31% in medium level, and 24% in low level transfer.

(3) Every high technology sector shows a different picture. In electronics, it has the highest ratio in the high level transfer, and the lowest ratio in the category of little transfer. In the chemicals, Rubber & plastic industry, although most firms have some technology transfer, it is dominated by medium level transfer. In pharmaceuticals, only 1 case reports high level transfer, while 5 cases report that big technology gaps exist. It means that only 20% firms in this industry can conduct associated transfer. Besides that, there are more than one third of firms without technology transfer. This industry is defined quite clearly and low technology activity is not easy to enter, it may be seen as a real picture of transfer in high technology industry.

(4) Standard sectors, except the engineering industry, show the same picture. Medium transfers are dominant accounting for 50-60%, and the low level stands at 30% or so, while the high level transfer usually has the smallest share. The characteristic of engineering industry is its high share in high level transfer, and low ratio in low level. This may be ascribed to the strong absorptive capability of the engineering industry in Dalian.

8.3 Acquiring Process--Transferability of FDI at Technology Component Level

The above discussions reveal that there is an exising technological gap in most FDI enterprises in Dalian, and the factors coming from supply and receive sides exert different impacts on the technology transferability. In order to scrutinize the acquiring process which bridges the acquiring potential and consequence, this section divides technology transfer into the flows of six technology components, which have been discussed in Chapter 2 and Chapter 5. Through the interviews, the contents, impacts and barriers of these flows are analyzed in detail.

8.3.1 Production Hardware Transfer

As discussed in chapter 5, this component is totally embedded knowledge directly used in production. It usually includes materials, products and machinery. Since the role of materials flow on transferring technology is not so obvious at present, our survey in Dalian is limited to products and equipment. The examination of this type of technology transfer can be summaried as: 1) The products update and equipment supply are the main results of foreign investment. 2) The main characteristic of new products is novel design and high quality, while equipment shows high automation and high producing standard. 3) The technology gap in products is higher than in equipment. 4) The main stimulus of new products to the local firms is reflected in

encouraging local partners or local firms to acquire more technology from foreign investors. 5) The problems of transferring this type technology are twofold: information blockage and computer lock.

1. Origin of products and equipment in FDI firms. Since the transplant of products and equipment is the foundation of technology transfer between developed and developing countries (OECD 1981), in the survey, we ask FDI firms to identify the origin of this hardware. The answers are shown in Table 8-11.It is clear that most FDI enterprises are the channels for Dalian to update products or increase the stock of machinery.

Table 8-11 The Origins of Products & Equipment

Items	Firm No.	Total Answer	Percentage
Origin of Product			
Previous Product	8	36	22
Taking from Abroad	25	36	69
Both of Above Two	3	36	8
Origin of Equipment*			
Previous Equipment	7	36	19
Bring By Foreigner	9	36	25
Purchasing Abroad	18	36	50
Purchasing Inside China	3	36	8
Imported Before Cooperation	6	36	16

* Some cases are multi-answer

Source: Enterprise Interviews

There are two points that are worth pointing out about the origins. Firstly, among the equipment which is not obtained from abroad, previously imported equipment accounts for quite a high ratio. It indicates that in addition to increasing the volume of the "active part" of technology by providing additional machinery, FDI also shows the function of activating the "dormant part" of technology (refer to 2.1.6). Without the inflow of FDI, this imported machinery is not fully used because of the limitation of institutions, lack of components, no competition management etc. Other reports from Shanghai and Fujian also show this role of FDI (Song 1992, Maddox 1993). Secondly, there is about one sixth of FDI firms which do not bring products or equipment into Dalian. The situation in equipment is more serious than in products. It is apparent that most of these investments are exploiting political opportunities rather than economic opportunities, ie foreign investors want to reap the benifits

without local production.

2. Characteristics and technology gap in production hardware. After the origin analysis, interviewed firms were asked to evaluate the quality of production hardware by identifying their features and advance. The answers are listed in Table 8-12 to 8-13.

Table 8-12 The Attributes of New Products & Equipment

Items	Firm No.	Total Answer	Percentage
New Products			
High Quality	6	28	21
Novelty	10	28	36
More Functions	5	28	18
All of the Above	5	28	18
Low Price	2	28	8
New Equipment			
High Automation	8	29	28
High Producing Standard	6	29	21
Both Above Two	14	29	48
Useless	1	29	3

Source: Enterprise Interviews

In terms of quality evaluation, two findings emerged. Firstly, most imported products and equipment show real advantages. For example, the median tyre doubles the mileage of the old tyre; the edge cutting machine is the product of the 1980s and Japan's government still does not permit its export to China; the multi-layers replace the single layer in Print Circuit Board production. There are only two cases reporting a negative impact. One was cheated by a foreign partner who imported an old machine which was made in Taiwan in the 1950s and then ran away. The other was a local partner who adopted a low quality product brought by a foreign partner and wanted to sell them to the Southeast Asia market, but it failed. The inflow of these products and equipment is changing the local product structure and its production capability.

Secondly, local partners or local personnel are more appreciative of new products than new equipment, although the two parts are inseparable. This not only shows in the characteristics evaluation, but also shows in the big difference between products and the equipment technology gap. This can be explained by the following

three points. (1) The local partner or local officials are keener for new products than for new equipment. It seems that the provision of advanced products is an important condition for foreigners to enter China. (2) The previous import of technology was mainly in equipment, which makes the technology distance between Dalian and outside world smaller in equipment than in products. (3) Foreign investors are unwilling or find it difficult to provide advanced process technology, because they want to exploit low labor advantages.

Table 8-13 Technology Gap of Products & Equipment

Items	Firm No.	Total Answer	Percentage
Products			
Over 15 Years Advanced	12	28	43
Between 10-15 Years	7	28	25
Between 0-9 Years	8	28	28
Below Previous Product	1	28	4
Equipment			
Over 15 Years Advanced	5	29	17
Between 10-15 Years	10	29	34
Between 0-9 Years	13	29	45
Below Previous Product	1	29	3

Source: Enterprise Interviews

3. Impact of production hardware inflow on local firms. It is apparent that the inflow of products and equipment makes indigenous firms or local personnel aware of the existence of some technologies because of the characteristics of the new products and the efficiency of the new equipment. With regard to the impacts, we focus on the results of this awareness, and ask local partners or local personnel to check their responses. Table 8-14 shows the answers.

Three findings can be drawn from the answers. Firstly, the stimuli of the inward products and equipment are not very strong to the local partners or to the local firms, although stimuli can be observed both inside and outside FDI firms. Over 40% firms cannot identify concrete incentives of new products inflow, while the situation in equipment is even worse, and over 60% of firms reports that they can do nothing except operate the equipment.

Table 8-14 The Impacts of New Products & Equipment on the Host Region

Items	Firm No.	Total Answer	Percentage
New Products (Within the Firm)			
Enlarge Market Share	9	28	32
Develop Relative Products	4	28	14
Increase Quality Standard	3	28	11
No Effects	12	28	43
New Products (Outside the Firm)			
Causing Imitation	6	28	21
Incentive Same Trade To Get It By FDI	7	28	25
Incentive Relative Firm To Get It By FDI	5	28	18
No Idea	10	28	36
New Equipment (Incentives)			
Manufacturing Components	5	29	17
Modifying Machinery	2	29	7
Import Other Equipment	4	29	14
No Effects	18	29	62
New Equipment (Result)			
Obviously Rise Productivity	15	29	52
Moderately Rise Productivity	9	29	31
Rarely Rise Productivity	5	29	18

Source: Enterprise Interviews

Secondly, among the stimuli germinated from new products and machinery, the outward oriented stimulus is stronger than the inward oriented stimulus. It means that the inflow of production hardware encourages local partners or local firms to obtain more technology from FDI, instead of putting more emphasis into in-house R & D and to obtain the associated technology by themselves. It is apparent that the main stimulus of new products is causing local firms, especially in same trade and relative industries to get it through FDI. The competition between them has converted to a competition to get FDI. It indicates that a technology dependency has occurred by the inflow of production hard ware, which may be explained partly by institution, and partly by the technology gap between the two parties.

Thirdly, the stimulus of new products is much bigger than the one of new equipment, although the efficiency of machinery is widely agreed by most firms. It can be explained by the differences of the two kinds of hardware. Products are open

to the market and machinery is closed in manufacturing factory.

4. The problems of transferring production hardware. There are two factors that hinder the transfer of this type of technology. One concerns computers. This means the technology used for manufacturing high quality products in high efficiency is usually locked in computers which are built-in to the equipment. Facing these "black boxes", most local partners or local firms find it very difficult to disclose the secrets locked in the computers. Therefore, technology transfer in some cases means equipment transplant. The other is information blockage. Since China's long term isolation and difficulties in travelling abroad, most local firms find that they cannot get enough information about the products or equipment. More than one third of joint ventures in the survey reported that they were cheated by foreign partners. In several cases, the over charged money for the equipment, compared with the international price, was the amount of investment supplied by foreign investors. It is clear that some foreign investors not only convert joint ventures into a channel to sell their equipment, but also take advantage of information barriers in China to get a share in joint ventures without making real investment themselves.

8.3.2 Organizational Hardware Transfer

Organizational hardware means equipment and facilities which are used for dealing with the non-production relations inside and outside enterprises. Because they are common instead of special tools, they are hardly contained in the package of technology transfer except in the companies which manufacture this equipment and facilities. However, in current China, two factors make it important to be concerned in the process of technology transfer. Firstly, it is an important component of FDI into China at present stage. Secondly, the differences between economic system of China and other countries make it an index to examine the adoption of international practices in enterprise management.

The flow of this type of component in Dalian shows the following features: 1) The scope of transplant is wide. 2) Among this inflow vehicles are dominant. 3) The role of this type of technology flow is mainly reflected in improving the infrastructure of the firms and only shows a little influence on changing their management. 4) There are two hindrances to transfering this component technology: foreigners take advantage of the incentives, and local personnel ignore the importance of it.

1. The scope of organizational hardware inflow. Table 8-15 shows the contents and scope of organizational hardware flow. Comparing it with Table 8-

11, we can see its inflow scope is wider than production hardware. Except one very small firm, all the enterprises transplant some of this type of equipment. The explanation for this strong inflow is that there is a regulation which gives permits to FDI firms to import a certain quantity of this type of equipment without tariffs. So nearly every firm takes this advantage. The wide scope of organization hardware inflow suggests that incentive policy gains more response in this component than in production hardware.

Table 8-15 The Contents of Organizational Equipment Inflow

Items	Firm No.	Total Answer	Percentage
Vehicles	12	36	33
Vehicles & Fax Machine	8	36	22
Vehicles, Fax & Other Office Machines	7	36	19
All of the Above & Computer Control System	8	36	22
Nothing	1	36	4

Source: Enterprise Interviews

In addition to the wide scope, the inflow of organizational hardware shows a clear hierarchy. Transportation vehicles rank first. They are included in any inflow options. 33% of the firms only bring in vehicles. Telecommunication facilities such as fax machine is the second choice of most firms, and other office equipment such as photocopy machines, safety systems are next. Using computers to equip firms is still seen as a luxury in this stage. The data in Table 8-15 shows that only one fifth of the enterprises are quite well equipped with organizational hardware.

The survey also finds that the possession of organizational hardware in a FDI firm (1) is in proportion to the investment scale. In large FDI firms, the equipment is complete and the investment ratio of this type of hardware to total investment is low; while in some small FDI firms, vehicles can be the single ingredient and account for over half of total investment. Li's (1992) investigation of 12 small FDI firms found that vehicle imports accounted for 60% of FDI; (2) is decided by the level of involvement of foreign investors. When foreign investors conduct or join the management, the firms usually fall into the third category. If they show some remote control, the firms are often shown in the second group. The first category mostly occurs in the FDI firms where capital is joint, but not management.

2. The impact of organizational hardware inflow. High bias towards the transportation vehicle in the organizational equipment flow limits the impact of this kind of technology, as shown in Table 8-16. For most firms, especially wholly or majority owned firms, the stimuli of this equipment and facilities inflow are weak. Two facts can be identified. One is the reinforcement of the technological infrastructure of the firms; the other is fostering of the "modern consciousness" of local partners and local employees. Because in the minds of these firms, this type of equipment or facilities are only treated by them as tools for promoting production.

Table 8-16 The Impacts of Organizational Hardware Inflow on the FDI Firms

Items	Firm No.	Total Answer	Percentage
1. Convenient in Transportation	7	35	20
2. 1+ Convenient in Communication	17	35	49
3. 2+ Accessing Information	4	35	11
4. 3+ Changing Organization Form & Increase office efficiency	2	35	6
5. Gain financial Benefits	5	35	14

Source: Enterprises Interview

For the other FDI firms, equipment and facilities show another two functions. Firstly, it is a way to earn money. The survey finds that some imported vehicles were subseqently sold. These firms take advantage of free tariffs on imported vehicle for using themselves. Secondly, it is a way to adopt international management styles, although the role is still very weak. For example, Riou changed the layout of its office while it got communication facilities, which increased the efficiency of its office work. Dalian Weigeshi Hydraulic Ltd. restructured the company after importing communication and computer facilities, which helped the company improved its performance.

The dominance of vehicle imports in organizational hardware flow, especially in some small firms where importing transportation vehicles is far more important than production equipment, not only indicates the low technology value of foreign investment, but also tests the resposes of some foreign investors to the incentives. In addition to the above analysis, the "single minded" inflow of this type of technology can be explained from another two aspects. One is that the importance of equipment as part of enterprises' technology foundation has not been recognized by local partners, since they do not really enter the international management environment.

The second is labor-intensive investment cannot adopt a labor-saving management style.

8.3.3 Production Document Transfer

Documents used in production are the result of humans systematically exploring natural secrets. They directly answer the question how to get thing done in specific circumstances. One characteristic of modern technology development is the independence and boom of this component (Steuer 1973, UNCTC 1984, Kranzberg 1986, Hobday 1991, TEP 1991). So it plays an important role in transferring technology in the current world.

The survey in Dalian highlights the following characteristics of this type of knowledge transfer: 1) The transfer of trade secrets is much less than production criteria. 2) Although the flow of this component is weak, the quality of various trade secrets is highly appreciated by local firms. 3) The transfer of this type of knowledge shows a obvious soft tendency. 4) Trade secrets are hardly supplied during FDI local operations. 5) Low level of R & D in FDI firms is another cause of low transferability of this component.

1. The contents and attributions of production documents. In order to examine the flow of production documents to Dalian, we divide them into two types and four categories as shown in Table 8-17. The first and the second categories belong to trade secrets. The function of this type of technology is usually as a door for entering a new production field, so it is tightly controlled by the technology developer or holder. The difference between them is that the former is patented, while the latter is not. The third and the fourth categories belong to another type. The role of this type of document is shown as an operational manual, so it is more open. The difference between them is that the third category places emphasis on operation processes, while the fourth focuses on the results of this operation.

The inflow of production documents is characterized by (1) The scope of inflow varies dramatically in the four categories. The higher the technology level, the narrower the inflow scope. There is an obvious difference between the two types of production documents. (2) The inflow of trade secrets is mainly concentrated in wholly or majority owned firms and large scale investment. For example, among the five cases in which patent(s) were used in their production, two are large wholly owned Japanese firms, and two are large Western investment firms, in which foreign investors' share is around 50%. Only one is from an overseas Chinese investor. (3) There is a quite big difference between production guides and production standards.

The reason for this is about half of the Japanese investment lacks operation documents except production criteria. Japanese investors prefer to train their staff in their home companies or in Dalian face to face. (4) As with the inflow of production equipment, about one fifth of the firms cannot get any production documents.

Table 8-17 Content of Production Documents Flow

Items	Firm No.	Total Answer	Percentage
Patent	5	36	14
Other Know-how Includes			
Design, Plan, etc.	11	36	31
Operation Manual	19	36	53
Production Standard or Criteria	28	36	78

Source: Enterprise Interviews

When local partners or local firms were asked to assess the attributes of inflow production documents, their evaluation of operation manuals and trade secrets were different. For the former, most think they are only clearer or offer more detail on operation procedure. But for the latter, appreciation is concentrated in two aspects. One is the appraisal for the documents. The advantages highlighted by them are their novelty, effectiveness, clarity and high standard. The other is the appraisal of the philosophy of developing these documents, such as simplicity and practicality. The survey finds that it is the design methodology instead of design level that has shocked the Chinese engineers and technicians most. For example, Mr. Xu, general engineer of Great China Electronic. Co. comments "We preferred to purchase perfect technology before. Our design tended to be very complicated, while in fact it is not effective in practice. Their (Foreign investors') design is simple, and only concerns the main aspect. But in fact theirs are more effective than ours." The fact that the valuation is bias towards the social aspect instead of natural aspect, and the assessment lacks the appraisal for high level of these trade secrets may reflects two problems. One is the low level of know-how flow. The other is the difficulty for local partners to access the core of trade secrets.

2. The impact of production documents flow. The importance of of transfer of this component not only reflects its independent flow, but also in its stimulation of other forms of knowledge. The hardening of it can form tools. The softening of it can germinate innovation skills. However, the survey findings shown

in Table 8-18, are disappointing. Firstly, the scope of absorption is narrow. Over 25% of the firms cannot find any effect in their operation, because many foreign investors fail to operate according to their contracts owing to various factors. Besides that, nearly half the firms answer that they only apply these documents in production, and it is very difficult to identify direct benefits out of this type of technology. The possible impact may be the accumulation of scattered knowledge in the staff. Three factors forge this situation. (1) The inflow document cannot cause direct technology transfer because its technology value is low, such as only obtain a production criterion or standard. (2) The documents cannot always be opened. It is obvious in wholly owned FDI firms, where local personnel cannot access the documents. (3) The document is difficult to use in other aspects. This is usually seen in high technology activities, because the application of these documents needs a comparatively high technology threshold. For example, in the Dalian Ruihui Pharmaceutical Co. the patent used is to produce final medicine. However, the intermediate materials is synthesized outside China. So the local partner can do nothing with the patent except apply it in production.

Table 8-18 Absorption of Production Document

Items	Firm No.	Total Answer	Percentage
Only Apply it	13	28	47
Can Copy It	3	28	11
Modifying It	2	28	7
Developing It	2	28	7
No Effects	8	28	28

Source: Enterprises Interview

Secondly, the absorption level is low. This not only shows in the low ratio of modifying and developing inflow production documents in the surveyed firms, which suggest the absorption only stays at the bottom of technology transfer ladder. But it is also reflected in the quality of absorption. The survey finds that two modifications both aim to modify it to low level or low standard, and one of two development is based on traditional Chinese handcrafting. While two of three copies occurred in detergent production, it is apparent that the absorption of production documents is difficult in high technology activities.

3. The barriers to the transfer of production documents. The low level transfer of this component implies that there are handicaps standing in the way

of the process. Table 8-19 lists the different explanations obtained in the interviews. It is clear that most interviewees ascribe the low transferability to the supply side. Comparing it with another report from Fujian (Ding et al 1992), which estimates 31.4% foreign investors cannot keep their words to supply key technology to FDI firms, the situation in Dalian is more serious. The survey finds that there are several ways used by foreigners to keep secrets. (1) Foreigners fail to provide production know-how or keep the local partner fully informed of relevant technological development, although there is a contract or agreement to do so. This is easier to be observed in trading companies. When they supply or sell their equipment, some foreign partners do not provide any associated know-how. (2) Control over the technology itself. In firms in the chemical industry, foreigners use numbers to label the materials or ingredients they used, instead of using the chemical names. In most Japanese wholly owned firms, there are strict regulations on keeping their production know-how. (3) Control over local personnel to access to technology. In the case of Ruihui pharmaceutic Co. when the patent is used, the general engineer of the local parent company is not permitted access it. In the case of Morgan proof-fire material Co. the local partner is not allowed to make any modifications on their design.

Table 8-19 Handicaps of Production Document Transfer

Items	Firm No.	Total Answer	Percentage
Foreigner Unwilling to Supply	10	28	36
Low Level of Foreigner Investors	5	28	18
Low level of Absortion Ability	7	28	25
No Absorb Motive	4	28	14
No Handicaps	2	28	7

Source: Enterprise Interviews

In addition to the reluctance or inability to supply, the too "soft" or intangible transfer channel is another reason for the low transfer of production documents. Since production documents are half embodied, they can be transferred in many ways. However, in Dalian, we find that the transfer of this component shows an obvious "soft" tendency. This means that independent flow of documents such as licensing, and technology investment show little importance in the FDI firms. The backward unbinding technology from products and equipment to documents, or say "reverse engineering" is also rarely reported by local partners or local firms. The most

important way to absorb this type of knowledge is personnel contact. However, it is clear that with technology access to it under the control of foreign investors, the effectiveness of this channel is discounted.

Another important factor affecting the transfer of production documents is the level of R & D in FDI firms. Many studies such as OECD (1981), Rosenburg (1982), Mowery & Rosenburg (1989) have repeatedly emphasized the importance of R & D in absorbing and exploiting technical and scientific information. However, the R & D activity in Dalian is very weak due to the problem of institution and the ignorance. Table 8-20 shows the current situation in Dalian.

Table 8-20 R & D Activities In Dalian FDI Enterprises

Items	Firm No.	Total Answer	Percentage
Have R & D	4	36	11
Have Only Development	14	36	39
Without R & D	18	36	50

Source: Enterprise Interviews

Two conclusions can be drawn from the survey. Firstly, R & D activity in Dalian FDI firms is very low. Half of FDI firms are without research and development activities. Four firms answer that they possess the capability of research and development however, all of them are grafting enterprises, and the R & D activities are converted from old factories. Among 14 FDI firms which show capability in development, most of them only spend a little money on modifying products to local markets. For example, in Pacific Multi-layers Co. which is an example of high technology and successful project in Dalian, the general manager admits that they do not conduct any research. Among 175 staff only one person works on "adapting" products to China's market. The ratio of money spend on this function to total sales in 1990 was 0.03%. Secondly, the R & D activities in FDI firms are not matched with the flow of production documents. Patents and production know-how usually flow to the wholly or majority subsidiaries, in which the function of development is to open up the domestic market, not to share technology. Firms with R & D capability possess certain unbinding capabilities, and are willing to do so, but no trade secrets flow into them, because many foreign investors are cost oriented and are reluctant to supply technology.

8.3.4 Organizational Document Transfer

The characteristics of this component transfer in Dalian can be summarised as: uneven flow is between regulation documents and development documents; the evaluation for these documents by local partners or local personnel is not as good as production know-how, but positive impacts can be identified; the flow of this component is characterized by the combination of personal contact and document transfer, and the problems which affect the transfer of this type of knowledge result mainly from the receiving side. More detailed analyses about these issues are presented in the following discussions..

1. Contents of organization documents flow. As with the analysis of production documents flow, we have divided organization documents into two types in the survey, as shown in Table 8-21. One is regulation documents. They are embedded the concepts of people's behavior in certain social circumstances, and contain all the regulations governing the operation of a company. During the survey, quality control, personal control and finance control are the foci of our concerns. The other type is non-regulation documents, which are embedded from the relations of a firm with other organizations. They show the recognition (market analysis), privileges (trade mark), opportunities (international network) and responses (strategic plan) of a firm to the outside world. Therefore, the regulation document is maintenance-oriented, common for many firms, and lasting for a long term; while a non-regulation document is development oriented, more specific or confidential, and changes rapidly. It is clear that the transfer of these documents could reflect the increase of management level in the host region.

The inflow of organization documents to Dalian is characterized by: (1) The scope of flow is narrower than production documents, although over 70% FDI firms answer that they obtained personnel management documents from foreign investors. Compared with table 8-17, it is apparent that inflow organization documents are less than production documents in both types. The gap between the two types of documents is also larger than production documents, which suggests the situation of this type technology flow is more complicated.

(2) Among the three types of regulation documents, accounting standards inflow is the least important. The data shows there is a big gap between financial control and production & personnel control in FDI firms. The explanations are two: Firstly, the big difference between China's accounting standards and international accounting standards (IAS) makes it difficult for FDI firms to adopt IAS. Secondly, some foreign investors are not interested in the local operation of FDI firms, because

as Oman (1989) points out that they are sellers rather than investors. So the finances are totally managed by Chinese partners in the old method, which is observed in the firms in which foreign investors' involvement level is low.

Table 8-21 Contents of Organizational Documents Flow

Items	Firm No.	Total Answer	Percentage
Regulation Documents			
Quality Control	22	36	61
Personnel Managing	26	36	72
Accounting Standards	8	36	22
Non-Regulation Documents			
Trade Marks	2	36	6
Market Analysis	10	36	28
Membership of International Organization	6	36	17
Strategic Plan	5	36	14

Source: Enterprise Interviews

(3) Among development documents inflow, market opportunity analysis is the most important document. The survey finds that during the local operation of FDI, it is possible for local parters to obtain some information about exports opportunities, if there is no competition with foreign investors. However, it is very difficult for FDI firms to use foreign investors' trade mark. The Chinese partner of Dalian Morgan Refectories Ltd. complained that the British investors do not allow them to use the trade mark of Morgan, although they should do so according to the contract. While the foreign general manager states that the quality of production is low, so no Morgan's trade mark can be used. Besides this, most foreign investors are reluctant to channel joint ventures into associated international organizations or market networks, because they usually treat these as tools to exert their control over local FDI firms.

2. The application of organization documents. Because the role of organizational documents is to overcome inefficiencies when production is undertaken, in the survey interviewees were asked to evaluate the characteristics of inflow documents, and the results of employing these documents. Table 8-22 displays the answers.

Two points are noteworthy here. (1) Although the flow of organization

document is less than production documents, the assessment of their characteristics is much more diverse than in the evaluation of production documents. Among them personnel management document are often the focus of debates. Similarly, the opinions about development documents are also divided, unlike for production secrets in which praise is unanimous. (2) Although the assessment of the documents is varied, the application of these documents shows positive results. Nearly half the firms report that they possess a more productive organization structure. For example, Dalian Dragon Shoes Co. dropped its management staff from 33% to 7% of the total employment after adopting the management system of the foreign investor. It is estimated by Dalian Centre for Foreign Enterprise Management that management staff is 60-70% lower in FDI firms compared with local firms.

Table 8-22 Characteristics and Effects of Organizational Documents

Items	Firm No.*	Total Answer	Percentage
<u>Evaluation of Documents</u>			
Very Systematic	11	26	42
Very Clear	15	26	58
Easy to Operate	17	26	65
Very Strict	18	26	69
Too General	8	26	31
Not reliable	5	26	19
Backward Family-Style Management	4	26	15
Not Suit Local Situation	3	26	12
<u>Effects of Using the Documents</u>			
Increase Exports	6	26	23
Confidence in Long Term Management	3	26	12
Firm Is Simpler & Effective	17	26	65
Active in Outward Development	4	26	15
Relation Is Wider	7	26	27
Staff left	5	26	19
No Effects	6	26	23

* Multiple answers
Source: Enterprise Interviews

3. Problems in organizational documents transfer. Unlike production documents transfer, which show a bias to personal contact, organization documents

mainly flow independently into Dalian. The reason for personal contact accounting for so low a percentage in conducting this kind technology transfer can be explained by the problems existing in the process of this type of knowledge transfer, which are listed in Table 8-23, especially the ignorance of the Chinese partners. The survey finds that there are two kinds of ignorance among them. Firstly, they are unaware of the value of organization documents because of their lack of experience of international business management, and poor management training. In these cases, when Chinese partners obtain production technology or regulation documents, they think it is enough, and fail to further obtain other documents.

Secondly, they look down on the organization documents. Among Chinese managers, there is a tendency to be contemptous of the philosophy of Western management. When they set up a joint venture with foreign investors, they seldom like Russian managers who pay more attention to foreign partner's management know-how (Hoyle, 1990), and usually only require the foreign partners to supply production technology. When they criticize the shortcomings of regulation documents, they fail or are unwilling to recognize the importance of non-regulation documents.

Table 8-23 Channels and Handicaps of Organizational Documents Transfer

Items	Firm No.	Total Answer	Percentage
Channels			
Independent Document	16	26	61
Personal Contact	3	26	12
Above Two	7	26	27
Problems			
Foreigner Supply is Few	3	26	12
Political System Limitation	4	26	15
Ignorance of Chinese Partner	11	26	42
Difficult to Access	4	26	15
No Problems	4	26	15

Source: Enterprise Interviews

Unlike joint ventures, where the ignorance of Chinese managers fail to use personal contacts to promote the transfer of non-regulation documents, in wholly owned and cooperation firms, it is difficult for local partners or personnel to get or access this type knowledge, which blocks the utilization of this transfer channel.

Besides this, the differences of social systems also can be a barrier, because this document transfer implies a change of management systems.

8.3.5 Production Skills Transfer

Production skills are "soft" technology kept in human beings. Therefore, its transfer is closely tied up with the movement of foreign engineers and technicians. The following features in transferring this type of technology were found in Dalian. Firstly, the scope of production skills inflow is narrow. Secondly, among the skills transferred by foreign investors, most are simple operational skills, while innovation skills account for only a small fraction. Thirdly, the channel of transferring this component is mainly in-job training. Consequently, the difficulties in the process mainly result from foreign investors' attitudes towards the technology transfer.

1. The scope and structure of production skills supplied to Dalian. In the survey, we asked interviewees to check the existence of foreign engineers & technicians in FDI firms and their functions in production. Their answers are listed at the top of Table 8-24. It is clear that the scope of production skills inflow is quite narrow, and nearly 40% of FDI firms are without any skills supply. The reasons for this are: (1) Many foreign investors are trading companies. They are without supply capability or supply enthusiasm. (2) The operation of imported hardware is within the capability of a local partner, and needs no further training. These cases are only observed in some grafting enterprises. (3) There is no production hardware inflow. therefore, production skills transfer is rootless. This situation is often observed in the FDI firms in which seeking incentives or deregulation are the most important motive of local or both side(s).

2. The assimilation of the supplied production skills. Comparing the production skills supply and absorption results, the situation is good. There is an obvious increase in the quality of products, the utilization of equipment, and productivity, which indicates the operation or maintain skills of workers in Dalian have improved. There is also an increase in innovation skills which leads to the development of new products and modification of old products. There are three explanations. Firstly, the quality of this type of technology is better than hard ware and mediumware. Among the evaluation, 30% of answers agree that the skills of foreign expertise are higher than the local personnel, while another 35% partly agree there are technological advantages.

Secondly, the transfer channels are multiple, although in-job training is dominant. In view of operation and maintenance skills transfer, domestic in-job training is the

Table 8-24 Flow and Absorption of Production Skills

Items	Firm No*	Total Answer	Percentage
Types of Skills:			
Operation Skills Only	8	36	22
Operation & Maintenance	11	36	30
Operation, Maintenance & Modification Skills	4	36	11
No Skills	13	36	36
Characteristics of Skills			
Knowledge Is New	7	23	30
Specialized in Certain Field	8	23	35
More Routine & Strict	8	23	35
Absorb Methods:			
Domestic In-Job Training	20	23	87
Abroad In-Job Training	6	23	26
Abroad Survey	4	23	17
Personal Contact	9	23	39
Document Study	5	23	22
Absorb Results:			
Design New Products	2	23	9
Modify Products	6	23	26
Raise the Ratio of Perfect Products	16	23	70
Raise Capability of Fulfil Design Ability	17	23	74
Raise Productivity	21	23	91

* Some are multi answers

Source: Enterprise Interviews

most important form. Most firms undertake certain in-job training. Although in many cases the situation is the same as Mr. Guo, general engineer of Dalian Electronic Industrial General Corporation, states. Namely that workers never master the technology of the production system, and only acquire the basic technical knowledge necessary for the operation of the production process. However, it also directly conducts a certain transfer of production skills, because most trainees are peasants and without any previous production skills. In terms of innovation skills transfer, in-job training is rare, and other transfer forms play some importance. For example,

among the two cases of new product designs, one comes from abroad investigation or survey. The other comes from the document study and personal contact.

Thirdly, local partners and personnel possess strong absorption capability. In the interviews, most local partners are confident about their absorptive capability. For example, Mr. Liu, Vice General manager of Dalian Morgan, states "we can absorb any technology if they (Foreigners) could expose it to us". The barriers identified by most interviewees are the following, and all of them connect with foreign investors. (1) Foreign investors usually limit the supply of skills to operation and maintenance level, and are reluctant to send high level expertise. (2) The narrow scope of foreign technicians and engineers makes . . local partners difficult to learn systematically. (3) Thirdly, foreign investors keep certain key positions from local partners and local personnel, which limits the learning opportunity. From these complaints, we can see that FDI at present do not target the talents of local scientists, engineers and technicians.

8.3.6 Organizational Skills Transfer

As production skills are carried out by foreign engineers and technicians, organization skills are carried out by foreign managers and staff. The examination of their involvement in the FDI management and their contribution reveals the features of this type of technology transfer, which can be concluded as: 1) Management skills and marketing skills are more easily transferred. 2) Local partners do not show as high appreciation of this type of knowledge as production know-how. 3) The impact of this inflow is not only limited to the skills, but also to the entrepreneuriship. 4) The main method of transferring this type of knowledge is informal personal contact instead of formal training. 5) Low level of involvement of foreign investors and the ignorance of the local partners constitute the barriers to transfer organisational skills.

1.Participation of foreign investors in management. Because organizational skills are more complex and more interactive than production skills, in the survey, we use the participation of foreign investors in FDI local operation as an index to measure the inflow of organizational skills, which is shown in Table 8-25.

It is clear that the participation of foreign investors in the management of FDI firms is very low. Over 40% FDI firms in fact are run by local partners or local personnel. The foreign investors usually appear once or twice per year to join the board meeting. However, compared with Liu's survey (1988), the involvement of foreign investors in daily management in this survey is high. In his survey of a dozen FDI firms, 62% of them were without foreign investors' representatives in Dalian. The difference

between the two surveys may be explained by two reasons. One is the increase of foreign investors' participation over time. The other is that our survey shows a bias towards high transferability firms, as discussed in chapter 5, which makes the involvement level higher than the average.

Table 8-25 Participation of Foreigner in Daily Management

Items	Firm No.	Total Answer	Percentage
No Substantial Participation	16	36	44
Share Daily Production Management	3	36	8
Overseas Marketing Only	6	36	17
Daily Production Management & Separated Marketing	4	36	11
Daily Production Management & Together Marketing	3	36	8
Total Control	4	36	11

Source: Enterprise Interviews

Among the FDI firms which have participation of foreign investors, the involvement is limited. Except for wholly owned firms, there are only a handful of FDI firms such as Huirui Pharmaceutical, Pacific Multi layers, Nch-hua Yang and Golden Land which adopt Western management style. However, most of them are domestic market oriented. This means the range of international management skills transfer is limited. Most cases in the survey are foreign investors in charge of exports with or without joining production management. Joint management within China is low, and outside China is even worse. In the survey, most Chinese partners answered that they were only involved in a limited selling activity. They were hardly involved in equipment and materials abroad purchasing. Compared with Shenzheng where over half foreign purchases and sales are involved with local partners (refer Table 4-4), the opportunity for local personnel to absorb organizational skills is less.

2. The stimuli of foreign investors' participation. It is apparent that the situation in which quite a few FDI firms are run by local partners or local personnel, due to the low involvement of foreign managers--limits the supply of organizational skills. Besides this the conflicts between Chinese partners and foreign managers are also common in joint ventures. The survey finds that there are obvious conflicts between the two sides in about one third of joint ventures where foreign managers participate in management in Dalian. Most of them result from the financial

problems and different management philosophy, and this detracts from the transfer of organization skills in the process, because unlike production skills transfer in which in-job training is the main channel, organization skills is mainly transferred by personal contact or learning by sharing. The survey finds that only 20% of the firms conduct specific training, and 80% of organizational skills flow through personal contact.

Table 8-26 The Absorption of Organizational Skills

Items	Firm No.*	Total Answer	Percentage
Management Skills Gain:			
international marketing skills	6	20	30
internal management skills	7	20	35
international financial skills	1	20	5
Entrepreneurial Spirit Gain:			
Independent spirit	5	20	25
Risk spirit	9	20	45
Market conscious	10	20	50
High enthusiasm and efficiency	8	20	40

* Multi answers

Source: Enterprise Interviews

Against this background, it is understandable that stimuli for local partners and personnel from the participation of foreign managers and staff is weak, which can be seen from Table 8-26. However, there are also two points to note. Firstly, among the organizational skills transfer, financial skills are hardly transferred for two reasons. One is the lack of knowledge of international accounting standards by local partners. The other is that financial management is always a sensitive problem in joint ventures and highly confidential in wholly owned firms, so it is difficult for local partners and personnel to access it.

Secondly, the impact of inflow of organizational skills is reflected not only in increasing the stock of managemental knowledge in the host region, but also in stimulating entrepreneurs. The latter shows more incentives to local partners and personnel. The next chapter will tackle this issue in some detail. Remembering the fact that China is changing from a planned economy to a market economy and all the relations are restructured, it is easy to understand that learning by showing is more impressive in management aspect than in production aspect in FDI firms.

Thirdly, unlike transfer of production skills in Dalian, where the Chinese partners or personnel always complain about the narrow scope of foreign engineers and technicians, many interviewees agree that the knowledge scope of foreign managers are wider than local partners', because most Chinese managers lack training in business management. This finding is supported by Ball's study (1993) which also finds that the knowledge scope of the Chinese managers is narrower than that of British managers. This situation indicates that the transfer barrier from the receiving side is larger than in production skills transfer.

8.3.7 Scenarios of Direct Technology Transfer

Considering the above analysis, technology transfer of interviewed FDI firms in Dalian could be divided into the following categories or models, according to (1) the state of acquiring inward technology by the local partners or local personnel; (2) the impact of this acquisition to the technology development of the local partners or local personnel. Table 8-27 summarizes the characteristics of each model and shows its share in the total number of interviewed FDI firms. It is apparent that current technology transfer spectrum mainly falls into the categories of inward technology consumption, although it shows some diversity.

1. Unbinding-Development Model. This is an ideal technology transfer model. It means that local partners not only acquire the inward technology from the foreign partners, but also develop some technology based on this acquisition. In this model, foreign investment is as a calayst to increase the technology competition of the local partners. The main reason for this high transferability can be attributed to a combination of appropriate technology supply and strong local unbinding capability.

In the survey, Dalian Great China Electronics Ltd. and Dalian Hand Crafting Products Ltd. fall into the category, which account for about 6% of interviewed FDI firms. Great China Electronics Ltd. is a joint venture between Dalian Science & Technology University and Ding Enterprises Ltd. USA. It is designed to assemble computers and electronic products, and provide consultant services to micro-electronic technology. During the investigation abroad, local personnel developed some software specifically for the Japanese market. Then the firm quickly expanded its computer software system production. Now, it exports most of its software system to Japan. Dalian Hand Crafting Products Ltd. shows the same situation. When the Chinese partner got the technology of glass melting from the US partner in producing lights, they modified it and applied it to manufacturing screens, which are mainly sold to the international market. The Chinese partner in Hand Crafting Products Ltd. states

Table 8-27 Models of Direct Technology Transfer in FDI Firms

Assimilation State	Firm No.(%)	Characteristics
Unbinding-- Development Model	2 (6)	Large technological gap High transferability--new technology produced International market oriented Obviously medium-ware flow All joint ventures Strong assimilation capability
Unbinding-- Diffusion Model	5 (14)	Medium technological gap High transferability--inward technology diffusion Organizational technology is appreciated Soft & Medium ware transfer All joint ventures & cooperation firms
Entirely Consuming-- Dependence Model	5 (14)	Large technological gap All domestic market entry projects Whole technology package supply Hardware transplant & operation skills transfer Western investment dominant Poor assimilation capability All high technology sectors All joint ventures The inflows cause more inflows
Partly Consuming-- Integration Model	11(30)	Medium technological gap dominant Incomplete technology package Mixed motives & origins Uncertain market orientation Varied integration between inward technology and local technology Medium assimilation capability
Workshop Transplanting-- Accumulation Model	4 (11)	Large technological gap Complete technology package Japanese investment dominant Exports oriented & New town oriented Long term operation Low training &Various skills leaking
Little Transfer-- Localization Model	9 (25)	Little production technology supply, Low foreigners' participation, Small technological gap HMT investment dominant Sensitive to policy changes

Source: Author's Construction

that it would have taken them ten years to develop the technology without the inward investment.

Summarizing the two cases, this transfer model is characteriszed by medium ware flow and development. This differs from most previous studies, in which technology transfer always follows the product-life-cycle and shows a single-way flow.

2. **Unbinding-Diffusion Model.** This model means that during the local operation of FDI firms, the local partners open the inward technology and diffuse it to other local firms. The difference between this model and the above model in Dalian is in the absorptive consequences of the inward technology. The former model led to some new technology or new products coming into being. The latter only stays in the stage of diffusing the inward technology. The explanations about this difference come out of two aspects. Firstly, the technological gap in this model is usually smaller than the last one. Secondly, the local unbinding capability is not as strong as the above model.

There are two sub-categories in this model. One category consists of FDI firms such as Nch-Hua Yang Ltd, and Klix Detergent Co. Ltd, in which the absorption-diffusion is mainly in production technology. Dalian Nch-Hua Yang Ltd is a joint venture between China and USA, which produces industrial detergent. Dalian Klix Detergent Co. Ltd is a joint ventures between China and Canada, which produces family detergent. Because their products show obvious advantages, and the production technology is not so difficult to unbind, the local personnel in the two FDI firms act as harbour of technology flow. Firstly, they obtain the inward technology, then they diffuse the technology to other local firms by various methods.

The other category is FDI firms such as Dalian Jing-Ya Electrical Co. Ltd., in which the absorption-diffusion is mainly in organization technology. Jing-Ya is a cooperation firm between Nippon Youkotsi Co. Ltd and Dalian Jing-Ya Electrical Components Factory. The Chinese partner had been loss-making for many years. The amount of loss was about £100,000 in 1984. After setting up the cooperation firm in 1985, it manufactured coils for Nippon Youkotsi Co. At the same time, it adopted the management system of the Japanese, and absorption of inward organization technology improved the performance of the firm. It has been profitable since 1985, and the profit was about £300,000 in 1991. When the business in Jing-Ya was developing, it subcontracted to 13 local firms, according to the model between it and Nippon Youkotsi Co. which spread the inward organization technology to a much wider audience.

3. Entirely Consuming-Dependence Model. In this model, all local partners produce new products or update their products through consuming the technology brought by FDI investors, and show an obvious leap forward in their production.But during this process, they cannot unbind or master the technology due to the uneven flow of the three knowledge forms. Therefore, there is no development or diffusion of the inward technology. Moreover, it needs to consume more inward technology if local partners want any development.

There are several features in this model. (1) It shows an obvious technology flow, but is mainly concentrated on equipment transplant and operation skills transfer. (2) The entry of the projects always causes a multiplier effect or attracts more investment/technology into the host region. (3) The failure of unbinding the inward technology mainly results from the poor assimilation capability, because all the projects are in high technology sectors, in which technological foundation of local partners are usually poor. Dalian Pacific Multi-Layer Circuit Board Co. Ltd. is a good example.

Dalian Pacific Multi-Layer Circuit Board Co. Ltd. is a joint venture between No. 14 Radio factory of Dalian and Pacific Infotech Corp of USA. Before the set up of this firm in 1989, the Chinese partner could only manufacture the single layer Circuit Board. Now the joint venture can manufacture 8-layer Circuit Boards. It has apparently updated the technology capability of Dalian in PCB manufacture. But this technology progress is mainly reflected in the import of advanced equipment. Over 90% equipment used in the production is imported from America, and most is highly automatic. Therefore, there are few technologies that can be absorbed by the local partner. However, the establishment of this project causes strong local linkages. Most of its products are sold in the domestic market, and local purchases of inputs increased from 10% in 1990 to 30% in 1992. After the operation of this project, two partners cooperated again and established another joint venture firm--Dalian Atlantic Super Multilayer Board Co. Ltd.--to manufacture the inputs of Pacific Multi-Layer Circuit Board Co. Ltd. It is clear that a vertical linkage is forming through up-stream movement of inward technology.

4. Partly Consuming-Integration Model. The firms in this model are operated by technology which is partly from foreign investors and partly from local partners. During the cooperation, there is an integration between the inward technology and the local technology. Because the technological gap between the two sides is usually not so big as the last category, and most inward technology is not a complete package, the contribution of this integration is mainly reflected in updating products and improving the performance of the FDI firms instead of in developing or

diffusing the inward technology. However, the different level of integration between inward technology and local technology makes the transferability in this model more diverse, although most are in the medium category. The operations of Dalian Weigeshi and Dalian Morgan show the diversity.

Dalian Weigeshi Hydraulic Component Ltd. is an example of high transfer. Before 1985, the performance of Dalian Hydraulic Component factory was poor. Because its product was backward, its market share was shrinking. In 1984, total sales were less than £500,000, and profits were below £50,000. After importing German hydraulic technology, and adopting DIN production standard, the performance improved. But the real development of the factory was after setting up a crafting firm with Weigeshi Hydraulic Ltd. of USA. While it updated its production technology, it also absorbed the organization technology of the foreign partner. After that the performance of the firm improved dramatically. Its total sales were £2,450,000 in 1989, and £5,500,000 in 1992.

Dalian Morgan shows another picture. It is a joint venture established by Dalian Refractory Factory and Morgan of England in 1989. It intended producing indefinite refractory materials and exporting them to Southeast Asia. The foreign partner provided part of the equipment and most distribution of the products. After it operated in 1991, the performance of the firm was poorer than expected. Exports also changed from final products to medium products at the level of one tenth of the contract. The local partners turned to one domestic research institute for technology aid, because they did not think that the inward technology was competitive, although they agreed that some distributions were five years more advanced than theirs.

5. Workshop Transplanting-Accumulation Model. This type of FDI firm can be classified as relocation of workshop. Although there are new products & equipment inflow, it is highly controlled by foreign investors, and the channel of technology transfer is very limited. However, local personnel can accumulate knowledge through production and management. Therefore, technology transfer within the firms is totally in software. Four firms (11%) are in this model, and Cannon Dalian is an example.

Cannon Dalian was established in the new town in 1989. Its had over 1,000 employees and investment was Japanese Yuan 9,500,000,000 up to May 1991, which is the biggest Japanese project in China. The main product of Cannon Dalian is the special black box for photocopy machines and laser printers, in which over 400 patents are used. It belongs to new generation of Cannon products. However, among this high technology project, technology transfer is limited. Firstly, local personnel

involvement in management and key position of production is low. Local personnel only share 40% management staff and all in the low level management. Secondly, there are strict measures to keep technology from diffusing. Thirdly, the training is mainly in operation skills and without associated medium ware inflow. Besides these, the poor forward and backward linkages limits its local impact. But the fact that Cannon Dalian increased its productivity 1.5 times within 1991 indicates that local personnel gain some skills from this operation.

6. **Little Transfer-Localization Model.** Although the FDI firms in this group are various, they are characterized by little technology transfer resulting from low technology supply. The survey finds that nine FDI firms (25% of all the sample) are in the name of international cooperation. They show little change in other aspects, especially in technology. The localization of these FDI firms shows the following reasons. (1) The foreign investor is only the supplier of capital, such as Dalian Business Computer Co.Ltd., in which the local partner supplies everything except part of the capital. (2) The foreign investor takes the advantage of incentive policies, and cheats local partner. For example, in Dalian Sha-Yi Machine Ltd. the Taiwanese investor took the money for purchasing equipment, but only transported some rubbish into Dalian. (3) Local partner and/or foreign investor are only interested in obtaining privilege policies. For instance, neither partners of Dalian Shapulai Industrial Co. Ltd. care about technology or production, and they all intend to get benefits from incentives or mistakes of governments at different levels.

Summary

Since the acquisition and absorption of imported technology is closely tied up with foreign investment projects at the beginning stage of FDI entering the host region, the check of the flow within FDI firms constitutes the core of technology transferability measurement. Acquiring potential, consequences, and process are three key issues in this direct measurement.

The width and structure of the technological gap between FDI and Dalian are employed to show the potential of acquiring imported technology by local firms and local personnel. The survey finds that there is a positive technological gap in most FDI firms (93%). However, two facts discount the potential: Firstly, the technological gap is quite narrow. Over half FDI firms (54%) imported technology only shows several years (<10 years) advance, and there are only 12% of FDI projects with a big (>15 years) technological gap. Secondly, the advantages possessed by foreign investors show a high bias towards a single advantage. There is only one fifth of

foreign investors possessing both production and organization advantages. The survey also finds that investors status is the most important factor to determine the FDI technology value.

Technology transfer ideally means bringing the technology receiver to the similar level as the technology supplier. A technological gap diminished through FDI local operation reflects technology transferability of FDI. The Questionnaire survey in Dalian provides an approximate picture of the result of acquiring inward technology within FDI projects. 25% of the FDI firms show a high transferability or an estimated over ten-year technological gap is overcome; one fourth of FDI firms is without technology transfer; and half the FDI enterprises report that they experience a medium technology transfer e.g. diminished gap within their firms is under ten years. The deviations of FDI's transferability indicate that foreign investors' national origins and investment motives play a more important role in determining transfer results than in transfer potential.

The examination of the transfer process by interviews shows that the knowledge flow within FDI firms is obvious but limited. The flow of technology in six components is uneven, which highlights the following problems: (1) Hardware transplant dominated the current technology transfer. The import of products and equipment, on the one hand, upgrades the local technological foundation; on the other hand, it causes technology dependency. The inflow of management equipment and facilities is converted into vehicles import and stimulates speculation. (2) Lack of inflow of various know-how makes the technology transfer superficial. In terms of production, most FDI firms stay at the stage of operation and maintenance without any R & D; in terms of organization, the firms cannot yet independently channel into the international market. (3) Skills transfer shows obvious deficiencies in supply. In terms of production skills, it is difficult to produce innovation ideas in on-job training of unskilled operators. In terms of management skills, "Localization" of FDI firms, resulting from low involvement of foreign investors in management, blocks the contacts between foreign expertise and local personnel.

Six scenarios of technology transferability could be identified from the interviewed FDI firms. It shows the diversity of technology transfer, although the transfer, generally speaking, is still at an early state. Local partners and personnel of most firms are in the cummulative stage by absorbing limited technology supplied by foreign investors. Diffusion of inward technology is only shown in simple production and in certain management aspects. There are only a few cases showing modification and development of inward technology. Relocated workshops and localized FDI firms hardly conduct technology transfer.

CHAPTER 9. DIFFUSION EFFECTS

9.0 Introduction

This chapter presents the third part of the survey findings. After analyzing the technology transfer within FDI firms in the last chapter, the purpose of this chapter is to examine the technology transfer outside the FDI firms by exploring the diffusion effects of FDI. Diffusion effects is defined here as the knowledge trickling down or spreading from inward investment, along with the exchange of materials and the movement of local staff in the host region. Since this effect also leads indigenous enterprises and local personnel to acquire imported technology, it constitutes an associated measurement of technology transfer through FDI. In order to check the spread of knowledge through these antennae of FDI, the first section of this chapter attempts to analyze the relationship of FDI with local customers or buyers. The second section aims to examine the backward linkages of FDI firms. The final section of this chapter intends to investigate the effect induced by movement of local personnel leaving FDI firms.

9.1 Technology Diffusing Through Forward Linkages

Forward linkages of FDI are the domestic use of FDI enterprises' output. They reflect the relations between inward investment and local buyers. The output sold by FDI firms on the local market, as Michalet (1977) states, is also a vehicle of technical knowledge flow between foreign investors and local buyers, whether these buyers are consumers or enterprises. The task of this section is to show the forward linkages of FDI enterprises in Dalian and the diffusion of technology along these linkages.

9.1.1 Level of Local Sales

The survey finds that most FDI firms in Dalian hold an important position in terms of local sales. As shown in Table 9-1, only one fifth FDI firms sell less than one quarter of their products in China market, while nearly half FDI firms sell more than three quarters of their products in domestic market. This structure obviously differs from the one of foreign investors' motivations discussed in chapter seven, in which nearly half foreign investors aim at saving costs, and only one fourth labels their purposes as market entry. The explanation for the difference could be the following: (1) The interview sample shows a bias towards high transferability projects, therefore, there is a automatic bias towards domestic market oriented. Because chapter eight has proved that there is a proportionate relation between market

entry and technology transferability. (2) Many FDI firms find it difficult to reach their exports targets at the beginning stage of local operations due to the learning process or the changing of operation environment. (3) Most FDI projects in Dalian are downstream. The survey finds that over 60% FDI firms belong to assembly or final products production, which is easier to convert to local sales.

Table 9-1 Local Sales Level of FDI Firms

Items	Firm No.	Total Answer	Percentage
Over 75 %	17	36	47
Between 50-75 %	4	36	11
Between 25-49 %	8	36	22
Less 25 %	7	36	19

Source: Enterprise Interviews

In addition to the high level of local sales, FDI firms in Dalian show the following characteristics, which can be drawn from Table 9-2: (1) Among the three investment forms, joint ventures show the highest local sales tendency, in which 74% are Chinese market oriented, and about 60% of FDI firms sell over three quarter of their products locally. This suggests that the technology level in joint ventures, as Hoyle (1990) comments, is high enough to attract local costumers, but is not high enough to compete in the world market. Among the interviewed firms, cooperation firms are international market dominant, all of them sell over half their products to the outside market. It is apparent that it is determined by its characteristic of processing workshop. Wholly owned firms are in the middle of the two forms and show outside market bias. Besides this, comparing with other enterprises, grafting firms show less dependency on the local markets, and have higher capability to enter international markets.

(2) Local sales levels of FDI show huge differences between different investors' national origination. There are three scenarios. HMT investment do not show obvious market orientation. Local sales and international sales have similar importance in their operation. Japanese investment shows obvious international market orientation, and 60% firms sell over half their products outside China. Western investment shows the opposite situation. 83% firms are local sales oriented, and 66% firms sell over 75% of their products locally. This finding confirms the other empirical studies such as Frank (1980) that Western investment shows high domestic penetration and Japanese investment is more or less like a "relocated workshop".

Table 9-2 Differences of Local Sales Among FDI Firms

Projects division	Level of Local Sales of FDI Firms (%)				
	>75	50-70	25-49	<25	Total
Ownership Form					
Joint Ventures	16	4	6	1	27
Cooperation	0	0	1	4	5
Wholly owned	1	0	1	2	4
Enterprise Attribute					
Grafting	6	1	4	4	15
Non-grafting	11	3	4	3	21
Firm Location					
old city	11	1	4	4	20
New Town	6	3	2	2	13
Suburb	0	0	2	1	3
Investor Origin					
HMT	6	1	6	1	14
Japan	3	1	1	5	10
Western	8	2	1	1	12
Investor Status					
Manu.Co.	11	3	4	6	24
Trading Co.	3	1	3	0	7
Individual	3	0	1	1	5
Sectoral Destination					
High tech	12	2	3	3	20
low tech	5	2	5	4	16
Investment Scale					
>$ 10 million	4	1	2	3	10
$1-10 million	5	3	2	1	11
<$ 1 million	8	0	4	3	15
Establishment Date					
-1988	5	3	1	0	9
1989	5	0	4	0	9
1990	4	0	0	4	8
1991	3	1	3	3	10

Source: Enterprise Interviews

(3) Local sales of FDI firms also varies significantly with the locations of FDI. In terms of regional destination, FDI firms located in the old city have a tendency to sell

their products in the local market, while the firms located in the suburbs show the opposite trend. And new town firms although mainly aimed at the local market, also show their importance in entering international markets. In terms of sectoral destination, for high technology industries, local sales are much higher than standard industries. 70% of the firms in the former aim to sell locally, while only 44% of the firms in the latter aim to do so.

(4) With regard to the investment scale of FDI firms, it is the medium scale investment that shows the highest local sales ratio, and 73% of this type of firm attempt to exploit the Chinese market, while large scale and small scale investments show a comparatively more balanced market orientation. The reasons of this situation are two. For the large scale investment, it is the restrictive policy that limits the local sale. For small scale investment, it is usually their technology level limiting their high level local sales.

(5) There is a trend that local sales are decreasing over time. Data shows that the number of FDI firms with a high level of local sales are decreasing, while those FDI firms with high level international market sales are increasing. The factors which promote this shift are the following: Firstly, the wholly owned firms, especially from Japan, are increasing very quickly. Secondly, government's incentives and restrictions have paid more attention to promoting exports.

9.1.2 The Objectives of Local Sales

Although all local sales could be a vehicle to transfer technology, the consequences of technology diffusing through forward linkages of FDI firms are different when local buyers are consumers or enterprises, because the contents and methods of technology diffusing are different. In the interview, we asked the interviewees to identify their objectives of local sales. Their answers indicate that local sales of FDI enterprises are concentrated in the three categories as shown in Table 9-3. This structure and the deviations among the three categories of FDI firms determine the features of the destinations of local sales.

Firstly, nearly half the FDI firms sell their products directly to domestic consumer market. However, in the case of high level (>75%) local sales, FDI ownership, the attribute of FDI enterprises and projects' sectoral distribution play an important role in this type forward linkage. The survey finds that all the projects except one in high level local sales are joint ventures; non-grafting enterprises dominate the category; and the number of high technology projects are two times those of standard technology project. Differing from the high level local sales, other levels of local sales are

dominated by small firms, and HMT investment instead of Western investment is the main stake. The survey also finds that these FDI firms market most of their products by themselves and do not pass them through local distribution networks. This differs from the cases in other developing countries at their beginning stage (Germidis 1977).

Secondly, selling to local firms is another main destination of FDI forward linkage, and nearly 30% of FDI projects fall into this category. This is characterized by (1) At present, no wholly owned subsidiary chooses local firms as their marketing target. They are more interested in local consumer markets or in relations with other FDI subsidiaries. (2) Medium and small-sized FDI firms show importance in this local sales destination, while there is only one large project, Weigeshi which sells its Hydraulic equipment to local enterprises. (3) Japanese and Western investment is more interested in establishing forward linkages with local firms than HMT investment. (4) FDI firms in non-high technology sector show more importance than high technology activities. (5) There is no big difference between grafting and non-grafting enterprises

Table 9-3 The Objectives of Local Sales

Items	Firm No.	Total Answer	Percentage
No LocaL Sales	4	36	11
Consume Market	14	36 (32)	39 (44)
Local Enterprises	9	36 (32)	25 (28)
From Local to FDI Firms	4	36 (32)	11 (13)
Other FDI Enterprises	2	36 (32)	5 (6)
No Clear Objective	3	36 (32)	8 (9)

Source: Enterprise Interviews

Thirdly, sales to other FDI firms has accounted for about one fifth of local sales. This type of local sales consists of two categories. One is targeting FDI firms when they are established. The other is shifting from local firms to FDI firms after they have set up. The features of this sale to other FDI firms are: (1) Cooperation is out of this relation. It is joint ventures and wholly owned subsidiaries that forge this forward linkage. (2) Grafting enterprises are also difficult to establish forward linkage with other FDI firms, while non-grafting enterprises account for over 80% in this relation. (3) The new town of Dalian, as the number one FDI location, does show a close relation to FDI firms, and 83% local sales to other FDI firms occurs in this area. (4) Sales to other FDI firms are dominated by large and medium-sized projects, unlike the other cases where medium and small scale firms are usually dominated.

9.1.3 Impact of Local Sales

The main role of FDI firms' local sales, in terms of the economy, is widely identified as import substitution (UNCTC 1985, 1987, 1989), no matter whether local buyers are consumers or enterprises. But the role of diffusing technology through FDI firms' local sales is different between two types of buyers. The survey finds that the impact can be divided into two levels in the two types of local buyers. Table 9-4 displays the consequences of local sales at the two levels.

Table 9-4 Technology Transfer Through Local Sales

Items	Firm No.	Total Answer	Percentage
Selling to Enterprises			
Increase Buyers' Products Quality	8	32	26
Increase Buyers' Products Quality + After Sales Service + Training	5	32	16
Increase Buyers' Products Quality + Provide Technology information + incentive other suppliers	5	32	16
Selling to Consumers			
No Effects or No Idea Except Products Flow	7	32	22
Show Marketing Know-how + Consumer Education	7	32	22

Source: Enterprise Interviews

1. Selling to enterprises. When local buyers are enterprises, the diffusing of technology through FDI forward linkages can be viewed at the following two levels. The first level is reflected in the flow of products provided by FDI firms. Data shows that about one fourth of the FDI firms answer that their provision of products helps local buyers to improve the quality of their products. For example, Golden Land Co. provides high quality cloth to FuTian clothing Co. and helps it upgrade products.Weigeshi Hydraulic Co. provides machinery to metallurgical companies and updates their equipment. Dalian Magnetic Head Ltd. increases its production standard by using the supplies of TD Mould Center Co.

Technology diffusion at the second level is tied up with the other activities conducted by FDI firms when they sell their products to other enterprises. 32% of

firms claims that they can identify this contribution in transferring technical knowledge. These associated activities can be divided into two groups. One is after sales service and personnel training for local buyers, which are mainly in high technology projects, especially in the electronics industry, because local buyers are not familiar with these products. These efforts usually combine products and operating skills together and accelerate the process for local buyers to get familiar with certain new technologies. The other group is usually in standard technology sectors. The high level of competition in these industries sometimes forces FDI firms to provide more technical information to convince the local buyers to put in their orders. At the same time, the products provided by FDI firms could be shown to local buyers' previous suppliers and constitutes a stimulus to local trade by forcing them to improve their products and services.

2. Selling to consumers. When local buyers are consumers, the impact of of local sales in changing local buyers' innovation capability is very weak. However, there are also two levels of knowledge flow. At the first level, it is the increase in products to consumer markets. Technical knowledge is conveyed by these products themselves. About half consumer market sales belong to this category.

At the second level, two ways are identified as the conveys to diffusing technology. One is the demonstration of marketing know-how. It has been mentioned that in Dalian most FDI firms market their products by themselves instead of passing their products to the local distribution networks. Besides this, the Chinese market shows the tendency of localization resulting from "Guanxi"--personal relations. It needs FDI firms to repeat their marketing activities in different regions. These factors make it possible for local firms to learn the marketing skills of FDI firms. For example, Nch-Hua Yang's organization structure and marketing strategies were copied by many small local firms when they imitated its products. The other way is consumer education. The analysis of local sales destination has revealed that most domestic consumer market oriented FDI is in high technology industries. In their local sales, education of the consumer often occurs due to the comparatively high technological content of their products. This education takes place not only through the traditional after-sales service, but also through training of the customers before purchases. During this education some technical knowledge can be diffused without really buying. As a result, customers become more discriminating about the quality of goods and services, which forces Chinese firms to raise their standards.

9.2 Technology Diffusing Through Backward Linkages

Backward linkages are the purchase of local inputs, which show the relationship

between FDI firms and local suppliers. Comparing with forward linkages of inward investment, backward linkages are more favored by the host country's government, because the purchase of local products and services not only brings more development opportunities such as increased employment and improved balance of payments to the local economy, but also offers a chance for indigenous firms to increase their production standards, access markets and information, and reinforce the local technology infrastructure. So enlarging backward relations of inward investment has been a focus of host country's policy, both in developing and developed countries (Germidis 1977; Frank 1980; Lall 1983, 1989; UNCTC 1985, 1989; Turok 1993).

9.2.1 Level of Local Purchases

In order to measure the backward linkages of FDI in Dalian, we asked interviewees how much input they purchased locally. Their answers are listed in the Table 9-5. Because of limitations in the information gathered, the data is not unified. Some are in money value and some are volume share. The latter is usually higher than the former. For example, in Morgan Refractories Ltd. the local purchase in value is about 60% and in volume is over 70%. Besides that, two levels of local purchase in one FDI firm is not common in Dalian as in Shenzhen, where FDI firms use more imported inputs (70%) when its products are sold in international markets, and its local purchasing is high (70%) when its products are sold in the domestic market (Lin 1991). The reason for this may be that the diversity of products in most Dalian FDI firms is low.

Table 9-5 Local Purchase Level of FDI Firms

Items	Firm No.	Total Answer	Percentage
Over 75 %	14	36	39
Between 50-75 %	8	36	22
Between 25-49 %	4	36	11
Less than 25 %	10	36	28

Source: Enterprise Interviews

In terms of local purchase level, backward linkages of FDI firms in Dalian look impressive. There are 61% of FDI firms buying more than 50% of their inputs locally, and 39% firms purchasing over 75% of their inputs in China, although there is over a quater of FDI firms buying less than 25% of their inputs locally. Compared with other cases studies where FDI only make marginal use of local suppliers

Table 9-6 The Characteristics of FDI Firms' Local Purchase

Project Division	Level of Local Purchase of FDI Firms (%)			
	>75%	50-75	25-49	<25
Ownership Form				
Joint Ventures	11	5	4	7
Cooperation	3	2	0	0
Wholly owned	0	1	0	3
Enterprise Attribute				
Grafting	8	4	1	1
Non-grafting	6	4	3	9
Firm Location				
old city	11	5	2	3
New Town	1	2	2	7
Suburb	2	1	0	0
Investor Origin				
HMT	6	2	3	3
Japan	2	2	0	6
Western	6	4	1	1
Investor Status				
Manu.Co.	8	7	3	6
Trading Co.	1	1	1	4
Individual	5	0	0	0
Sectoral Destination				
High tech.	3	7	4	7
Standard tech.	11	1	0	3
Investment Scale				
> 10 million	1	1	1	4
1-10 million	7	5	1	2
< 1 million	6	2	2	4
Establishment Date				
-1988	4	4	0	1
1989	3	1	1	4
1990	3	1	3	1
1991	4	2	0	4

Source: Enterprise Interviews

(Michalet 1977; Turok 1993), the backward linkage of inward investment seems strong. Combining with the discussion in the last section, seems that FDI firms in

Dalian buy a lot and sell a lot locally and have a close relationship with local economy.

However, further analysis reveals that backward linkages in Dalian are not so good. First the quality of local purchase is poor, and shows an extreme bias towards basic material purchases. Steel, copper, wool, plastic, feather, paper board, some chemicals, and agricultural products are the main products bought by FDI enterprises. It is apparent that most of them are location specific, simple to manufacture, and very high transport costs. Table 9-6 shows that in high technology sectors, 70% of firms purchase over 3/4 their input abroad, while in standard technology sectors, about 80% of firms buy over 3/4 their input locally.

Secondly, the big orders hardly go to local suppliers, and local purchases do not show an increasing trend. Among seven investments of over US$ 10 million projects, only Weigeshi Hydraulic Co. purchase over 3/4 their inputs--steel and metal products--locally, and Nodic tire Co. plan to purchase over half their inputs (mainly rubber) locally. The rest of the firms obtain their inputs mainly from abroad. Compared with this, medium and small-sized firms show a high local purchasing tendency. The situation shows that a low ratio of manufacturing products and small scale in local purchase do not change obviously over time. The data shows that although FDI firms at a high level local purchase slightly increased, the high level abroad purchase also increased, even at a quicker pace.

Table 9-7 The Obstacles to Local Purchase

Items	Firm No.	Total Answer	Percentage
Quality is Too Low	11	34	32
Lack Suitable Type	8	34	23
Price is Too High	4	34	12
Supply is Unreliable	3	34	9
Managing Reason	8	34	23

Source: Enterprise Interviews

The obstacles to increasing local purchasing, as shown in Table 9-7, are mainly on the supplier side. The survey finds that over 70% of FDI firms in Dalian say they would like to purchase or are willing to increase their purchases locally, because most of their imports are below a scale that is economic. If they can purchase more locally, it will help keep their total costs low. It is apparent that there is scope for local firms to increase their supply by updating their products and increasing their production

standards. Of course, this is just the perspective of the FDI firms. Local suppliers may identify other demand-side obstacles to local purchasing as well.

9.2.2 Suppliers of Local Purchase

It is understandable that local firms are the main local suppliers, as data indicated in Table 9-8, because local purchase of FDI firms at present stage is concentrated on raw materials. However, there are two points noteworthy in terms of local suppliers' structure. First FDI enterprises play a more important role for other FDI firms in local purchase than in local sales. Compared with Table 9-3, the trade between FDI firms is 16 percentage points higher in backward linkages than in forward linkages. Secondly, the shift of local purchase from other categories such as import or buying from indigenous firms to FDI firms is obvious. 9 firms fall into this category, whereas there are only 4 cases in the local sales. It is clear that local purchase of FDI firms is a method to forge a close relationship among FDI enterprises.

Table 9-8 Suppliers of Local Purchases

Items	Firm No.	Total Answer	Percentage
Not the Issue	2	36	6
Local Enterprises	22	36 (34)	61 (65)
From Import or Local Firms to FDI Enterprises	9	36 (34)	25 (26)
Other FDI Enterprises	3	36 (34)	8 (9)

Source: Enterprise Interviews

Table 9-9 provides more information about the suppliers change in local purchases of FDI firms. It is apparent that: (1) The shift mainly takes place in joint ventures, and wholly owned subsidiaries also show a clear transformation of their local purchase suppliers. (2) The shift mainly occurs in the comparatively old FDI firms. The data of time change shows that newly set up FDI enterprises aim to get supply from other established FDI firms, while old FDI firms gradually turn to newly set up FDI firms to source their inputs. (3) Most shifts are observed in HMT investment and Western investment, while Japanese investors hardly change their input suppliers, because on one hand Japanese investors show high requirement for the quality of products; on the other hand most Japanese investment is one link of their horizontal or vertical relation which has been designed carefully. (4) The smaller the investment scale, the clearer the shift. It can be explained that it is easier for small firms to adjust their

Table 9-9 Characteristics of Local Purchase Suppliers

Items	Other FDI	Local Firms	Shifting Objective
Ownership Form			
Joint Ventures	2	17	6
Cooperation	1	3	1
Wholly owned	0	2	2
Enterprise Attribute			
Grafting	1	8	5
Non-grafting	2	14	4
Firm Location			
old city	1	10	6
New Town	2	9	3
Suburb	0	3	0
Investor Origin			
HMT	1	8	4
Japan	0	8	1
Western	2	6	4
Investor Status			
Manu.Co.	3	15	5
Trading Co.	0	3	3
Individual	0	4	1
Sectoral Destination			
High tech	2	13	5
low tech	1	9	4
Investment Scale			
> 10 million	1	5	1
1-10 million	1	6	3
< 1 million	1	11	5
Establishment Date			
-1988	0	6	2
1989	0	6	3
1990	2	4	2
1991	1	6	2

Source: Enterprise Interviews

management than medium and large firms. (5) The ratio of firms shift from other sources to FDI firms in standard industries is higher than in high technology industries, which may suggest that backward linkages in traditional industry are easier

to establish than in high technology industry.

In addition to the above analysis, the shift of local purchase suppliers can be explained by another reason: the status change of previous indigenous firms. That means the local suppliers find a foreign partner and fall into the category of FDI firms. For example, Dalian Wireless Factory which is the supplier of XA Electronics Products Co. formed a joint venture with a Japanese investor. Although the supply from it has not yet changed, the backward relation of XA has changed in name. This factor can also shed light on the conflict between the obvious shift of local purchase suppliers and stagnant growth of local purchase levels in FDI firms.

9.2.3 The Impact of Local Purchase

It has been repeatedly stated that technology transfer through backward linkages is affected by the relationships established between FDI firms and their local suppliers. For example, Turok (1993) outlines two scenarios. One leads to technology development, the other leads to technology dependence. The case in Dalian, in terms of diffusing technology, shows two characteristics. First there are three types of relationships between FDI firms and their local suppliers, and they provoke different knowledge flows. Secondly, the linkages between FDI firms and their local suppliers are too weak to identify the consequences of backward linkages between the two scenarios. Table 9-10 displays the nature and the impact of the linkages.

1. "Shopping around". The survey finds that more than 20% of firms cannot provide any help to local suppliers through their local purchasing. Their local purchase is simple "buying" without other interaction with local suppliers. It is noteworthy that this "no effect" category is 4 percentage points higher than the one in local sales, which may suggest the incentives of "pure buy" is smaller than "pure sales", because in the latter products themselves contain certain stimulus to the host region.

Looking inside this group, three types of shopping around can be identified. First FDI firms are concerned about the transportation costs and shop locally. The large scale raw materials purchases fall into this category. For example, Borollo produces steel tubes by purchasing steel locally. Secondly, the quality of products and raw materials is generally good and there is high competition among suppliers, so FDI firms shop around. Most food processing projects show this tendency. Thirdly, when one FDI firm is purchasing from another FDI firm, both are quite familiar with their functions, there is no room for them to show technology trickle down. The relationship between Pacific and Atlantic Co. is an example.

Table 9-10 Technology Transfer by Local Purchase

Items	Firm No.	Total Answer	Percentage
Not an issue	2	36	6
No Effects	9	36 (34)	26 (26)
Increase Quality Criteria	15	36 (34)	42 (44)
Increase Quality + Improve Supply Method	5	36 (34)	14 (15)
Transfer Organization Technology	2	36 (34)	6 (6)
Transfer Organization + Production Technology	3	36 (34)	8 (9)

Source: Enterprise Interviews

2. "Conditioned buying". The main relationship between FDI firms and local suppliers is that FDI firms impose a high product standard without helping local suppliers to satisfy this standard, or impose a new supply procedure without helping local suppliers to realize it. Therefore, technology diffusing is "passive" instead of "active" in this category. The survey finds that 60% backward linkages is in this "conditioned buying". It is common in various investment origination, destinations and operation forms.

The relationship in conditioned buying is simple, and the incentives are obvious. First it is helpful to upgrade production by conveying certain technical knowledge. In Dalian, as in other regions of China, production standards are generally low. When a high production standard is set by FDI firms, it makes local suppliers aware of their shortcomings. When the high standard is accompanied by samples, more technical information can be conveyed. For example, Double chemical Co. obtain a product sample from Huan-Yung, then they use it to find a foreign investor to set up a joint venture to manufacture it.

Secondly, it helps local firms to know the importance of product quality, and adopt new supply methods. Because China had a shortage of supply for a long time, the quality of products has not been treated as a high priority in society. When facing high production standards and new supply methods set by FDI firms, many local firms were shocked. For example, one rejection of Marine Food Co. by one of local suppliers which was slightly below the products criterion made it keep high product standard in the later supply. Besides that, the contacts between FDI firms and local firms spread new supply philosophy and methods. For instance, just-in-time

management is becoming familiar by local firms through their relation with FDI.

3. "Controlled buying". The third category proves that the use of local engineering capability by FDI firms can contribute to further develop the technological potential of local firms, because there is obvious technology diffusion through local purchase. In these cases, FDI firms not only set a high product criterion for local purchase, but also offer certain assistance to local firms. However, this type of relationship only a handful cases in Dalian. They usually occur in standard industries, and joint ventures are the main type.

The control or assistance of FDI firms to their local suppliers can be divided into two types in Dalian. First there is management assistance only. This situation is observed when there is not a obvious production technology gap between FDI firms and their suppliers. There is only organization skills diffused through local purchase. For example, when Dalian Dragon Shoes Co. can not finish its order, it subcontracts some shoes production to Dalian Feather materials factory. At the same time it sends managers to the factory and helps reorganize its production, and obviously increases its productivity.

The other type of control or assistance is a comprehensive package. It involves either the assimilation of manufacturing techniques or the improvement of management and organization in local suppliers. It is reported in the cases that there is a production technology gap between FDI firms and local firms. For instance, in JingYa electrical equipment Co., when it subcontracts its products to other factories, it not only sends its expertise to the local suppliers to train operators so that they can undertake the work in the same products quality as JingYa, but also helps local suppliers to restructure their organization, so that they can obtain the same productivity as itself. XA goes even further. It not only purchases some components of its product from Dalian wireless Factory, but also helps it to get some imported machinery, and update its suppliers.

9.3 Technology Diffusing Through Staff Movement

Recruitment and training of local personnel has been considered to be one of the most important aspects of technology transfer by FDI (OECD 1977, 1981; Smali 1985; UNCTC 1990). Two functions of transferring technology could be identified from the employment of local personnel in FDI enterprises. First is knowledge accumulation. When recruitment and training take places, the flow of production skills and organization skills within FDI firms would increase the knowledge stock of local personnel, which has been discussed in chapter eight. Secondly, there might be

a multiplier effect induced by the fact that qualified personnel leave the subsidiary and thus transfer scientific and technical knowledge to other sectors of the economy (Germidis et al 1977). This section aims to check this multiplier effect in Dalian at present.

9.3.1 Characteristics of Local Personnel Outflow

In the survey, we find that the scope of local personnel moving out of FDI enterprise is not great. Table 9-11 shows that only 40% FDI firms experience any outflow of local staff. This may suggest the channel of diffusing technology through staff movement is narrow. However, compared with another survey undertook by Germidis et al (1977) in 12 developing countries, in which all the case studies show comparatively low mobility for qualified workers and almost none for management, the outflow structure of local personnel in Dalian, as shown in Table 9-12, is more favorable to produce multiplier effect, because engineers and technicians outflow is the main type of outflow staff.

Table 9-11 The Outflow of Local Personnel

Items	Firm No.	Total Answer	Percentage
No Personnel Move	21	36	58
Have Personnel Move	15	36	42

Source: Enterprise Interviews

Table 9-12 The Structure of Outflow Personnel

Items	Firm No.	Total Answer	Percentage
1. Managers	1	15	7
2. Engineers & Technicians	6	15	40
3. Manual Workers	5	15	33
4. 2 + 3	1	15	7
5. 1 + 2 + 3	2	15	13

Source: Enterprise Interviews

By further analyzing the current situation of local personnel leaving FDI firms in Dalian, some characteristics emerge. First, among the 40% FDI firms which

Table 9-13 Outflow of Local Staff Among FDI Firms

Items	Manage.	Tech.	Manual.	All	Tech+Manu
Ownership Form					
Joint Ventures	0	5	4	0	1
Cooperation	1	0	0	0	1
Wholly owned	0	0	2	1	0
Enterprise Attribute					
Grafting	1	2	3	0	0
Non-grafting	0	4	2	1	2
Firm Location					
Old City	1	3	3	0	0
New Town	0	3	2	0	0
Suburb	0	0	0	1	2
Investor Origin					
HMT	1	1	1	1	2
Japan	0	1	4	0	0
Western	0	4	0	0	0
Investor Status					
Manu.Co.	0	6	2	1	0
Trading Co.	1	0	1	0	0
Individual	0	0	2	0	2
Sectoral Destination					
High tech	1	4	1	1	0
Low tech	0	2	4	0	2
Investment Scale					
> 10 million	0	0	1	0	0
1-10 million	0	2	3	1	0
< 1 million	1	4	1	1	2
Establishment Date					
-1988	0	3	1	0	0
1989	0	1	1	1	0
1990	0	1	2	0	1
1991	1	1	1	0	1

Source: Enterprise Interviews

experience an outflow of local personnel, the absolute amount of leaving staff is quite high. For example, there was 20% local personnel left Great Dragon Shoes Co. only

within the first year. Several firms report that 10% of local employees leave them every year. Among the leaving local personnel, most of them are manual workers.

Secondly, there is a close relation between employee recruitment and outflow. Currently, FDI firms recruit their employees in the following three ways: converting from Chinese parent company; advertizing from the society (urban); and recruiting from the countryside. Most skilled local personnel are obtained from the former two ways, and most unskilled personnel are employed through the last one. It is not the case in Dalian for FDI firms to provide training courses for members of universities to select their future employees, as in Beijing and in other developing countries (Passos 1977, Maddox 1993). The survey finds: (1) Converting staff are the most stable among three origins of employee. The low rotation of staff in cooperation firms, in grafting enterprises, as shown in Table 9-13, gives the evidence. (2) Unskilled local personnel recruited from countryside shows two scenarios. If they work in the old city center or in the new town, they are quite stable. But when they are employed in the suburbs, they are more likely to leave, which can be seen from the high rotation of suburb FDI firms. (3) The local employee recruited from society shows the highest mobility both in skilled and semi-skilled personnel. They do not care "iron rice bowl"--permanent employment--as converted staff, and do not experience a big change in living standard as the young peasants.

Thirdly, the movement of skilled local personnel and unskilled local personnel shows different pictures. Generally speaking, unskilled local personnel come from wholly owned firms, Japanese investment, individual investors, small and medium-sized enterprises, and standard technology sectors. While qualified local personnel are from Western investment, high technology sectors, joint ventures, old FDI firms and non-grafting enterprises.

Table 9-14 Comparison of Annual Salary in New Town (RMB Yuan)

Items	1986	1987	1988	1989	1990	1991	1992
A. FDI Firms Average	1989	2001	2017	2599	3211	3790	3084
B. Total Average	1787	1805	1845	2617	3109	3802	2905
C. A-B	202	196	172	-18	2	-12	179

Source: Economic Development Bureau of Dalian ETDZ, 1992

Fourthly, the negative drive is stronger than positive drive for local personnel leaving FDI firms. The survey finds that there are several reasons for local personnel

leaving FDI Firms. (1) They dislike the work.This means that local personnel cannot tolerate the hard work, low pay or poor working conditions and leave. This type of outflow mainly occurs in the unskilled or semi-skilled workers. When these workers are transferred from other factories, especially state-owned factories, instead of recruitment from the countryside, they are more likely to give up. Japanese investment and HMT investment report a high ratio of this outflow.

(2) FDI firms are regarded as hopeless in terms of salary. One important reason for local personnel working in FDI firms is its high salary. However, the salary gap is diminishing over time, because local salary levels are increasing faster than FDI firms, as shown in Table 9-14. Therefore, the previous attraction of FDI firms is declining. This type is widely reported in different FDI firms and in various local personnel.

(3) Setting up new enterprises. About half the engineers and technicians' outflows is directly connected with the establishment of new firms in Dalian, which can be seen as the spin-offs of inward technology.

9.3.2 Multiplier Effect of Local Personnel Outflow

The institutional transformation in China at the present stage does not limit multiplier effect only to the production field, and only in qualified local personnel, albeit the rotation of qualified staff of the FDI firms is the main stake of technology spin-offs from inward investment. The impact of local personnel outflow is observed from the following two aspects in the survey.

1. Diffusing certain production technology. Although there are only a few cases in the survey, technical knowledge transfer through the movement of local staff does take place in Dalian. The rapid development of detergent production can be seen as an example. Dalian Nch-Hua Yang Ltd is a joint venture between China and USA, which produces industrial detergent. Dalian Klix Detergent Co. Ltd is a joint venture between China and Canada, which produces family detergent. Because the new products are more effective than the old ones, both enterprises show high profits. In order to keep control of the technology, foreign investors use numbers instead of chemical names to label the materials they use. However, the local staff working in the laboratory discoved the contents by repeatedly trying the combinations. Then they moved out to set up their own firms or sell this distribution to other associated firms. After only several years, there are more than ten small firms established in Dalian to produce detergents, all of them are spin-offs of the two FDI firms.

2. Spreading entrepreneurialism and management skills. In addition to production skills diffusing, Dalian also benefits from the organization skills acquired by local personnel on the management of FDI firms when local personnel leave FDI enterprises. This type transfer of technology is wider than the last one and can be identified from three aspects. First local personnel flow back to state-owned firms and promote the reform of these firms. Several interviewees answered that outflow staff went back to their previous state-owned companies or factories, because these firms had adopted the management style of FDI firms, and offered them positions to carry on the reform or do the same job as in FDI firms. Since they can enjoy the welfare of state-owned companies, and at the same time can benefit from the success of business, they are willing to go back.

Secondly, local personnel transfer to management positions and help to diminish the gap between production and organization. Among the outflow engineers and technicians, there is an obvious trend that they no longer only do the technical work, and more and more go to management. It is a common problem in China's education that there is a big gap between natural science and social science. Therefore, most engineers and technicians know little about business and management. Since there is not so big a gap in FDI firms, where it is common for one staff to do several different jobs which often include both natural science and social science, the gain for most local engineers and technicians is in the organizational aspect instead of in production aspect. So when they move out, they enjoy a more mixed job than a pure technical job, which also diffuse the management skills.

Thirdly, local personnel use their experience to set up new firms and spread the enterpreneurialism. The working experience in FDI firms gives most local personnel, more or less, a lesson in the new social order, risk awareness and market competition. It also encourages enterpreneurialism among local personnel. When they find opportunity they set up new firms by themselves. For example, Mr. Sun, an aquatic product specialist, after working in Marine Food Co. for two years, left the company and established a small factory to produce the same product to export to Japan, because he had acquired the information of Japanese market of shellfish and obtained the marketing know-how. It is noteworthy that the spread of entrepreneurial skills is not limited to qualified staff. Mr. Qi, a semi-skilled worker in Brollo, gave up his job and set up a small factory to produce elbow joints for exports. He agreed in the interview that it resulted from his observation of the developments of Brollo.

Summary

Measured by local sales, the forward linkages of FDI in Dalian are strong,

because nearly 60% of FDI firms, which mainly consist of joint ventures, Western investment and high technology projects, sell over half their products locally. however, the local consumer market is the most important destination of local sales. Only about a quarter of FDI firms target indigenous enterprises. Therefore, the diffusion of technology through forward linkages is more indirect than direct. Learning by using, consumer education and marketing show-how are the main channels.

Shown as local purchase of materials or services, backward linkages of FDI in Dalian is characterized by (1) Dominance of primary products. Although over 60% of FDI firms purchase more than 50% of their inputs locally, Japanese firms, high technology firms, large order and high value added products do not purchased locally. (2) Trade between FDI firms. Over the last few years, FDI firms have become an important supplier of other FDI enterprises. Now trade between FDI firms in Dalian accounts for over one third of FDI total local purchases. (3) Few purchasers offer assistance to local suppliers. Among three types of buyers, shopping around and conditioned buying account for 85%. Controlled buying which provides direct assistance in production or management to local suppliers only accounts for 15%. Therefore, the potential of diffusing technology directly through backward linkages is restricted.

As in other developing countries, the mobility of local personnel in FDI firms is low. Only about 40% of surveyed firms experienced any outflow of staff. However, unlike the case in other developing countries, technicians and engineers are also the main type of outflow staff. Among the FDI firms which saw staff leaving, manual workers are reported by 53% of FDI firms, while engineers and technicians are reported by 60% of FDI firms. Although most manual workers leaving FDI firms do nothing to diffuse technology, Dalian does benefit from the movement of qualified local personnel, which is observed from directly diffusing production know-how, entrepreneurial skills and management skills.

CHAPTER 10. POLICY RESPONSES AND PROPOSALS

10.0 Introduction

In addition to examining the three effects of technology transfer to Dalian through FDI, the survey also tackled the policy issues. Because, as in other developing countries, technology transfer in Dalian also depends on the policy of governments' control over FDI, aid for R & D and industrial innovation, and reinforcement for local technological infrastructure. Section one of this chapter will analyze the contents of current policies from incentive and restrictive aspects. Section two examines the achievements and limitations in implementing these policies. Section three proposes six measures to promote technology transfer based on the survey findings and the experience of other countries.

10.1 Contents of Current Policies

When it was chosen as one of 14 open coastal cities in 1984, Dalian set its outward development objectives as "Quicken tempo in the utilization of foreign capital, importation of advanced technology and revamping of existing enterprises" (Wei 1984). In order to realize the targets, Dalian along with the Chinese government has adopted many incentives. However, under the highly controlled planned economy at that time, restrictive measures for FDI were inevitable. So the current policies consist of incentive and restrictive measures.

10.1.1 Incentive Packages

1. Income Tax exemption and reduction. The incentives in this category are as follows: (1) Corporation Tax exemption and reduction. In Dalian, any FDI firm which is scheduled to operate for a period of ten years or longer has a reduced rate of 24% corporation tax imposed. It is not only much lower than the one imposed on state-owned firms (55%), but also 6 percentage points lower than the standard rate set by the central government imposed on FDI firms in other regions. In addition to this reduction, FDI firms can enjoy another three privileges. Firstly, corporation tax can be further reduced to 15% if FDI firms are located in DETDZ. Secondly, FDI firms can be exempt from corporation tax completely in the first two profit-making years, and are allowed a 50% reduction in the third to the fifth years. Thirdly, the annual loss of FDI firms may be offset against the gains of the next fiscal year. If the gains of the next year are not enough to make up the loss of the previous year, then this process

may continue to the fifth year. (2) Local Income Tax exemption. Dalian government announced that local income tax which is usually 10% of the amount of the corporation tax can be exempt for seven years from the first profit-making year. (3) Withholding Income Tax exemption and reduction. Withholding Income Tax is 20% of the income obtained from dividends, interest, rentals, royalties and other sources in China for foreigners who have no business establishments in China, and 10% for foreign investors (Sheng,1990). However, it can be reduced or exempted in Dalian. (4) Income Remitting Tax exemption. The rate of Income Remitting Tax is 10% of the amount of remitting income out of China. The Dalian government also announced that foreign investors can be exempted if they are export-oriented or in the new town. (5) Personal Income Tax reduction. In Dalian, the local government offers a 50% reduction of personal income tax, which has 6 rates starting from 5% on over 800 yuan (US$ 140) per month to 45% on above 12,000 yuan per month (Dalian Center for Foreign Investment Enterprises Management (DCFIEM) 1991).

2. Customs Duty and Industrial & Commercial Consolidated Tax (ICCT) exemption and reduction. The incentives in this group are mainly reflected in: (1) Exemption from ICCT and import duties for building materials, production equipment, raw materials, vehicles, office equipment & stationery imported by FDI firms for their own use. (2) Exemption from ICCT and export duties for export products manufacturing by FDI firms. (3) Exemption from customs duties and ICCT for goods exported for the purpose of comprehensive compensation and not produced by FDI firms. (4) The reduction or exemption of ICCT on products produced by the FDI for domestic sales under certain conditions.

3. Cheap land use fees. With regard to land use, incentives are reflected in two aspects: land renting and land purchasing. In renting a piece of land, the Dalian government not only charges very cheap land use fee for foreign investors, for example 12.1 yuan (US$ 2.1) per square meter per year in 1991, which is in the bottom of the range of land using charge in the China, but also promises that the price is adjusted every three years, and the range of the adjust will not exceed 30%. In purchasing the right of using a piece of land, Dalian government first charges a low price. For example, 350 yuan per square meter for ready-to-use land, and 200 yuan for rough land in 1991. Secondly, it offers a long duration which can last up to 70 years and without any change in the price. Thirdly, it accepts the delay of payment. 40% of total payment can be paid in three years. Fourthly, it permits the free switch of the using right or leasing. Foreign investors can switch the right of using this piece of land in the operation period freely with no limitation on the price. When the term becomes due, the user of the land has his preference of continued use with a new contract.

4. Provision of low fees for other facilities utility. With regarding other facilities, the incentives include: (1) A guarantee of the supply of water, fuel coal and oil, as well as the power to FDI firms. Since 1984, the Dalian government has formulated many regulations to ensure the associated departments provide satisfied service. (2) A low price for this supply. In Dalian, FDI firms are charged at the same low prices for using these facilities as state-owned enterprises. In 1991, for industrial consumption, water price was 0.22-0.35 yuan/t; Gasoline, No.70, No. 90 and Diesel are 1720, 1820, and 1600 yuan/t respectively; coal was 80-220 yuan/t and coal gas is 0.30 yuan/cb.m; power was 0.35-0.40 yuan/kw. (3) Exemption of some fees from FDI firms. For instance, FDI firms are exempted from the fee for increase power consumption.

5. Maintaining low labor costs. In order to keep low labour cost, the Dalian government have adopted following policies: (1) Chosen the lowest wage level required by the central government for FDI firms, which is only 120% of the wage level of worker and staffs of the state-owned enterprises in the same trade. (2) Exempted some subsidies from FDI firms, and only required FDI firms to submit RMB 25-50 yuan per month per capita as the subsidies. (3) Set a low requirement for employees' welfare. According to the central government employees in FDI firms should enjoy the same welfare as the workers and staff of the state-owned enterprises. However, in Dalian the FDI firms only keep 20% of the wage of a employee as his insurance and 17% of the wage as his health insurance. In current China, welfare and subsidies are the main share of labor costs. One study reported that they were 30% larger than the wage in Dalian (Liu 1989). These measures adopted by Dalian government keep the labor costs even lower than the local level (DETDZ 1992).

6. Domestic capital access and high depreciation rate of fixed capital. Since 1986, China Bank has given priority to loans to FDI firms for their short term capital and other urgent needs. In addition to permit FDI firms access to domestic capital, the Dalian government also increased the depreciation rate of fixed capital in FDI firms. In Dalian, the deprecation rate of buildings is 15%, which is 10 percentage points higher than the national level. The depreciation rate of machinery is 20%, while the rate set by the central government is 10%. The depreciation rate for transport vehicles and instruments is 30-40%. Compared with the national rate, it is 10 to 20 percentage points higher (DCFEM 1991).

10.1.2 Restrictive Packages

1. The requirement of 25% minimum foreign investment share. Unlike other Asian countries such as India and Korea where ceiling of foreign

investors' share in the FDI firms exists (UNCTAD 1990), China does not put any ceiling for FDI, but sets a bottom one of one quarter investment share for foreign investors. This means that for any FDI firm, no matter whether the investment is in the form of money or equipment, the share of foreign investors in the Registered investment must be over 25%, although there is not the minimum allowable amount of foreign investment such as Korea over US$ 100,000 (Yu 1990). In addition to the minimum 25% share of FDI in registered investment, Dalian also implements another restriction on the ratio of registered investment to total investment. Table 10-1 shows the ratio in different investment scale. It is clear that the smaller the scales, the higher requirement for foreign investor to use their own assets as investment.

Table 10-1 Requirement for Minimum Foreign Investment

Total Investment Amount US$ Mn.	Registered Investment/ Total Investment	Minimum Foreign Investment US$ Mn.
< 3	> 7/10	Amount * 7/40
3--10	> 1/ 2	Amount * 1/ 8
10--30	> 2/ 5	Amount * 1/10
> 30	> 1/ 3	Amount * 1/12

Sources: Arranged by author based on Liu (1989. 120)

2. High exports demand. Although there is not an explicit regulation for FDI firms to export a given percentage of their products from China, in Dalian, there is a tendency to require foreign investors to export more than 50% of their products. There are several measures used to implement the policy. First the government does not issue a permit to a FDI firm if it will not promise to export over 50% of their products. Secondly, it imposes ICCT and other taxes on the local sales of FDI firms. Thirdly, it withdraws many incentives such as the taxation reduction and increases the requirement of subsidies for employees in the FDI firms when they fail to achieve their export targets.

3 Limiting FDI in certain sectors. Although encouraging FDI into manufacturing, energy production, transportation, agriculture, and keeping it from other activities had been a nation wide policy before 1991, the Dalian government showed an unusual enthusiasm in carrying out the policy. From 1984 to 1987, only production firms and limited service activities such as hotels could get permits to operate in Dalian. From 1988 to 1989 there was not any non-production project among 253 new FDI projects (Ma, 1990). In addition to using approval entry system,

various discrimination measures such as high charges for non-production enterprises to use different facilities were employed to carry out the limitation. It is noteworthy that along with the policy change of the central government, Dalian government has also shown a change after 1991. Now FDI into real estate and commercial activities are allowed. Two branches of Japanese banks and a free trade zone opened in 1992. Tourism resources such as Jinshi beach is assigned to be developed by FDI (Dalian Daily October 30 1992; People's Daily March 26 1994).

4. **Setting a ceiling of 20% on technology investment in total investment.** This policy directly connects with technology transfer by FDI. It means that patent, know-how and trade marks which consist of property rights can be treated as a special capital and is accounted into investment. However, the portion of industrial property cannot be over 20% of registered investment. Besides that there is a special limitation for know-how. Its share in foreign investment can not exceed 10%. In dealing with this type of "technology investment", three criteria are set up to identify know-how: (1) it can produce highly sought after new products; (2) it can obviously improve the quality of current products and increase the productivity dramatically, and (3) It can save raw materials, fuel and power. In order to carry out this policy, the assessment of property rights, the requirement for associated documents and certain legal procedures are required to use know-how as investment. Gu (1991) summarizes the reasons for setting this ceiling as: it may increase the risk of Chinese partner; it may increase the control of foreign investor over the firm; and it may increase the profits of foreign investors.

10.2 Impact of Current Policies

Although the role of policies, no matter whether positive or negative, is difficult to separate from those of other factors such as location, population size, economic development level and the tradition of culture, the survey finds that there are some issues connected with the current policies. This section first summaries the achievements of formulation and implementation of the current policies. Then discusses the problems raised by employing these policies. Finally it analyses the absence of a coherent policy package, in terms of technology transfer through FDI.

10.2.1 Achievements of Current Policies

1. **The achievements obtained by implementing an incentives policy.** Firstly, it attracts and keeps a large scale inflow of FDI. In a broad sense,

the pouring of FDI into China is the result of its adopting an "open door" policy. In the narrow sense, chapter seven has revealed that at least 17% of FDI projects and 6% of FDI investment entering Dalian are directly attracted by various incentives. It can be counted as the first round contribution of incentive policies. In addition to the favored policy pursuing investment, other foreign investment, especially cost saving investment which accounts for 50% of FDI projects and 30% of FDI investment in Dalian is also connected with incentive package, because obtaining low cost labor, land and other facilities are the main concerns of this type of foreign investment. The large scale inflow of this kind of investment can be partly counted as the second round contribution of incentive packages.

Secondly, it has accelerated the construction of Dalian New Town. Chapter six pointed out that the construction of Dalian new town began in 1984. Within only 7 years, it evolved from a piece of farm land to a new town with a built-up area of 10 square kilometers, which laid down the skeleton of a big modern city with over 1 million population which will cover an area of 191 square kilometers in 20 years. At the end of 1991, it actually absorbed FDI worth $346 million, which accounted for over half of utilized FDI in Dalian. From September 1991 to September 1992, its industrial total output was RMB 979 million, of which 88% came from FDI firms (Economic Development Bureau, DETDZ 1992). It is apparent that without a series of privileged policies, Dalian new town could not have evolved so quickly.

Thirdly, it helps to create a good investment climate. The gateway location, broad hinterland, comparatively sound industrial base and infrastructure make the "hardware" of Dalian investment environment quite good. The incentives contribute a lot to improve the 'software' of investment environment. In the interviews, many foreign investors and business men, especially Japanese, point out that one reason for them coming to Dalian was the 'hospitality' of Dalian.

2. The achievements of implementing a restrictive policy. First it keeps a high share of foreign investment in registered investment and in total investment. The analysis of Chapter seven has revealed that the average foreign investment share in total investment is 59% in Dalian, which is not only 34 percentage points higher than the 25% minimum limit, but also higher than other coastal areas such as Shanghai, Qingdao by the end of 1991 (Yao 1992, Ma 1992).

Secondly, it promotes the exports by FDI. The strict restriction on export ratio of FDI firms reinforced by various incentives, won Dalian a rapid growth of exports in the last decade. Its rate of increase is much higher than the national average. From 1986 to 1992, China doubled its foreign trade, and exports increased from about $30

billion to $70 billion (Reeves 1993), While in the same period Dalian's exports increased from US $80 million in 1985 to US $998 million in 1991. The balance of foreign exchange also increased. It was US $62 million in 1990, and was US$ 112 million in 1991 (DCFET 1990-1). Chapter nine has revealed that most large FDI firms are internationally market orientated in Dalian.

Thirdly, the technology value of FDI in Dalian is higher than the national level or than other neighbouring cities. Since the strict limitation of FDI in production, for example the ratio of industrial investment to total FDI in 1989 to 1991 was 94.6%, 96.8% and 77.9% respectively (DSB 1989-1991), the technology value of FDI, generally speaking, is higher than the national level and some other coastal regions. For example, FDI high technology investment was less than 10% in total FDI investment national wide (Xia 1992). However, it was over 10% in Dalian, and at least two times higher than its rival city Qingdao (He 1992).

10.2.2 Problems Raised By Implementing Current Policies

1. Problems raised from implementing incentive measures. While the incentive package confers many benefits, it also causes some problems. The following three problems are closely connected with the implementation of the incentives: Firstly, taxation reduction and exemption are not much help in improving the management of some FDI firms. Moreover, they become a tool for some FDI firms to avoid tax obligations. The large scale reduction and exemption of corporation tax and other taxes puts FDI firms in a more advantageous position compared with other state-owned firms in the same trade. Some of them, especially "localized" joint ventures, do not seem to pay much attention to updating their production technology or improving their organization technology, and only live on "privilege policies". In addition to the shield of low technology or poor management of some FDI firms, taxes reduction can be a way for some FDI firms to avoid taxes "legally". Because there is a two-year period of corporation tax exemption, a three-year period of corporation tax reduction and at most five-year period of loss compensation in the taxation incentives. It has been pointed out by some studies that some FDI firms keep their operation in loss or in compensation during the first few years. Then they enjoy five years tax reduction and exemption. When the firms begin to pay the normal taxes, the projects may have closed down (Nie 1991, Ma 1992). In the survey, several Japanese firms reported lossing, while they kept increasing their investment. The analysis of chapter 7.1.4 has revealed that the ratio of profits to total sales in Dalian FDI firms is decreasing. It is not only lower than the local firms, but also lower than other coastal regions such as Fujian, where a survey of 260 FDI firms finds that the ratio of profits to total assets was over 5.5% in 1991 (Tao 1992).

Secondly, low cost incentives are of no help in attracting high quality foreign investment, although they are effective in attracting other investment. The survey finds that there are three problems connecting with the low cost incentives. (1) They fail to attract FDI with high technology value. The analysis in Chapter 8 reveals that technology gap in incentive purchase and low cost purchase is narrower than market purchase; the technology transferability in this two groups is also quite low. (2) They cause the deterioration of working conditions in certain FDI firms. Since the low requirement for insurance and welfare of labor, some FDI firms lack necessary facilities and safe working conditions. The last chapter mentioned that most workers left their job because of the low pay and worse working conditions. The data in the new town shows that the average wage in FDI firms was lower than the average level in 1989 and 1991. Recent reports about the conflict between some foreign investors and their employees suggest that the problem is getting worse (Financial Times September 23 1993, Economist 2-8th October 1993). (3) They disturb market prices and fail to conduct effective utilization of land and facilities. Because prices of land and some facilities provided by Dalian government are lower than the market price and lower than the price provided to state- owned enterprises, the cost of development cannot be offset. Which, on one hand, increases the financial burden of providing these facilities, especially ready-to-use land in the new town. On the other hand, it gives chances to some FDI firms to gain benefits from speculation of these utilities.

Thirdly, the access to local capital markets makes some foreign investors shift their duty of investment to Chinese side. For example, in Dalian Special Equipment Co. Ltd, the foreign investor took the advantage of access domestic market, did not bring all their investment to Dalian according to their contract. The project relies on the loan of Chinese banks, and foreign partner get benefits without associated investment. The survey finds that among joint ventures and cooperation firms, over half the Chinese partners have a 20-30% heavier burden than specified in the contract. A recent national survey indicates that this burden in 1066 cases is about 10% (China Statistic Bureau 1994 refer to People's Daily March 28, 1994).

2. The problems raised by implementing restrictive policies. The survey finds that the following problems are connected with the restrictive policies: (1) The discrimination against non-production FDI limits the scope and progress of Dalian in updating or advancing its economic structure by FDI, as did Guangdong and Fujian in the last decade. The limitation of the investment field makes FDI stick to industry, although this shows some advantages, it has meant that Dalian has lost the opportunity to diversify its economic activities by FDI. Up to now, the ratio of non-production FDI is still much lower than other coastal regions. And there is not yet a

clear shift of economic structure after nearly one decade of openness. It is apparent that it is against the objective set by Dalian to become the Northern Hong Kong.

(2) The high requirement of exports limits the entry of high technology enterprises. Although Dalian FDI firms experience a rapid growth in exports, the technology value of FDI does not increase over time, and technology transferability of inward investment does not increase, either. This goes against the theory and other empirical studies (Dunning 1981, 1989; OECD 1993). In the survey, many interviewees regard the high exports demand as a brake on technology transfer, because in high technology projects labour shares a smaller portion of the total cost. Without market entry, the investment environment for these high technology projects are not so attractive.

(3) The ceiling on technology investment limits intangible technology, especially know-how flowing into Dalian through FDI. The limitation of know-how's share in the package of foreign investment, and the difficulties raised from assessing its value, makes it convenient for foreign investors to establish a project only with hardware. For Chinese partners, the clear cut limitation makes them lack flexibility in bargaining and management. For example, Xingyuan chemical industrial Co. Ltd., a joint venture with Japan, at the stage of negotiation, the project was rejected, because know-how in total foreign investment was over the limitation of 10%. After the concession of the foreign partner, the project was established. But the product could not reach a high standard and the Japanese partner told the Chinese partner that the low quality of product resulted from the absence of know-how which was cut in the negotiation. At last the Chinese partner spent more money than before to buy the know-how back, and increase the product quality. Mr. Gao, general manager of the company said in the interview "Technology is wealth. Nobody will come with it if you do not want to pay for it."

10.2.3 Gaps in Current Policies

1. Technology transfer has not been a priority in current policy. Although technology development has been mentioned repeatedly in various documents, technology transfer is not yet a focus of current policy in Dalian. In fact the various incentives and regulations are strongly oriented to the quantity rather than the quality of FDI. It is reflected in the following two aspects: Firstly, few incentives or limitations are formulated in terms of technology transfer. It is the amount of foreign investment that serves as the criterion to evaluate the performance of local officials and managers, and the amount of technology transfer cannot find a place in the current system. Moreover, many officials are not clear about the meaning and

importance of technology transfer. Secondly, up to now there is no authorising agent or office in Dalian in charge of the promotion of technology transfer. The Committee of Science and Technology is not involved in FDI issues; The Committee of Foreign Economy and Trade does not know much about technology, and the Centre for Foreign Enterprises Management mainly offers services for the entry of FDI and does not care about technology transfer.

2. There are no measures to increase local supply for FDI firms. Unlike many host regions' governments which impose content quotas on foreign investment (Germidis 1977, Frank 1980, UNCTC 1985, Turok 1993), the Dalian government does not take this issue seriously. All the concerns from 1984 to 1991 were aimed at the supply of electricity, water and other basic raw materials. The development of local suppliers and the supply industry was ignored, although as chapter nine revealed there were good opportunities for Dalian to strengthen backward linkages of FDI with local firms.

3. R & D is totally outside the concern of current policy. Although there are some measures attracting FDI into high technology sectors and becoming export-oriented, such as exemption from certain taxes and the offer of cheaper land and facilities use fees, there is not yet any concern about the issue of R & D in Dalian. So in Dalian the R & D activities in most FDI firms is nil. The survey also finds that there is a technology dependent tendency at the level of firms. Most managers in the interviews do not know what their long term technology development strategy is. They bet their future on the further import of technology or getting it from other FDI. While at the level of local government, many officials do not even identify or concern themselves about it, let alone employ the proper policies or measures.

4 Lack of measures to promote the integration between large and medium-sized firms with FDI. The survey finds that there is a new dual-structure emerging in current Dalian, in terms of technology transfer. One pole is inward investment and the other is large & medium-sized state owned enterprises. Because of the poor backward and forward relations between FDI firms and local enterprises, the bridge connecting them are grafting firms. In Dalian, the ratio of grafting firms among total FDI firms has been lower than the national level. Up to the end of 1991, foreign investment via grafting enterprises only accounted for 5.4% of total FDI investment, while the national level is over 1/5 (Nie 1991, Ji 1992). Bearing in mind the fact that most grafting firms are set up by foreign investors and small local firms, the separation of large and medium sized state-owned enterprises from FDI is more serious in Dalian. Therefore, the situation that large and medium-sized

enterprises are crippled by inefficiency and fast losing market share does not show much improvement (Thomson 1991). Since 1984, there has been one document from the Dalian government dealing with the issue. It offered some exemption and reduction of taxes for established grafting firms, however, it failed to tackle the problems which hinder the establishment of grafting enterprises such as old assets evaluation and old staff settlements.

5. Internal training is ignored by current policy. With regard to human resources, the survey finds that two problems in Dalian as in other regions of China, are prominent. One is that local personnel are unfamiliar with a market economy, and cannot perform according to international practices. The other is that most of the work force is unskilled or semi-skilled. Therefore, training is necessary. However, there is little attention paid for internal training, especially among managers and foremen, in the field of high technology activities. The survey finds that it is a common phenomena that many Chinese managers in joint ventures can not manage the firm according to international practices, while they often frown on the skills of foreign managers. Faced with this issue, Dalian CFEM spend a lot of time mediating between the two sides, but do not provide a suitable training programme to solve the common problem.

10.3 Policies Proposal

It is clear that the problems faced by Dalian in technology transfer through FDI can not be resolved entirely at local level, nor be changed within the short term. However, adopting or formulating appropriate policies will be helpful for Dalian to promote technology transfer through inward investment. Combining the survey findings and the experience of other countries, this section gives six suggestions to policy makers in the Dalian government in order to maximise the positive impacts of FDI on Dalian technology development.

10.3.1 Open the Door Wider

It has been discussed by many studies that the social-economic structure of the host region plays an important role in technology transfer through FDI. The more inflow of FDI, the higher possibility for local enterprises to access inward technology; the more diverse the FDI activity, the more knowledge transfer. Compared with the 1980s, Dalian was more open at the beginning of 1990s. However, compared with Guangdong and Fujian, the door in Dalian is not wide enough to let various FDI activities into its territory, which definitely hinders the

realization of its development goal--to become a Northern Hong Kong. Therefore, the first task for the Dalian government should be formulate new measures or abolish some restrictive measures to open its door wide and form a favorable social-economic context for technology development.

Opening the door wider does not mean Dalian should offer more incentives. The experiences of Dynamic Asia Economies (DAEs) show that offering incentives and privilege is not the best way to attract FDI, because they may distort the pattern of market signals (OECD 1993). The situation in Dalian also confirms this conclusion. According to DAEs, the most effective way to attract FDI is to create an open framework and establish liberal rules of the game that enable the investor to make his choice of investment on purely economic and technical criteria. These rules must be transparent, non-discretionary and non-discriminatory (OECD 1993). Based on this principle, the following measures are recommended for the Dalian government:

* **Do not limit FDI only to production activities, and encourage FDI into other fields such as technological service and consultancies.**
* **Do not rely on a single investment source, but seek diversified origins of FDI.**
* **It should not only aim at the outside world, but also pay attention to the hinterland.**
* **It should promote economic reform and improve Dalian's investment environment.**

In order to encourage FDI into other activities, the Dalian government should treat production and non-production activities equally, and let FDI be distributed into service, particularly technological service, enjoying the same policy incentives. As with other developing regions, Dalian's capability for technological service is backward and information blocks have been an important handicap of technology development. Since 1991, Dalian has experienced a rapid increase of FDI in real estate (People's Daily March 28 1993). However, compared with national level and other coastal regions, the scope of FDI activity is still quite narrow. The involvement of FDI in information activity is still very low (Walker 1993).

Among the current foreign investment in Dalian, the share of Western investment is quite low, less than 20% both in projects and in investment. However, the survey finds that Western investment shows high technology value and high technology transferability. So marketing Dalian not only in Japan, but to a wider field, especially in the Western world, should be a task of the Dalian government in the

future. It can either increase the technology transfer, or decrease the dependency on a limited number of large investors.

The survey reveals that about one fifth of joint ventures and cooperation projects in Dalian are attracted by hinterland's firms, eg Chinese partners come to Dalian from the three provinces of the Northeast China. However, the technology value of foreign investment in these firms is generally lower than the local firms. This suggests that the technological resources of the hinterland, especially in electronics and chemical industries have not be utilized by Dalian effectively, because in these sectors, the hinterland has a more sound foundation than Dalian. Therefore, Dalian should take advantage of its gateway location and make it more open and more attractive to its hinterland. The most important measure for attracting high quality investment from the hinterland is to let investors from inland China enjoy the same policy privileges, and abolish the discrimination for inward investors with different origins.

Although Dalian has a comparatively good atmosphere for foreign investment, there are still many problems remaining according to international practices. For example, Mr. Kenji Umemura, deputy general manager of the Bank of Tokyo Ltd. Dalian Office, comments in the interview that the policies and measures in Dalian are not transparent. You can obtain various explanations from different departments for one regulation. Mr. Cheung, general manager of Xifang medical materials Co. complains of the poor management of DCFEM and Dalian Housing Department, because they sell the property of the company without informing Xifang Co. Therefore, further improvement of the 'software' of Dalian investment according to international practices, such as increasing the transparence of policy making, raising the working efficiency of the department of the goverment and simplifying the FDI entry procedures, is another way of making Dalian more open.

10.3.2 Trade-off Between the Technology Level of FDI and Domestic Market Protection

It is clear that not many foreign investors are willing to bring their capital, technology and market together into another developing country. Many studies have revealed that there is a trade-off between market orientation and technology level of FDI (Germidis 1977; Frank 1980; UNCTC 1985, 1989, 1990; OECD 1981, 1989, 1992, 1993). Using less skilled manpower to supply products for export is usually conducted by FDI with low technology level, while domestic oriented foreign investment is often a channel to transfer comparatively high level technology. The case in Dalian is the same. Chapter eight has revealed that the technology gap and

technology transferability of FDI are much higher in market entry FDI than in cost saving FDI. Therefore, the trade-off between exports requirement and technology value of foreign investment becomes a focus of Dalian's policy over the control of FDI. Obviously, the following are key components for this trade-off:

* **It should pay more attention to the quality of FDI,**
* **It should relax the strict requirement for high exports, particularly for high quality investment.**
* **It should use the domestic market to develop its electronics industry.**

The current policy shows an obvious bias towards domestic market protection. This leads to a rapid growth of exports. However, it also means Dalian loses an opportunity to obtain high level technology through FDI. The decline of Dalian feather and products industry is an example. Before the middle of 1980s, Dalian's feather and products industry had enjoyed a high reputation in China. When Dalian opened its door, Dalian Light Industry Bureau (DLIB) set up a strategy for utilizing FDI--international market oriented. Therefore, high requirements for exports were imposed on every FDI firm. The result was technology in this industry did not show much improvement, and exports decreased after the first rise. Meanwhile, its rival city Qingdao improved its technology in the leather and products industry by offering foreign investors access to the domestic market. Now many leather products of Qingdao such as leather shoes have overtaken Dalian both in the share of domestic market and international market. Mr. Fan, an official of DLIB, regards high protection for domestic market as shortsighted when he reviews the strategy they have employed for several years.

In the future, the Dalian government should not go to such extremes any more, because a certain trade between technology and the domestic market is inevitable when a new generation of FDI enters China (Nicoll 1994). Given this background, the Dalian government should shift its priority to obtain more high level technology and update local technology capability through FDI by offering them some opportunities to access to domestic market. It can take a lesson from other coastal regions. For example, Shanghai used the lure of a domestic market for telecommunication equipment to make Alcate transfer semiconductor production in its territory (Curry 1993). The large scale inflow of FDI in telecommunications enabled this industry to evolve from an infant one into one of five strategic industries in Shanghai within only a few years (People's Daily April 27, 1994). Tianjing, based on the huge domestic market for personal computers, attracted IBM to produce its newest model of personal computer, which has not yet appeared in the American market, with its Chinese partner (Curry 1991, Maddox 1993).

When Dalian attempts to lure FDI with high level technology through domestic market access, it should pay more attention to the electronics industry. Compared with other industries, especially the engineering industry, the electronics industry in Dalian is quite small as analyzed in chapter six. Although in the last few years, Dalian has experienced an increase of FDI in this field, it has not benefited much from it, because wholly owned subsidiary and downstream assembly activity dominated the investment. The following measures could be used by the Dalian government to encourage high quality investment into this industry:

--Providing additional financial incentives following a properly mapped-out strategy,
--Stimulating research institutes in this field such as Dalian Institute of Electronics to cooperate with foreign investors,
--Providing necessary skills training, and
--Co-operating with the hinterland companies in the electronics industry to attract large projects.

10.3.3 Relax the Restriction On The Share of Technology Investment

The survey finds that technology transfer within FDI firms in Dalian is, at present, mainly conducted by hardware transplant and personal contact, as shown in Table 10-2. Document flow, which is the typical technology transfer does not show much importance. Only 12% of surveyed firms identify it as a channel to obtain imported technology. Although this phenomenon results from many factors, the government's limitation on the share of technology investment in total foreign investment is an important factor. As with any commodity, technology will not be supplied by foreign investors without proper payment for it (Yu 1990). Therefore, it will be necessary to gradually relax the control on technology and formulate some incentives over technology investment in order to increase the technology value of FDI.

Table 10-2 The Main Channel of Technology Transfer

Items	FDI Firm No.	Total Answer	Percentage
1. Not the Issue Or Channel	2	36	6
2. Equipment & Machinery	22	36	47
3. Personal Contact	11	36	17
4. 2 + 3	3	36	8
5. 2 + Documents	2	36	6
6. 3 + Documents	2	36	6

Source: Enterprise Interviews

The core to relaxing the restriction on the share of technology investment is to abolish the two ceilings on technology investment and on know-how.

There are three reasons for this suggestion. First FDI can be an important channel of transfer technology, especially various know-how, because when the major asset of a firm is know-how and it wishes to make such knowledge available abroad, it is unlikely for the firm to sell its knowledge and experience in the marketplace because of the high transaction cost involved (Rapakko 1990). In this situation, FDI becomes the best channel to transfer know-how. Korea's experience shows that 79% of imported technology was supplied through FDI enterprises between 1982 and 1987, measured by the flow of royalties (Yu 1990).

Secondly, the experience of other developing countries, especially Pacific Asia, indicates that the evolution of FDI in a host region experiences the following stages: At the beginning, FDI usually aims to exploit the low cost advantages, so it is labor intensive and land intensive. Along with the FDI and local economy development, the cost of labour increases, then labour-intensive FDI move to other low cost areas. Without the compensation of technology intensive FDI, the economy of the host region would decline (OECD 1988, 1992, 1993). Dalian and other coastal regions, facing the severe competition of inland China in terms of lower labor costs and more incentives, may experience the shift of FDI from labour intensive to technology intensive in the near future. These ceilings would postpone or prevent the shift.

Thirdly, the worries of setting these ceilings would be relieved along with improvement of the investment environment, wider exchange of technical and business information, and the increase of local technological service capability. Therefore, the focus of the policy should shift from trying to stop cheating by limiting it, to emphasizing absorption by providing a more effective service such as consultation. At the same time, decreasing the cost of technology transaction by deregulation, and protecting the value of intelligent property by legislation should also be included in the policy package.

10.3.4 Increase R & D and Effectively Use In-House R & D

As in other developing countries, China has turned to industrialized countries for know-how and technology so as to modernize its economy and to enter international markets (Baker 1990). However, as UNCTC (1990) states whatever degree of technological autonomy a developing country attains it is achieved through the

foundation of a local scientific and technology infrastructure. This survey testifies to the importance of local absorptive capabilities in technology transfer by outlining such a picture in current Dalian. On the one hand, technology transfer is hindered by computer blockage and technological information in FDI firms; on the other hand, there is little R & D activity undertaken by FDI firms, and local research centers are separated from FDI. Therefore, in order to increase technology transfer, the Dalian government should help to increase the level of R & D in FDI firms and effectively use in-house R & D.

Empirical studies such as Michalet (1977), Young (1988), Hoyle (1990), Bloom (1992) have suggested that foreign investors could transfer some R & D activity from home country to host country under the following circumstances: (1) They cannot carry on the same activities in the home country because of the limitations such as no suitable material or natural environment. (2) Market oriented activity needs to be located in the host region to modify products. (3) There is abundant local high level man power. It is clear that the last two points show how important it is for Dalian to obtain more inward R & D activity.

In order to increase the R & D level in FDI firms and more effectively use local research centers, in addition to opening certain domestic markets, the following measures should be employed by the Dalian government:

* **Reinforcing internal training to increase the technology level of local expertise.**
* **Offering special incentives for R & D activity.**
* **Encouraging cooperation between local research centers and FDI.**

It has been proved repeatedly that the ability to adopt a new technology, to evaluate a new technique, or even to pose a feasible research problem to an external research group requires substantial technical expertise within the firm (Movery and Rosenburg 1989). Dalian possesses a higher ratio of engineers and technicians to the work force in China, but most of them concentrated on traditional industry and knowledge depreciation is serious.So setting up certain training or innovation centres to accelarate the development of local human resources is necessary.

At present, there is no incentive for FDI firms to increase their R & D activity in the Dalian policy package. Since R & D is the spring of new technology, it should be treated with some privileges. In Pacific Asia, increasing R & D level has been a

focus of governments incentives to FDI. For example, in Malaysia, companies can claim a double deduction for expenditure on R & D and worker's training (Jegathesan 1990). Therefore, the Dalian government could learn from the experience of other countries and provide more attractive financial incentives to stimulate FDI enterprises to increase their R & D level.

Although Dalian boasts over 200 research institutes, the current situation is that these research institutes are separate from industry, and remote from FDI. In order to use these resources which is the main type of in-house R & D, the Dalian government must employ some measures to bridge the gap between FDI and local research centers. The following two ways are suggested:

--***Encouraging local research centers to establish joint ventures with foreign investors while the government gives financial support.***

--***Encoraging local research centers and local firms to form joint ventures with foreign investors while government relaxes the limitations to access domestic market.***

10.3.5 Give Special Support To Grafting Enterprises

In order to tackle the issue of large and medium-sized local enterprises being separated from technology transfer through FDI, the Dalian government should make efforts to encourage the establishment of grafting enterprises. Because this type of enterprise is not only a bridge to connect FDI and large and medium-sized local firms, but also shows several advantages such as saving foreign exchange; shortening construction period; and transfering more technology. However, the survey finds that there are many problems which hinder the establishment of grafting firms. For example, the evaluation of an old factory's assets is always arguable; the burden of the old factory is difficult to share; and the differences between the grafting part and the rest tends to lead to conflict instead of cooperation.

Against this context, the following measures are suggested for the Dalian government to promote the cooperation between FDI and local large and medium-sized enterprises:

* **Offers more opportunity for local firms to contact with foreign investors.**
* **Impose certain performance requirements along with selective incentives for FDI.**
* **Further reform the large and medium-sized local firms.**

An open region should not only be open for foreigners, but also open for its residents. More contact opportunities between local firms and foreign investors can be obtained by the ways as follows:

--Deregulating and cutting the red tape, so that local managers can go abroad easily. In current Dalian, going abroad for local managers is still very estrictive and it takes a long time to go through the red tape.

--Providing more information service for local firms. In current China, production and R & D, production and foreign trade are separated to some extent. In addition to deregulation, it raises the demand for government to offer more information to bridge the various gaps.

--Promoting the activities of public relations. Dalian holds a garment festival and a trade fair once a year at present. However, the business activities are still quite weak. Up to now it cannot establish an image which differs it from other coastal cities. Therefore, it needs the Dalian goverment to organise more marketing activities and enable investors to acquire local large and medium-sized firms.

In order to promote the cooperation between inward investment and the indigenous firms, many countries impose certain limitations or performance requirements. For example, Korea allows FDI to enter only when they form a joint venture with an existing domestic company in the same line of business, especially in traditional industries such as diesel engines, tractors, motor vehicles, textile fabrics, silicon steel (Yu 1990). The Dalian government should also combine selective incentives and performance requirements in its policy package. For instance, there should be some requirements such as increasing local purchase level or setting a joint venture with local firms when it offers special fiancial incentives, or relaxs the control on accessing to the domestic market.

Obviously, many problems related to the local large and medium-sized enterprises cannot be settled without an institutional change. Although this task is beyond the capability of local government, certain reforms can be conducted at the level of local government. For example:

--Adopting international accounting standards to make bookkeeping of local firms understandable to foreign investors;

--Formulating clear regulations to deal with the burden of these enterprises;

--Making the relationship between grafting part and the remaining part ransparent, especially when the grafting part purchases supply or service from the rest.

--Improving the method of settling disputes between the two partners; and keeping the principle of fair play.

10.3.6 Having an Agent in Charge of Technology Transfer.

In order to carry out the above measures, having a high profile office or agent in the Dalian government to promote technology transfer would be necessary. Because the door of Dalian opens wide, a more selective policy should be employed to deal with the inflow of various investments; while relaxing the limitations on technology investment, the demand for technical information and technology evaluation will be increased; while domestic market access is used as an instrument to lure high technology projects; sectoral policy and integrating measures are called for.

It has been pointed out in the last section that there is a vacancy among current departments of Dalian, in terms of technology transfer. Therefore, the function of promoting technology transfer can be embodied by setting up a new agent to deal with the issues of technology transfer, or reinforcing certain established offices.

Whether it is newly set up or is reinforced, this agent should conduct the following tasks:

* **It should develop a properly mapped-out strategy and policy framework to guide companies in the future direction and priority of the types of technology to be acquired.**
* **It should promote the development of a sound technology foundation in Dalian.**
* **It should organize or provide necessary training.**
* **It should promote study on FDI.**

The experience of Dynamic Asian Economies (DAEs) shows that a properly mapped-out strategy and policy framework is very important. It can either increase the effectiveness of technology transfer, or reduce the dependency of technology development. Besides this, their experience also shows that major technology transfer to the DAEs were made possible by the excellent physical and financial infrastructure

available locally and the high standard of manpower and management training in this area (OECD 1993). The survey in Dalian also finds that conditions for a high technology project to operate locally are highly developed infrastructure which includes not only an efficient internal organization, but also a community of outside suppliers who can deliver quality components of every description. Therefore, in addition to giving guidance to established FDI firms, the government should also help local suppliers update their technical standards, and increase their ability to meet specifications, deadlines and to respond quickly to the changing situation. These can be done by coordinating various technical service institutes and providing various skills training.

The survey has revealed that training has been a very weak link in Dalian. It is not only shown in the production aspect, but also in organization aspect. The experience of other Pacific Asia countries proves that local personnel training is a long term task, and beyond the production aspect. For example, Malaysia spent nearly 25 years to built up a core of workers in the electronic equipment and electronics industry (total number approximately 100,000) who are capable of learning, adopting, absorbing and improving on the ever higher level of technology in this industry. When it began to host FDI, it set up the Asian Institute of Management in 1968 to provide training for local personnel (Jegathesan 1990). The technological upgrading in the electronics industry in Singapore between 1968 and 1975 was facilitated by the growing pool of technical skills and experience (Fong et al 1977). Therefore, Dalian should organize and provide more training programmes, because the transformation of society makes local personnel unfamiliar with the concept of management responsibility or organizational know-how (Vines 1992). Without proper training, the partners in joint ventures are often operating under a totally different system of thinking. It definitely hinders the transfer of technology both in production and organization.

Since technology transfer through FDI is a comparatively new issue in Dalian, there are many problems which need studying. However, at present, the study of FDI in Dalian is poor. Many problems raised in the various stages of FDI operation are not clear. Even the number of established FDI firms are confused. How many technology into Dalian is unclear, let alone technology transfer through FDI. Therefore, clarifying the problems associated with FDI is urgent. Without the understanding of characteristics and trends of FDI development, making proper local strategy and policy is impossible.

Summary

Like most developing countries, China treats FDI in a privileged way which is shown by offering various incentives. In Dalian, these incentives include taxation reduction; cheap labour, land and facilities provision; domestic capital access and high depreciation rate. At the same time, some limitations are imposed of: 25% minimum foreign investment ratio, two ceilings of technology investment share, exports requirements, and limiting FDI in certain activities.

The impact of these policies is obvious. Keeping a rapid growth inflow of FDI into Dalian is the biggest achievement, which is mainly reflected in increased exports, the new town construction and a high ratio of industrial investment. The biggest problem resulting from these policies is that the quality of FDI is still low and does not show an obvious increasing trend, because current policies are more suitable for labor intensive investment instead of technology intensive investment. They can be observed not only from the measures used in the current policy package, but also from the measures which are not covered by the package, such as the ignoring of integration of FDI with local economy; paying little attention to R & D; and failing to conduct proper training programmes.

Combining the problems revealed in the study and the experience of other developing countries, six policies are suggested aimed at enlarging the transferability of FDI, and promoting the shift of inward investment from labor intensive to technology intensive. They are:

--Open the door wider and forge a favorable social-economic structure.

--Use the domestic market as a lever to attract high technology value FDI.

--Relax the limitation on the flow of know-how.

--Encourage FDI to increase R & D level and activate local research centers.

--Offer support for local large and medium-sized enterprises to cooperate with FDI.

--Set technology transfer as an important priority and establish associate agents to deal with the relevant issues.

CHAPTER 11. CONCLUSION

11.0 Introduction

This chapter aims to summarize the study and give some suggestions for further studies. It consists of two parts. Section one reviews the research methodology, highlights the survey findings, and summarizes the policy proposals. Section two discusses the limitations of this study, and based on them, raises several questions for the further studies.

11.1 Summary of the Research

11.1.1 Three Effects of Technology Transfer to Host Country By Inward Investment

Since there is not a suitable paradigm for analyzing the technology transfer to China through FDI at present stage, the first effort of this study is to start at the very beginning of the issue--forging an analytical framework by tracing the mechanism of technology progress and FDI development. Two types of gains are obtained during this process.

1. Some findings in the three ancestors of this study were highlighted or organized in a more coherent method. In terms of technology development, chapter two first suggests a technology ball to show the complex of technology contents. Secondly, it displays a spectrum of learning mechanism, which spreads from learning by doing to learning by training, and each of these learning channel interacts with externalities. Thirdly, it divides technology development into two types, and locates technology transfer in the "short circuit" model which shows "backward" expansion tendency.

In terms of the evolution of FDI, chapter three outlines the dynamics of FDI development. (1) The precondition of capital flow crossing national boundaries is the advantage of foreign investors in production and/or in organization. (2) These advantages not only affect the local performance of FDI, but also determine the deviations among the different origins and destinations of FDI. (3) The tools used by foreign investors to control their overseas subsidiaries are common ownership, a common pool of resources, and a common strategy.

In terms of technology transfer by FDI, chapter four discusses the six elements in a basic technology transfer model; the disagreement between knowledge

flow and learning mechanism in transfer channels; and the process of technology transfer at the two ends--technology sending and technology unbinding. At the same time, the scattered studies on the issue in China are surveyed.

2. A framework with three checking effects is developed. Based on the literature analysis, three effects were synthesized into a working framework in chapter five. (1) Accessing effects. This is designed to measure the accessibility of indigenous firms and local personnel to inward investment by checking the contact possibility and contact conditions between them. This indirect measurement of technology transferability, on one hand, shows the features of technology carriers; on the other hand, reflects the externalities of FDI local operations. (2) Obtaining effects. This aims to measure the acquisition of technology by local partners or local personnel from foreign investors within FDI enterprises. Through the examination of acquiring potential, acquiring results and acquiring process, the transferability of inward investment tied up with FDI projects is checked not only as a whole, but also at the level of technology components. (3) Diffusion effects. This is designed to examine the spin-offs of inward technology outside the boundaries of FDI firms. The inward and outward flows of materials and local personnel in FDI firms offer opportunities to trace the trickling down of knowledge through various antennae of FDI in the host region.

11.1.2 Hypotheses Tests--Current Transferability of FDI and Its Deviations

Within the theoretical framework, a postal questionnaire survey and various face-to-face interviews were undertaken in Dalian, one of 14 open coastal cities and one of forerunners in hosting FDI in China at present. Chapter 6 sets the scene of this study by outlining the characteristics of Dalian's economy. The tests of the hypotheses are distributed in chapter 7 to chapter 10, which also display the current transferability of FDI and its deviations.

1. FDI constitutes a very important channel of transfer technology to China. This channel varied with the national origins of FDI-- Western investors seem like donors, Japanese give very little, and HMT investors are like a middle man. Refering back to the hypotheses, this study confirms the two statements in hypothesis one. Firstly, it finds that the technological level of foreign investors is generally higher than the local partners or local same trade. As shown in 8.1.1 93% of FDI firms identify a positive technological gap between foreign investors and the local partners/local firms, and 40% of them regard this gap as a ten year period distance.

This gap not only supports the idea of Dunning in his eclectic paradigm that the precondition of FDI flow is its technological advantages, but also induces the transfer of technology between FDI and the local partners and local personnel. The analysis in 8.2.1 reveals that under this technological distance, 25% of FDI firms in Dalian experienced a technological leap forward by over ten years, and another 50% of FDI firms showed the same trend although at a comparatively slow pace.

In addition to the direct technology transfer within the FDI firms, the analyses in 7.1 show that FDI constitutes 25% of Dalian's annual fixed capital investment, 20% of total industrial sales and profits, 50% of exports, 5% of total employment, and 70% of opportunities contacting outside technology, which offer the possibility of transferring technology to the host region by demonstration effects. Chapter 9 shows that over 50% of FDI firms can diffuse certain technology to the host region through forward and backward linkages and local personnel movement. The combination of the three effects constitutes the mechanism of current technology transfer.

Secondly, Western investment shows much more technology transfer than other investors. The post questionnaire survey finds that among the three national origins of FDI, Western investment shows the highest technology value. Among it large technological gap (over 15 years) projects account for 20%, while in Japan and HMT investors, the ratio is 12% and 5% respectively. In addition to the high technology value, Western investment also shows the best transfer results. Among all the high transferability projects, Western investment accounts for one third, although its share in total FDI projects is less than 20%. Combining the various comparisons, we find that Western investors are characterized by market entry, high technology level and open management, which have won them a high reputation in the host region. Japanese investors are cost saving oriented, preferring wholly owned subsidiaries, and more conservative in local operation. HMT investors are active in most aspects, and more sensitive to various incentives but lower in technology level.

2. Joint ventures: the best and the worst form of technology transfer in current China, because of local partners' distorted motives. With regard to hypothesis 2, in which joint ventures were assumed to be the best channel of transfer technology to China through FDI, the findings of this study partly confirm and partly refute the assumption.

Firstly, the survey found that most direct technology transfer was conducted by the joint ventures. The postal questionnaire survey revealed that among high transfer projects, joint ventures account for 83%. Among medium transfer project, joint ventures stand for 68%. The ratios in wholly owned and cooperation firms are

3%, 10% and 14%, 22% respectively.

Secondly, joint ventures show the highest efficiency in transfer technology, which could be measured by the smallest difference between technological gap and technology transferability (Table 8-9). The findings in the interview also confirm the efficiency of joint ventures. The top two groups in current transfer spectrum are most joint ventures, and the cases of unbinding and developing the inward technology only occured in joint ventures.

The refutation comes from the fact that quite a few no/few transfer technology firms adopted this form. It can also be observed from the postal questionnaire survey and the interviews. From the former, we can see that 81% of low technology foreign investors use this channel to enter China. From the latter, we can see that most "localized" FDI firms are under this ownership.

The reason behind the fact that joint ventures are the best and the worst forms for transferring technology to China through FDI is the distorted motives of the local partners. The survey found that at least one third of local partners looking for a foreign partner does not aim at technology, but aims to obtain privileged policies from governments at different levels in China. Under this context, the transferability of joint ventures shows two extreme. This finding differs from most previous discussions on the issue, in which concerns are mainly given to the technology suppliers, and the receiving side is ignored.

3. The disagreement of foreign investors' willingness and capability of supply technology discounts the advantages of foreign investors with manufacturing capability. The willingness and capability of receiving technology by local partners confirms the high efficiency of "grafting firms" in assimilating inward technology. In hypothesis 3, we assume that among three ~~three~~ status of foreign investors, manufacturing companies transfer more technology than trading companies and individual investors, because this type of investor is usually the owner of technology and they are more appreciation of the local operation. The survey confirms the statement. At the same time, it also finds that the lack of willness discounts the efficieny of this type of investment.

The quesionnaire survey reveals that as technology owners, manufacturing companies do show high technology value. In the category of over 15 years technological gap, it accounts for 77%; in the category of 10-15 years technological gap, it accounts for 52%, and few manufacturing companies with low technology

enter Dalian. However, their efficiency or enthusiasm, comapred with trading companies and individual investors (reflected in Table 8-4 and Table 8-7) is low. The shares of trading companies and individual investors in over 10-year technology gap are 34% and 6% respectively, while their shares in high level transfer are 41% and 10% respectively.

Contrasting with this situation of the supply side, the case for receiving side is different. Grafting firms, which use the assets of an old factory and are located in the local partner's property, show high efficiency in assimilating inward technology, because of the agreement of willingness and unbinding capability. The survey finds that although grafting firms only account for 26% of projects with over ten years technological gap, they account for 46% in high transferability projects, while the ratios in non-grafting firms are 74% and 54% respectively. The survey also finds that few grafting firms cannot transfer technology, if there is a technology gap. While in non-grafting firms more than one fourth cannot conduct technology transfer when there is a technology gap.

4. There are more barriers in organisational technology transfer, and unparalleled learning capabilities of local partners differs China from other developing countries. Hypothesis 4 predicts the difficulties in transferring organisational technology. This study confirms this prediction.

Firstly, organisational hardware inflow was converted into vehicles import. Although compared with production hardware the scope of organisational equipment and facilities is not narrow, its contents are highly concentrated in vehicles as shown in 8.3.2., which provide little help for local partners to update their technological infrastructure and adopt advanced management systems.

Secondly, the importance of this type of technology was not fully reconganized by local partners. The interviews found that unlike production know-how, the importance of organisational know-how was not fully understood by local partners. The findings in 8.3.4 reveal that the ignorance of local partners constitutes the main handicap of transferring organisational know-how.

Thirdly, quite a few "localized" FDI firms make the involvement level of the foreign investor in daily management low, which blocks the channel of transferring this type of technology. The survey found about 30% of interviewed FDI firms ~~only~~ jointed ventures but did not share management. The localization of management in these firms reduces the personal contacts between foreign investors and local personnel.

The general low willingness and weak unbinding capability make the assimilation of organisational technology by local partners quite poor. Contrasted with high willingness and comparatively strong unbinding capability in assimilating inward production technology, this unparalled learning abilities differs China from other developing countries in another aspect.

5. Hardware transplant dominates the current technology transfer, but several cases challenge the traditional production-life-cycle theory of FDI. Hypothesis 5 assumes that among the components of technology, hardware transplant is easier to conduct than skills and know-how transfer. The scrutinization of technology transfer at component level in this study confirms the assumption. At the same time, it finds disagreement with the traditional theories of FDI in certain cases.

In terms of the scope of technology inflow, about 70% of interviewed FDI firms reported the inflow of hardware, both in production equipment and in organisational facilities. While various skills transfer were checked in over 50% of FDI firms. But trade secrets transfer either in production or organisational aspects only occured in about one fourth of FDI firms. Therefore, the inflow structure of the three knowledge forms is 3:2:1.

In addition to the development level of the host region and the begining stage of FDI inflow, government ceilings put on technology investment (refer 10.1.2 and 10.2.2) can be another reason for this uneven inflow, because it increases the costs of transactions of various know-how. The poor transfer of innovation skills and various know-how is causing technological dependency in the host region.

Among this uneven flow, two cases in the interviews challenge the traditional theories of FDI of comparative-advantage and production-life-cycle theories, which predict the persistence of a traditional division of labour between developed and developing countries. But the two cases at the top of current transfer spectrum displayed in 8.3.7 show a different picture. The local partners in these two cases not only unbind the inward technology, but also develop some new technology based on the assimilation. Their experiences suggest that technology transfer is not always a one-way, and technology receivers are not always the followers.

6. Two kinds of problems are raised from implementing current policy calls for a more coherent policy framework. Based on the current requirements of international investment flow and other countries' experience, hypothesis 6 predicts that single incentives are not so efficient to deal with the issue of

technology transfer as setting up a more open and coherent policy framework. The case study confirms the prediction.

Firstly, the survey finds that incentives do not play an important role in attracting FDI. Only 17% of FDI projects and 6% of FDI investment are attracted by various incentives. Market potential (26% in projects and 58% in investment) and low cost (49% in projects and 29% in investment) play more important roles than offerring incentives

Secondly, in terms of long term development, current policy shows a bias towards the quantity of FDI instead of the quality, and towards promoting exports instead of increasing competition. Although this benefits Dalian in some aspects such as increasing exports and improving the balance of payments, it also raises some problems such as no obvious increase of FDI technology value.

Thirdly, the absence of a current policy package keeps the host region from benefiting more advantages from the local operation of FDI, such as the integration between FDI and local large medium-sized enterprises, changing local economic structure, and increased R & D capability. Therefore, a more open and more coherent policy framework is needed.

Summarizing the survey findings, we find that foreign funded firms constitute a very important channel of transferring technology to China. Through it, the technology gap between China and developed countries was diminished by about ten years. The mechanism by which technology is currently being transferred is a combination of the following three phenomena: high indirect transfer resulting from the high involvement of FDI in the local economy; fragmented direct transfer caused by uneven flow of technology components, and quite poor associated transfer originated from weak local linkages and poor spin-offs led by local personnel movement. The current transferability of FDI firms can be viewed as a spectrum of six transfer models. The distribution of FDI firms in this spectrum shows either the primary stage of technology transfer in FDI firms, or a close relationship between transferability with the origins of FDI, and the two features of local partners.

11.1.3 Six Visible Hands

The fact that FDI keeps rapidly increasing in Dalian is testimony to the achievements of the current policy in many aspects. However, there are problems revealed by the survey, which are (1) technology transfer is mainly in the transplant of hard ware and technology dependency is raising; (2) technological gap and

transferability of FDI do not show an increase trend over time as in other countries; (3) the separation of FDI and local large & medium-sized enterprises is forging a new dual structure and reducing the transferability of FDI.Chapter ten finds that these problems are partly raised from implementing incentives and imposing restrictive, and partly the result of the absence of certain measures in the current policy package. It confirms hypothesis 6 that establishing an open policy framework is more important than just offering incentives.

Combining the problems revealed in the study and the experience of other developing countries, this study recommends six policies for the Dalian government to maximise the positive impact of FDI on local technology development.

1. Welcome technology--open the door wide and forge a favorable social-economic structure. Since FDI is connected with technology and the inflow of FDI in Dalian had been limited to manufacturing, it is necessary to remove the restrictions on FDI activity and establish an open policy framework. The more diverse the FDI activity, and the smoother the relationship between foreign investors and host region, the more technology inflow and the more technology transfer.

2. Pay for technology--remove the technology investment ceilings. In order to obtain a more balanced inflow of equipment, various know-how and skills, which could increase the whole capability of local technology, and reduce the host regions's technological dependence, the ceilings imposed on technology investment should be relaxed or removed, because it hinders the flow of know-how within FDI firms.

3. Trade for technology--relax demands for high exports ratio for high technology investment. Since a "relocated workshop" is poor in transfer technology, and it is impossible for China to buy technology on a large scale at present, using the domestic market as a way to conduct high technology inflow is inevitable. Therefore, the Dalian government should adjust its priorities and try to get more high technology investment and develop local supply industry by opening up the domestic market.

4. Unbinding technology--incentive FDI firms to raise their R & D level, and effectively use in-home R & D. The absence of R & D in current policy, and the low level of R & D in most FDI firms requires Dalian government to formulate associated measures to encourage FDI firms to increase their R & D level and provoke local research centers to take part in the unbinding of imported technology.

5. Integrate technology--encourage the establishment of grafting firms. Grafting firms can be seen as a bridge to connect the current separation of FDI and local large and medium-sized enterprises, because the corporation between them can reduce repeat construction, effectively use production resources and increase the integration of the local economy and technology. Deregulation and relieving the burden of local large and medium-sized firms are necessary.

6. Emphasize technology--have an agent to deal with technology transfer. Along with the development of FDI, a shift of labor intensive to technology intensive FDI will take place, and more problems associated with technology transfer will also be raised. Therefore, setting technology transfer as an important priority and establishing an associate agent to deal with relative issues would be one condition for promoting technology transfer through FDI.

11.2 Recommendations For Further Studies

11.2.1 Limitations of the Study

This study is concentrated on measuring and enlarging technology transfer to Dalian through FDI. It shows some contributions in clarifying the issue. However, it fails to cover some important problems connected with technology transfer through FDI, owing to the limitation of the research duration. Besides that, the study itself also raises some problems. The following limitations are acknowledged:

1. Lack of comparisons. As no other similar study has been undertaken as far as the researcher knows, it is difficult to carry out a thorough comparison with previous research, either in the measurement of the three technology transfer effects or in the analysis of technology flow at components level. In addition to the lack of international comparison, this study has concentrated on the situation of Dalian and did not compare much between Dalian and other regions of China due to the limitation of research data. Therefore, this study was only a snapshot of Dalian during the end of the 1980s and the begining of the 1990s.

2. The relationship between the six components of technology was not explored. In this study, a six-part technology matrix was developed and technology flows were examined at the components level. However, (1) the internal logic of the six components, and (2) the dynamics of the integration of technology progress and economic development at component level were not fully explored, because of the limitation of research duration, which undermine the in-depth analysis of technology transfer at micro level.

3. Technology development on the supply side was excluded. This study concentrated on an analysis of the transferability of FDI firms in current China, and did not include technology development on the supply side in the concerns. Therefore, the checking of technology transfer in this study was based on a static background instead of a dynamic context.

4. No specific industry was thoroughly analyzed. Because of the problems in obtaining necessary data and the limitation of the author's technical knowledge, this study did not chose any particular industry as a key industry to further explore, although there were many comparisons between different industries. The lack of this type analysis made it difficult to identify the vertical linkage of technology inflow.

11.2.2 Recommendations for Further Studies

Combining the survey findings and the limitations of this study, the following four questions are raised for further studies.

1. Is the technology gap diminished or enlarged between China and developed countries? Although this study reveals that most local partners bridge a technological gap through the inflow of FDI, it does not mean the distance between local enterprises and foreign investors is absolutely diminished. Because the progress of local firms and local personnel is only viewed from the stand point of the technology receiver, and there is not a comparison between the advance of technology receiver and the progress of technology supplier. Therefore, the gap change is unclear within a dynamic background. Some studies such as UNIDO (1992) and Simon (1992) state that despite a significant increase in foreign investment flows into the electronics industry, technological sophistication in China is lagging behind the international frontier due to inefficient and duplicate production; aging equipment; low labor productivity; shortages of foreign exchange, parts and components. Against this context, a study which puts technology transfer of FDI on the background of global technology development, especially in new technologies, will be valuable to further reveal the contribution of FDI to China's modernization.

2. What is really responsible for the low technology content of FDI? This study has revealed that the technology content of FDI is still low in Dalian. Many factors such as the policy package, unbinding capability, motives of international cooperation and economic environment are connected with the issue. It suggests that Dalian employs an unbalanced policy package, which pays more

attention to the quantity of FDI instead of the quality, therefore, it gains in exports and looses in technology transfer. However, these questions such as: (1) What is really responsible for the situation? (2) Can a different policy package really make a difference, even though wages and skills are still low? can only be answered based on systematic comparisons between regions with a samilar economic environment but different policy package, or adopting the samilar policy package but possessing different economic environment. So more comparative research between Dalian and other coastal cities in China could be helpful to clarify the contribution of different factors.

3. What can China draw from other countries' experiences based on the characteristics of updating her technology through FDI? The survey finds that distorted motives and unparalleled learning capabilities of local partners differ China from other developing countries or other former Socialist countries. However, like most developing countries, China needs technology supplied by developed countries to update her technology. Under this context, what lessons or experiences can be drawn by China from other countries, especially those have "upgraded" their technology through FDI such as Japan, Korea, Singapore? What policy should be formulated to combine the two issues? It is apparent that only more comparative international work can provide the answers to these questions.

4. What will be the general model for China to integrate inward technology with its own technology? The survey finds that at the present stage, every trade in Dalian wants to update its technology by FDI, and the inflow of FDI is triggering more FDI coming to Dalian. However, whether the continuous inflow of FDI will automatically form a network of technology and increase the whole technology capability of the host region is unclear, because the survey also finds that horizontal and vertical linkages of technology are incomplete, and technology dependence is increasing. In addition to the vagueness of technology supply, technology diffusing is also uncertain. Now, most local partners and local personnel are at the stage of consuming imported technology and do not show much evidence of diffusing it. But after a period of accumulation, diffusing may be inevitable, since technology transfer, from the stand point of technology receiver, is the same as innovation; that cumulative effects of minor technical change may be greater than the effects of major technical changes (Rosenburg 1982), Under this context, a longitudinal study which aims to reveal the general model of integration between inward technology and local technology in China, i.e. tracing the imported technology from inland to diffusion in China will be helpful for understanding the development pattern of China in the world economy.

REFERENCES

Abramovitz, M.(1993) "The Search for the Sources of Growth: Areas of Ignorance, Old and New". The Journal of Economic History. Vol.53, No.2, pp.217-241

Abramovitz, M.(1956) "Resources and Output Trends in the U.S. since 1870." American Economic Review, Vol.46, No.2, pp.5-23.

Adeoba, Adetunji (1990)"The Transfer and Joint Venture," UNCTAD, Joint Ventures as a Channel for the Transfer of Technology. pp.107-109.

Aggarwal, R.(1976) Financial Policies for the Multinational Company: the management of foreign exchange. Praeger.

Aggarwal, R.(c1984) the Literature of International Business Finance: a bibliography of slected business and academic sources. Praeger.

Amin, A. et al (1986) ed. Technological Change, Industrial Restructuring and Regional Development. Allen & Unwin.

Arrow, K.(1962) "The Economic Implications of Learning by Doing", Review of Economic Studies, pp.155-173.

Ayres, R. U.(1987) Barriers and Breakthroughs: An 'Expanding Frontiers' Model of the Technology-Industry Life Cycle. IIASA.

Aydalot, P. and Keepble, D.(1988) High_tech Industry and Innovative Environments: the Europe Experience. Routledge.

Baker, C. L.(1990) "Regulation of Technology Flows" UNCTAD, Joint Ventures As A Channel for the Transfer of Technology. pp.31-37.

Ball, D. F. Zhang, R and Pearson, A. W.(1993) "Perceptions of United Kingdom Exporters in Transferring Technology into People's Republic of China." R & D Management, Vol.23, pp.29-41.

Baranson, J.(1978) Technology and the Multinationals. Lexington Books.

Beamish, P.W.(1988) Multinational joint ventures in Developing Countries. Routledge.

Been, A. W.(1971) The Man-Made World. The Open University Press.

Bell, M.(1984) "Learning' and the accumulation of industrial technological capability in developing countries."Fransman M.and King, K. ed. Technological capability in the Third World. St. Martin's Press. pp.187-209.

Blomstrom, M.(1990) Transnational Corporations and Manufacturing Exports from Developing Countries. UNCTC.

Bloom, M.(1992) Technological Change in the Korea Electronics Industry, OECD.

Brenheny, M.J. et al.(1987) ed. The Development of High Technology Industries. Routledge.

Brook, C. A.(1984) "The Rapidly Field of High Technology Development and 'Science Parks," In Brunswich Environmental Papers. Paper 44.

Brown, C. A.(1990) Tax Aspects of the Transfer of Technology: the Asia-Pacific Rim. Canadian Tax Paper No.87.

Buckley, P.J. et al.(1988) Foreign Direct Investment by Small UK Firms: the success and failure of first-time investors abroad. 2nd edition. MacMillan.

Buckley, P.J. and Casson, M.(1991) "Multinational Enterprises in Less Developed Countries: cultural and economic interaction". Buckley, P.J. and Clegg, J.ed. Multinational Enterprises in Less Developed Countries. MacMillan. pp.27-55

Buckley, P.J. and Clegg, J. (1991) ed. Multinational Enterprises in Less Developed Countries. MacMillan..

Cabble, V. et al.(1987) ed. Developing with Foreign Investment. Croom Helm.

Cabble, V. and Persaud, B.(1987) "New Trends and Policy Problems in Foreign Investment: the experience of commonwealt developing countries," Cabble, Vincent et al. ed.Developing with Foreign Investment. Croom Helm.

Cantwell, J.(1991) "A survey of the theories of international production," Pitelis, C. et al ed. The Nature of Transnational Firms. Routledge. pp.16-63.

Carpentier, M.(1990) Manageing Technological Change: a key element in technology transfer. European Centre for the Development of Vacational Training.

Casson, M.(1992) eds. International Business and Global Integration. MacMillan.

Casson, M. and Zheng, J. (1992) "Western Joint Ventures In China," Casson, M. eds. International Business and Global Integration. MacMillan. pp.25-62.

Cavusgil, S. T.(1985) "Multinational Corporations and the Management of the Technology Transfer," Smali, A.C. eds. Technology Transfer: Geographical, Economic, and Technical Dimensions. Quorum Books. pp.36-50.

Cheng, B.Q.(1992) "The Survey of Three Capital enterprises in Zhejiang Province," International Economic Corporation, No.8, pp19-22.

Cheng, Z.S.(1991) "The Analysis of loss of Three-Capital Firms," International Economic Corporation, No.11, pp.14-16.

China Statistic Bureau (1994). "The Reasons of FDI Increasing, People's Dalialy (Overseas Edition) March 28.

China Statistic Publishing House.(1991).China Urban Statistics Yearbook.

Chu, B.T.(1987) Foreign Investment In China. University Publisher & Printer.

Clark, P.(1987) Anglo-American Innovation. Walter de Gruyter.

Cohen, W.M. and Levinthal, D.A.(1989) Innovation and Learning: the two faces of R & D. Economic Journal 99, pp.569-596.

Commercial Department, British Embassy (1992) "Dalian's Development Plan". China-Britain Trade Review. Aug. pp.10-11.

Committee of Science & Technology of China (1991) Identification of High Technology People's Daily, March 30 1991.

Conklin, D.W.(1991) Comparative economic system. Cambridge University Press.
Conroy, R.(1992) Technology Change in China. OECD.
Curry, L. (1991) "Computer Makers Go In Search of Chinese Goodwill," Financial Times. Feb.20
Curry, L. (1993) "High Price of Enter," Financial Times. Nov. 18
Dalian Centre for Economic Research (1992) "An Outline of Dalian's Taxes Revenue of Foreign Investment firms,".
Dalian Centre for Foreign Enterprise Management (1992) "The Development of Three-Capital Enterprises,".
Dalian Centre for Foreign Enterprise Management (1991) "The Compile of Regulations Invoving FDI in Dalian,".
Dalian Committee of Foreign Economy and Trade (1985-1991) Annual Report.
Dalian Committee of Foreign Economy and Trade (1986) Guid to Investment In Dalian.
Dalian Committee of Foreign Economy & Trade (1991) Guides to Investment in Dalian.
Dalian Committee of Foreign Economy & Trade (1989) The Open-Door Dalian.
Dalian Customs (1989- 1991) Statistic Yearbook of Dalian Customs.
Dalian Economic and Technology Development Zone (1992) "The Window of Northeast China: An ideal Investment Place"
Dalian Science & Technology Commettee (1992) Development Plan of Dalian High Technology Park.
Dalian Statistic Buearu (1991) Development of Dalian During 7.5 Plan.
Dalian Statistic Buearu (1985-1991) Dalian Statistic Yearbook.
Dalian Statistic Bureau (1992) Summary of Dalian Economy 1-9, 1992 and Forecasting.
Dalian Policy Research Office (1985) Further Reforming Dalian Economy.
Dalian Port Management Bureau (1990), Port of Dalian 1899-1989.
Dension, E. F.(1962) The Sources of Economic Growth in the U.S. and the Alternatives Before Us. Supplementary Paper No.13. New York: Committee for Economic Development.
DTI (1973) Report on Research and Development 1972-1973. HMSO. Department of Trade and Industry.
DTI (1989) Evaluation of R & D--A Policymaker's Perspective. HMSO. Department of Trade and Industry.
Dunning, J. H. (1991) "The Eclectic Paradigm of International Production: a personal perspective," Pitelis, C. et al ed. The Nature of Transnational Firms. Routledge. pp.117-136.
Dunning, J. H.(1981) International Production and Multinational Enterprise. George Aleen & Unwin.

Dunning, J. H.(1986) Japanese Participation in British Industry. Croom Helm.
Dunning, J. H.(1988) Multinationals, Technology and Competitiveness. Unwin Hyman.
Dunning, J. H. (1977) "Trade, location of economic activity and the multinational enterprise: a search for an eclectic approach," in Ohlin, B., P.O. Hesselborn and Wijkman, P.M.pp.395-418.
Edgington, D.W.(1991) "Japanese Direct Investment and Austrialian Economic Development," Morris, J. eds. Japan and the Global Economy. Routledge.
The Encyclopedia Americana. 1971
Enos, J.L. and Park, W.H.(1988) The adoption and diffusion of imported technology: the case of Korea. Croom Helm..
Faber, M. and Proops, J. L.R.(1990) Evolution, Time, Production and the Environment. Springer-Verlag,
Feibleman, J. K.(1980) Technology and Reality. Martinus Nijhoff Publishers.
Fong, P. E. and Lim, L. (1977) The Electronics Industry in Singapore: Structure, Technology and Linkages, Chopmen Enterprises.
Fong, P. E (1987) "Foreign Investment and the State in Singapore," Cabble, V. et al ed. Developing with Foreign Investment. Croom Helm. pp.84-100.
Frank, I.(1980) Foreign Enterprise in Developing Countries. The John Hopkins University Press.
Freeman, C. (1988) "Diffusion: The Spread of New Technology to Firms, Sectors, and Nations," Heertje, A. eds. Innovation, Technology, and Finance. Basil Blackwell. pp.38-70.
Freeman, C.(1982) The Economics of Industrial Innovation. 2nd edition. Frances Printer.
Freeman, C.(1990) eds. The Economics of Innovation. Edward Elgar Publishing Limited.
Freeman, C.(1986) "The Role of Technical Change in National Economic Development," Amin, A. et al. ed. Technological Change, Industrial Restructuring and Regional Development. Allen & Unwin.
Galenson, W. (1985) eds. Foreign Trade and Investment. The University of Wisconsin Press.
Georghiou, L. et al (1986) Post-Innovation Performance. MacMillan.
Germidis, D.(1977) "Transfer of Technology By Multinational Corporations and Absorptive Capability of the Developing Countries: A Synthesis," OECD. Transfer of Technology By Multinational Corporations. pp. 10-43.
Gomulka, S. (1990) The Theory of Technological Change and Economic Growth. Routledge.
Gong, M. C. (1991) ed. Dalian City. China Planning Publish House.
Goulet, D. (1989) The Uncertain Promise. 2nd edition. New Horizons Press.

Grossman, G. M. and Helpman, E. (1991) Innovation and Growth in the Global Economy. The MIT Press.

Grubber, W. H. et al (1969) "Research on the Human Factor in the Transfer of Technology," Grubber, W. H. et al. ed. Factors in Transfer of Technology. The MIT Press. pp.255-282.

Grubber, W. H. et al (1969) ed. Factors in Transfer of Technology. The MIT Press.

Gu, L.M. (1991) "Lease and Technology Investment in Joint Ventures," International Economic Corporation, No.1, pp.4.

Guo, C.(1987) "The Achievements of Dalian in Utilising FDI," International Economic Corporation. No.7, pp.11-13.

Habibie, B. J.(1990) "Sophisticated Technologies: Taking Root in Developing Countries," International Journal of Technology Management. Vol.5, No.5, pp.489-497.

Haggard, S. (1991)Pathways from the Periphery: the Politics of Growth in the Newly Industrializing Countries, Cornell University Press.

Hall, P. et al (1985) ed. Silicon Landscapes. Allen & Unwin.

Hall, P. et al (1987) ed. Western Sunrise. Allen & Unwin.

Han, B.C. (1992) "New Blueprint for an Old Industrial Base" Beijing Review. Vol.35, No.7, Feb. 17-23, pp.14-18.

Haos, R. M. (1966)Science, Technology & Marketing. American Marketing Association.

He, C. L (1991) eds. 1980-1989 Yearbook of China Special Economic Zones and the Coastal Economic and Technology Development Zones. Reform Publish House.

He, L.H.(1992) "The Role of Qingdao in Shandong Peninsula," A Working Paper of Qingdao Centre for Economic Development Research.

Heertje, A. (1977) Economics and Technological Change. Weidenfeld and Nicolson.

Heertje, A. (1988) eds. Innovation, Technology, and Finance. Basil Blackwell.

Hendry, S. (1991) "A Rival for Hong Kong?". China Trade Report. Jan. pp.8-9.

Hilpent, (1991) Regional Innovation and Decentralization. Routledge.

Hirschman, A.O.(1958) The Strategy of Economic Development. Yale University Press.

Hisao, N. (1987) "The Development of High Technology in Japan," Brenheny, M.J. et al. ed. The Development of High Technology Industries. Routledge.

Hobday, M. (1991) "Semiconductor Technology and the Newly Industrializing Countries: The Diffusion of ASICs (Application Specific Integrated Circuits)" World Development. Vol.19, No.4 pp. 375-397.

Holberton, S. (1992) "The China Syndrome" Financial Times. July 15.

Hood, N. and Young, S. (1982) Multinationals In Retreat, Edinburgh University Press.

Hou, C.M.(1965) Foreign Investment and Economic Development in China: 1840-1937. Harward University Press.

Hoyle, M. (1990) "The Management of Technology in Joint Ventures," UNCTAD Joint Ventures As A Channel for the Transfer of Technology. pp.17-24.

Hu, Y. M.(1990) " the Characteristics and Development of FDI Firms in Liaoning Province" International Economic Cooperation. No.3, pp. 33-34.

Hull, C. J.(1990)"Training Technology transfer Interdediaries: TII's contribution," CEDEFOP, Managing Technological Change: A Key Element in Technology Transfer. pp.25-40.

Hutton, J.(1988) The World of International Manager. Phillip Allian.

Hymer, S. (1970) "The Efficiency (Contradictions) of Multinational Corporations," American Economic Association Paper and Proceedings. Vol.60, No.2, pp.441-448.

Hymer, S. (1972) "The Multinational Corporation and the Law Uneven Development," J. Bhagwati eds. Economics and World Order from the 1970s to the 1990. MacMillan. pp.113-140.

Ishikawa, S. (1981) Essays on Technology, Employment and Institutions In Economic Development. Tokoy Kinokaniya Company.

Jegathesan, J. (1990) "Factors Affecting Access to Technology Through Joint Ventures," UNCTAD, Joint Ventures as a Channel for the Transfer of Technology. pp.101-106.

Ji, C.W. (1992) "The Experience and Prospective in Attracting FDI," International Economic Corporation, No.6, pp.3-5.

Jomo, K. S.(1993) eds. Industrialization Malaysia: policy, performance, prospect. Routledge.

Julder, J. (1988) European Multinationals in Core Technologies. John Wiley & Son.

Kaynak, E. (1985) "Transfer of Technology from Developed to Developing Countries: some insights from Turkey," Smali, A. C. eds. Technology transfer: Geographical, Economic, and Technical Dimensions. Quorum Books. pp.104-115.

Knaap, B.van der (1987) eds. New Technology and Regional Development. Croom Helm.

Knaap, G.A. van der et al (1987) "Technology and Industrial Change: an overview," Knaap, B. van der eds. New Technology and Regional Development. Croom Helm.

Koo, B.Y.(1985)"The Role of Direct Investment in Korea's Recent Economic Growth," Galenson, W. eds. Foreign Trade and Investment. The University of Wisconsin Press. pp.176-216.

Kosenko, R. and Smali, A. C. (1985) "China's Four Modernisation Program and Technology Transfer." Smali, A C. eds. Technology transfer: Geographical, Economic, and Technical Dimensions. Quorum Books. pp.107-132.

Kraemer, K. L. et al.(1992) "Economic development, government policy and the diffusion of computing in Asia-Pacific countries" Public Administration Review. Vol.52, No.2, Mar/Apr. pp.146-156.

Kranzberg, M. (1986) "The Technological Elements in International Technology Transfer: Historical Perspective," McIntyer, John R. et al. ed. The Political Economy of Internationa Technology Transfer. Quorum Books. pp.31-46.

Kuznets, S.(1966) Modern Economic Growth: Rate, Structure and Spread.Yale University Press.

Lall, S. et al (1989) Foreign Investment, Transnationals and Developing Countries. 4th Print. MacMillan.

Lall, S.(1983) eds. The New Multinationals: The Spread of Third World Enterprise. John Wiley & Sons.

Lee, J.J. et al (1991)"The Problems Among the Grafting Firms" International Economic Cooperation. No.4, pp. 14-15.

Leibenstein, H. (1976) Beyond Economic Man: a new foundation for microeconomics. Harward University Press.

Leibenstein, H.(1987) Inside the Firm: the inefficiencies of hierarchy. Harward University Press.

Li, J.Z.(1989) "The Advantages and Disadvantages of Dalian Economic Technology Development Zone," International Economic Corpration. No.8, pp.26-28.

Li, Y. et al (1991) "An Analysis of Multiplier Effect of Direct Foreign Capital in China," Quantitative and Technical Economics. Vol.8, No.2, pp.64-67.

Li, Z.Y. (1992) "The Problems In Small FDI Enterprises," International Economic Corporation. No.2, pp.13-14.

Liaoning Province Commission of Foreign Economic relations & Trade (1990) Liaoning--An Ideal Place for Your Investment.

Lim, L. Y.C. and Fong, P.E. (1991) Foreign Direct Investment and Industrialisation in Malaysia, Singapore, Taiwan and Thailand. OECD.

Lin, Y.C. (1991) "The management and development of FDI enterprises in Shenzhen," International Economic Corporation. No.12, pp.3-7.

Liu, J. (1989) eds. Foreign Funded Enterprises Law. Dalian Publish House.

Liu, J. (1988) "Some Problems in Setting Up FDI Enterprises," International Economic Corporation. No.11, pp.13-16.

Livingston, J.M.(1989) The Internationalization of Business. MacMillan.

Lubman, S. B.(1984) "Technology Transfer to China: Policies, Law and Practice," Moser, M. J. eds. Foreign Trade, Investment and the Law in the P.R.C. Oxford University Press.

Luo, M.(1990)"A Urgent Problem--Transferring Price in FDI Firms," International Economic Corporation, No.2, pp.33-34.

Ma, C. (1992) "Achivements and Problems in Attracting FDI in Dalian," A Report of Dalian Centre for Economic Development Research.

Ma, C. (1990) "The Retrospect of FDI Utilisation," A Report for Dalian Centre for Economic Research.

Ma, Z.Y. et al. (1992) "The analysis of Three-Capital Firms in Qingdao," Qingdao Economy, No.4, pp25-28.

McCalman, J. (1991) "The Japanisation of Slicon Glen: implications for spin-off and supplier linkages." Quarterly Economic Commentary. No.1, pp56-63.

Mackenzie, D. et al (1985) ed. The social Shaping of Technology. Open University Press.

Maddox, B.(1993) "Well Worth the Risk," Financial Times. Nov. 18.

Malecki, E.J. (1991) Technology and Economic development. Longman Science & Technical.

Markusen, A. et al (1986). High Tech America. Allen & Unwin.

Marton, K.(1986) Multinationals, Technology, and Industrialisation. Lexington Books.

Meissner, F. (1988) Technology Transfer in the Developing World. Praeger.

Methe, David T. (1991) Technology Competition In Global Industries. Quorum Books.

McIntyer, J. R. (1986) "Critical Perspective on International Technology Transfer," McIntyer, John R. et al. ed. The Political Economy of International Technology Transfer. Quorum Books. pp3-24.

McIntyer, J. R. et al. (1986) ed. The Political Economy of International Technology Transfer. Quorum Books. 1986.

Michalet, C.A.(1991) "Global Competition and Its Impleication for Firms," in OECD, Technology and productivity: The Challenges for Economic Policy.

Michalet, C.A.(1977) "Multinational corporations and transfer of technology: A comparative approach of the cases of Greece, Ivory Cost, Morocco and Spain," OECD. Transfer of Technology By Multinational Corporations. pp46-76.

Monck, C.S.P.et al (1988). Science Parks and the Growth of High Tech Firms. Croom Helm.

Morphet, C.S.(1987) "Research, Development and Innovation in the Segmental Economy: spatial implications," Knaap, Bert van der eds. New Technology and Regional Development. Croom Helm.pp45-62.

Moser, M. J.(1984) eds. Foreign Trade, Investment and the Law in the P.R.C. Oxford University Press.

Mowery, D.C. and Rosenburg, N. (1989) Technology and the Pursit of economic growth. Cambridge University Press.
NEDC (1989). Technology Transfer Mechanism. National Economic Development Council.
Nelson, R. R.(1984) High Tech Policies: A Five-Nation Comparison. American Enterprise Institute for Public Policy Research.
Nicoll, A. (1994) "China's New Wave," Financial Times Feb. 11.
Nie, H.Y. (1991) "The Retrospective of Utilisation of FDI in the last Nine Years," International Economic Corporation, No.1, pp8-10.
Nunez, W.P. (1990) Foreign Direct Investment and Industrial Development in Mexico. OECD.
OECD (1990). Advanced Materials Policies and Technological Challenges.
OECD (1993). Economic Integration: OECD economies, Dynamic Asian Economies and Central and Eastern European Countries.
OECD (1993). Foreign Direct Investment Relations Between the OECD and the Dynamic Asian Economies.
OECD (1991). International Conference Cycle.
OECD (1990). Liberalisation of Capital Movements and Financial Services in the OECD Area.
OECD (1989). New Forms of Investment in Developing Country Industry.
OECD (1983). Investing in Developing Countries. fifth edition.
OECD (1987), International Investment and Multinational Enterprises: recent international direct investment trends.
OECD (1989). OECD Science abd Technology Indicates Report No.3; R & D Production and Diffusion of Technology.
OECD (1988). New Technologies in the 1990s: a social-economic strategy.
OECD (1988) The Newly Industrializing Countries: challenge and opportunity for OECD industries.
OECD (1988). Science and Technology Policy Outlook.
OECD (1987). Structural and Organisation of Multinational Enterprises.
OECD (1977). Transfer of Technology By Multinational Corporations.
OECD (1979). Trends in Industrial R & D.
Office of Technology Assessment, Comgress of the United States (1988). Technology Transfer to China.
Oman, C. (1989) New Forms of Investment in Developing Country Industries: mining, petrochemicals, automobiles, textile, food. OECD.
Passos, C. de Faro (1977) "Multinational corporations and transfer of technology: the case of Mexico," OECD, Transfer of Technology By Multinational Corporations. pp192-218.

Pattie, G. (1987) "The Role of Technology Transfer in an Industrialized Society," Reed, John ed. Technology Transfer: Putting R & D to Work. Longman. pp.3-7.

Pi, Q. S. (1989) "Some Problems in the Tianjing Development Zone," International Economic Corporation, No.1, pp18-23.

Pierre, A. J. (1987) ed. A High Technology Gap. Council on Foreign Relations.

Phillip A. R. (1988) Technology Transfer: A Policy Model. National Defense University Press.

Pitelis, C. et al (1991) ed. The Nature of Transnational Firms. Routledge.

Planning Department, ETDZ (1992) New Town Planning (Draft).

Planning Department of Dalian (1992), Dalian Master Plan.

Press, F. (1987)"Technological Competition and the Estern Alliance" Pierre, A. J. ed. A High Technology Gap. Council on Foreign Relations. pp11-43.

Price, D. J. de S. (1969) "The structure of Publication in Science and Technology," Grubber, William H. et al ed. Factors in Transfer of Technology. The MIT Press. pp91-104.

Qing, Q.L.and Chui, L.(1992) "Involvement of Chinese Partners in Abroad Purchase In Shenzheng," Special Economic Zone Economy. No. 8, pp51-52.

Rapakko, T. (1990) "Industrial Property Rights and Transfer of Technology To Joint Venture," UNCTAD. Joint Ventures As A Channel for the Transfer of Technology.

Ray, G. F. (1984) The Diffusion of Mature Technologies. Cambridge University Press.

Reed, J. (1987) ed. Technology Transfer: Putting R & D to Work. Longman.

Reeves, N. (1993) "Chinese Experience May Be the Way Forward for Russian Economic Reform," Financial Times, March 22.

Reuber, G. L. et al. (1973) Private Foreign Investment in Development. Clarendon Press.

Rodina, l. A.(1991) "Capital Investment in Socialist Countries," Sherr, A. B. et al ed. International Joint Ventures. Quorum Books. pp57-79.

Roman, D. D.(1986) "Science Policy, Technology Transfer, Economic Impacts, and Socialogical Implications in the West-West Context." McIntyer, John R. et al. ed. The Political Economy of International Technology Transfer. Quorum Books.

Rosenburg, N. (1994) Exploring the Black Box: technology and economics. Cambridge University Press.

Rosenburg, N. (1982) Inside the Black Box: technology and economics. Cambridge University Press.

Rosenburg, N. (1976) Perspectives on Technology. Cambridge University Press.

Rostow, W.(1962) The stages of Economic Growth. Cambridge University Press.

Rothgeb, J.Jr.(1988) "Direct Foreign Investment in Mining and Manufacturing in Underdeveloped States". Social Science Journal 25. pp29-34

Rothgeb, J.Jr.(1988)"Testing Alternative Conceptions of the Relationship Between Direct Investment and External Debt in Poor Countries," Comparative Political Studies. 19 April. pp147-166

Ryan, C.G.(1984) The Marketing of Technology. Peter Peregrings Ltd.

Safarian, A.E. and Bertin, G. Y. (1987) eds. Multinationals, Governments, and International Technology Transfer. Croomhelm.

Schmookler, J. (1966) Invention and Economic Growth. Harvard University Press.

Schumpeter, J.A.(1939) Business Cycles. McGraw-Hill Book Company Inc.

Scott, M. FG.(1993) 'Explaining Economic Growth' The American Economic Review. Vol.83, No.2, pp421-425

Seurat, S. (1979) Technology Transfer: A Realistic Approach. Gulf Publishing Company Book Division.

Shanklin, W.L. and Ryans, J.K. Jr.(1984) Marketing High-Tech. D.C. Heath and Company.

Shen, X.F. (1990) "Present Situation and Approaches to the Acquisition of Technology Through Joint Ventures In China". UNCTAD. Joint Ventures As A Channel For the Transfer of Technology. pp45-47.

Sherr, A. B. et al (1991) ed. International Joint Ventures. Quorum Books. pp57-79.

Shibusawa, M. Ahmad,Z.H and Bridges, B. (1992) Pacific Asia in the 1990s. Routledge.

Simon, D. F. (1992) "Sparking the electronics industry" China Business Review. Vol.19, No.1, Jan/Feb. pp22-28.

Smali, A. C. (1985) eds. Technology transfer: Geographical, Economic, and Technical Dimensions. Quorum Books.

Solow, R.M.(1988) Growth Theory: an exposition. Oxford University Press.

Solow, R.M.(1957) "Technical Change and the Aggregate Production Function", the Review of Economics and Statistics. Vol.39. No.3 pp312-320.

Song, X.J.(1992) "The Problems In Assimilating Imported Technology In Fujian," International Economic Corporation. No.3, pp38-39.

Steuer, M.D.(1973) et al. The Impact of Foreign Direct Investment on the United Kingdom. HMSO.

Stewart, C. T. Jr. et al (1987) ed. Technology Transfer and Human Factors. Lexington Books.

Stobaugh, R. (1984) et al. Techynology Crossing Borders. Harward Business School Press.

Sun, W.Y. (1992) "An Serious Problem in the Exports of FDI Firms," International Economic Corporation, No.8, pp10-12.

Tao, S.G.(1992) "The Erosin of Frofits in FDI Firms and Proposal Policies," Import and Consultancy, No.3, pp16-17.

TEP/OECD (1991). International Conference Cycle. Technology Economy Programme.

TEP/OECD (1991). Technology in a Changing World.

TEP/OECD (1992). Technology and the Economy: the Key Relationships.

Thomas, S. C. (1990)"Catching Up". The China Business Review. Nov.-Dec. p:6-11.

Thomson, R. (1991) "What Price Ideology?" Finacial Times. October 18.

Toulmin, S. (1969) "Innovation and the Problem of Utilisation." Grubber, William H. et al. ed. Factors in Transfer of Technology. The MIT Press. pp24-38.

Tsai, P.L.(1991) "Determinants of Foreign Direct Investment in Taiwan: An alternative approach with time-series data" World Development Vol.19, No.2/3, pp.275-285.

Turok, I. (1993) "Inward Investment and Local Linkages: How Deeply Embedded is 'Slicon Glen?" Regional Studies Vol.27, No.5, pp401-418.

UN (1993).World Investment Report: transnational corporations and integrational production.

UNCTAD (1985). A Strategy for the Technological Transformation of Developing Countries.

UNCTAD (1979). The industrial Policies of the Developed Market- economy Countries and Their Effect on the Exports of Manufactures and Semi-manufactures from the developing Countries.

UNCTAD (1990), Joint Ventures As A Channel for the Transfer of Technology.

UNCTAD (1993). World Investment Report 1993: Transnational Corporations and Integrated International Production.

UNCTC/ESCAP (1984). Costs and Conditions of Technology Transfer Through Transnational Corporations.

UNCTC (1989). Foreign Direct Investment and Transnational Corporations in Services.

UNCTC (1990), Regional Economic Integration and Transnational Corporation in the 1990s.

UNCTC (1987), Transnational Corporation and Technology Transfer: effects and policy issue.

UNCTC (1990). Transnational Corporations and the Transfer of New and Emerging Technology to Developing Countries.

UNCTC (1985), Transnational Corporation in World Development Third Survey.

UNIDO (1992). China. United Nations Industrial Development Organization, Blakwell Publishers.

Vernon, R. and Wells, L. T. Jr.(1981) Economic Environment of International Business. 3rd edition. Prentice-Hall Inc.

Vines, S. (1992) "Mr. Wu shows China the Road to Riches," Gardian Dec.29.

Wade, W.J. (1990) "Knowledge in a Box". Chief Executive No. 63, pp44-47.

Walker, T. (1993) "Lure of the Billion-buyer Market," Finacial Times. June 14.

Wang, D.M. (1992)'Good Results of Dalian Income of Involving Foreigner Taxes.' Dalian Economic Study. No.2, pp38.

Wang, S. and Fei, N. (1992) "What Handicaps AffectingTechnological Advances of Large & Middle-sized Enterprises," Sicence and Technology Development & Reform. No.2, pp.48-49.

Wang, W. (1991) "The Key Issue of Good Management for FDI Firms" Dalian Finance. No.1-2, pp.41-42.

Wang, Z.(1992) "The Economic Relations Between Taiwan Strait," Important and Consultancy. No.3, pp.4-6.

Weekly, J. K. and Aggawal, R.(1987) International Business: operating in the global economy. Dryden Press.

Wei, F.H.(1984) "Working Report of Dalian City Councile".

William, F. (1993) "Investors Rush to Pour money into China," Financial Times. September 15.

Wu, J. (1989) "The Big Achievement of Ten Years Operation of FDI Enterprises," International Economic Corporation. No.11, pp33-34.

Xia, J. M.(1992) "Mistakes in Utilizing FDI," International Economic Corporation, No.10, p31.

Xiu, C.X. (1991) "FDI and the Evolution of Industrial Structure," International Economic Corporation, No.1, pp20-22.

Xiu, L.(1988) "Employing Staff According to the International Practice," International Economic Corporation, No.7, pp25-26.

Yankey, G. (1987) International Patents and Technology Transfer to Less Developed Countries. Avebury.

Yao, Z.H.(1992) "Pay More Attention to the Quality of Industrial Structure," International Economic Corporation, No.9, pp9-10.

Young, K. H. and Steigerwald, C. E .(1990)"Is Foreign Investment in the US Transferring US Technology Abroad?" Business Econonics. Vol. 25, No. 4, pp28-30.

Young, S. et al.(1988) "Global Strategies, Multinational subsidiary Role and Economic Impact in Scotland" Regional Studies. Vol.22, No. 6, pp487-497.

Young, S. et al. (1989) International Market Entry and Development. Harvest Wheatsheaf.

Young, S. et al. (1988) Multinationals and the British Economy. Croom Helm.

Young, S. et al.(1986) "the Regional Implications of Inward Direct Investment,"

Amin, Ash et al ed. Technological Change, Industrial Restructuring and Regional Development. Allen & Unwin.

Yu, B.X. (1991) "The Problems In 'Grafting Firms," International Economic Corporation, No.5, pp29-30.

Yu, H. Y. (1990) "Joint Ventures as a channel for the transfer of technology in the Republic of Korea," UNCTAD, Joint Ventures As A Channel for the Transfer of Technology pp77-100.

Yue, C. S. (1985) "The Role of Foreign Trade and Investment in the Development of Singapore," Galenson, Walter eds. Foreign Trade and Investment. The University of Wisconsin Press. pp. 259-297.

Zhang, F. J.(1991). "The Analysis of the Problems in Xiameng Economic Development Zone," International Economic Corporation, No.2, pp.10-11.

Zhang, L.Y. (1994), "Locationa-specific Advantages and Manufacturing Direct Foreign Investment in South China," World Development, Vol. 22, No. 1, pp.45-53.

Zhang, R.R. (1991)"The Vast Vist as for the Development of Foreign Economic Relations and Trade in Dalian," DCFET.

Zhao, C.(1991) "The Problems of FDI in Shantou Economic Zone," Journal of Shantou University No. 4, pp.1-13.

Zhen, M.L. (1991) "New Trends of FDI in the Pearl Delda," International Economic Corporation. No.7, pp.35-37.

APPENDIX I. POSTAL-QUESTIONNAIRE USED IN DALIAN

1. Ownership of the firm is: (Please tick appropriate category)
   a.wholly owned
   b.joint ventures
   c.cooperation
   d.other (please specify)_____

2. The attribute of the firm type, if the firm is not wholly-owned (Please tick appropriate category)
   a.Grafting firm
   b.newly setting up
   c.other (please specify)_____

3. The origin of Chinese partner, if the firm is not wholly-owned: (Please tick appropriate category)
   a.Dalian
   b.hinterland(northeast three provinces)
   c.other (please specify)_____

4. The motive of foreign investor is: (Please tick appropriate category)
   a.accessing Chinese market
   b.getting low production cost
   c.getting incentives
   d.getting natural resources
   e.other (please specify)_____

5. The motives of Chinese partner, if the firm is not wholly-owned (Please tick appropriate category)
   a.getting favorable treatment
   b.getting foreign capital
   c.getting production technology
   d.getting managemental technology
   e.getting foreign capital & production know-how
   f.getting production technology & managemental technology
   g.other (please specify)_____

6. The date of the firm established: (Please tick appropriate category)
   a.<= 1888
   b.1989
   c.1990
   d.>=1991

7. The location of the firm is: (Please tick appropriate category)
   a.old city centre
   b.new town or DETDZ
   c.suburb

8. The national origin of foreign investors:(Please tick appropriate category)
   a.Hong Kong, Macao and Taiwan
   b.Japan
   c.Western countries
   d.other (please specify)_____

9. The status of foreign investors: (Please tick appropriate category)
   a.company with manufacturing
   b.trading company
   c.individual
   d.other (please specify)_____

10. Which industry the project belongs to:(Please tick appropriate category)
    a.electrical & electronics
    b.engineering
    c.textile
    d.chemical,rubber & plastic
    e.food & drink
    f.leather & products
    g.pharmaceutical
    h.hand crafting
    i.construction materials
    j.others

11. Contracted or agreed the duration of the project is_____ years.

12. Total investment of the project is US$ (1,000)_____

13. The registered investment of the project is US$ (1,000)_____

14. The foreign investment in the project is US$ (1,000)_____

15. The main product manufactured or will be manufactured by the project is:
(Please tick appropriate category)

a.final product
b.intermediate product
c.raw material
d.other (please specify)_____

16. The technological level of foreign investors--pleas estimate the technological gap between foreign investor and local partner or local same trade by the following two criteria: (Please tick appropriate category)

(1) How many years is it for the technology developer in the world to develop the technology used by foreign investor,and to displace the technology used by local firms before FDI enterprise set up.

(2) How many years is it needed for local firms to develop currently used technology by themselves, based on the technology capability before FDI came.

a. >15 years
b.10-15 years
c. 0- 9 years
d. <0 years

17. If the technological level of foreign investor is higher than local partner or local same trade, advantages of foreign investor is shown in: (Please tick appropriate category)

a.product technology only
b.equipment (process technology) only
c.product & equipment
d.organizational technology only
e.product & equipment & organizational technology
f.other (please specify)_____

18. Technology leap forward of local partner or local same trade. (Please tick appropriate category)

a.high technology transferability or over ten-year diminished technological gap.
The following may be the criteria, if the technological development cannot be estimated directly:

(1) obviously upgrade products;
(2) got advanced key equipment;
(3) master new process;
(4) develop new product(s);
(5) enter certain world network;
(6) access important information channel;
(7) dramatic reform of management; and
(8) arrive advanced international standard.

b.medium technology transferability or 5-10 years technological gap reduced. The following may be the criteria, if the technological development cannot be estimated directly:

(1) improvement of products quality;
(2) improvement of the management;
(3) enlarging of the export channel;
(4) use other trade marks, especially for export;
(5) improvement of the appearance of product;
(6) familiar with outside world;
(7) employed certain training beyond only operation training;
(8) get some advanced equipment;
(9) adopt international standard or criteria; and

c.low or little technology transferability < 5 years or no obvious technological gap is diminished. The following cases may indicate this category:

(1) no technology supply;
(2) foreign investors' technology is lower than the local's;
(3) only unskilled operation training;
(4) foreign partner only as a seller of equipment which are not difficult to get;
(5) foreign partner only as a buyer of product;
(6) foreign partner only as a loaner of capital; and
(7) no involvement of foreign investors in the operation.

19. The technological absorptive capability of local partner, (Please tick appropriate category)

a.strong absorptive capability, which could be shown as:

(1) has the capability to manufacture the same, or relative product;
(2) fully understand the technology and has associated R & D capability to unbind the imported technology, although did not has the required

manufacture capability;

(3) has mastered the upstream or downstream technologies of the imported technology;

b.medium absorptive capability which may include:

(1) possessing certain manufacturing capability but not familiar with the import technology;

(2) possessing certain adaption ability but lack of understanding of imported technology and lack of manufacturing foundation;

c.weak absorptive capability, which may be shown as:

(1) no manufacturing capability before;

(2) lack of required skilled human resources;

20. The performance of the firm is: (Please tick appropriate category)

a.profitable

b.loss

c.under construction

d.other (please specify)_____

21. The market orientation of the firm is: (Please tick appropriate category)

a.domestic market

b.international market

c.other (please specify)_____

APPENDIX II. THE FDI FIRMS INTERVIEWED IN DALIAN

Da Tung Copperclad Laminates Co. Ltd.
Add. 43 Zhong Nan Road, Dalian, China
Tel. 282256
Contact: Mr. Ye Xue Hua, Senior Engineer.

Dalian Atlantic Super-Multilayer Board Co. Ltd.
Add. 8 Puzhao Street, Economic and Technical Development Zone, Dalian.
Tel. 721223
Contact: Mr. Wang Dan. Vice General Manager.

Dalian Brollo Steel Tubes Ltd.
Add. 931 Xinan Road, Dalian, China
Tel 641510
Contact: Mr. Chen, Ji Zhuang. Vice General Manager.

Dalian Business Computer Co.Ltd.
Add. 310 Tianjing Street, Dalian, China
Tel. 654745
Contact: Mr. Cheng, Liujian. Manager.

Dalian Canon Co. Ltd.
Add. 3 Chang chun Street, Economic Development Zone, Dalian, China.
Tel. 712853
Contact: Mr. Li, Feng Ming. Engineer, Office Director.

Dalian Hand Crafting Products Ltd.
Add. 4 Xiyuan Road, Dalian, China
Tel. 411296
Contact: Mr. Song, Zhi-jie. Vice Manager.

Dalian Dragon Shoes Co. Ltd.
Add. 9 Xingzhou Road, Xigang District, Dalian, China.
Tel. 641624
Contact: Mr. Ren, Changshan. Manager
Mr. Li, Jing. Worker

Dalian Golden Land Worsted Co. Ltd.

Add. 18 Jingzhou Road, Economic Development Zone, Dalian, China.
Tel. 703821
Contact: Ms. Wang Lanying. Vice General Manager.

Dalian Great China Electronic Co. Ltd.

Add. 32 Stalin Road, Dalian, China
Tel. 604606
Contact: Mr. Xu, Wen Xiao. General Engineer.

Dalian Huirui Pharmaceutical Co. Ltd.

Add. 2 Chang Chun Street, Economic Development Zone, Dalian, China.
Tel. 711818
Contact: Mr.Tang, Zheng Gang. Deputy Director, Chief Engineer.

Dalian Jinpeng Precious Materials Co. Ltd.

Add. 580 Zhongshan Road, Shahekou District, Dalian
Tel. 402438
Contact: Mr. Liu, Yu Cheng. Senior Engineer, Vice General Manager.

Dalian Jing-Ya Electrical Co. Ltd.

Add. 126 Beijing Street, Dalian, China
Tel. 330003
Contact: Ms. Su, Jinglian. General Manager.

Dalian Klix Detergent Co.Ltd.

Add. 9 Stalin Road, Dalian, China.
Tel. 238218
Contact: Mr. Guo, chengkun. Deputy Manager

Dalian Magnetic Head Ltd.

Add. 350 Zhong Nan Road, Zhongshan District, Dalian
Tel. 284354
Contact: Mr. Li, Shang Yi. Company Manager, Senior Engineer.

Dalian Morgan Refractories Ltd.

Add. 932 Xinan Road Sha He Kou District, Dalian, China
Tel. 651508
Contact: Mr. Hofmann, David J. General Manager.
Mr. Liu, Hui. Deputy General Manager.

Dalian Nanmei Pharmaceutical Co. Ltd.

Add. 25 YingHua Street, Xigang District, Dalian
Tel. 335687
Contact: Mr. Zhang, Yunde. Director of Office, Economist.

Dalian Nodic Tyre Co. Ltd.

Add. 11 Xiangzhou Road, Economic Development Zone, Dalian, China.
Tel. 718543
Contact: Mr. Fang, Wei. Manufacturing Manager.

Dalian Pacific Multi-Layer Circuit Board Co. Ltd.

Add. 22 Ha-er-bin Road, Economic and Technical Development Zone, Dalian, China.
Tel. 712590
Contact: Mr. Smith, Robert G (Jerry), President.

Dalian Okano Valve Factory.

Add. 18 Xinan Road, Dalian, China.
Tel. 641543
Contact: Mr. Cai, Shi-jun. Director & Vice General Manager

Dalian Riou Engineering Co. Ltd.

Add. 801 Xi Nan Road, Dalian, China.
Tel. 653211
Contact: Ms. Wang, Xiaofeng. Senior Engineer, Office Chief.

Dalian Shapulai Industrial Co. Ltd.

Add. 5 Danan Road, Dalian, China
Tel. 436258
Contact: Mr. Shen, Li-lin. General Manager.

Dalian Sha-Yi Machine Ltd.

Add. 20 Xian Road, Xigang District, Dalian, China.
Tel. 413616
Contact: Mr. Zhao, Fen-yi. Vice General Manager.

Dalian Special Equipment Co. Ltd.

Add. 6 Xing Lin Street, Economic and Technical Development Zone.
Tel. 711498
Contact: Mr. Gong, Bo. Engineer.

Dalian Video Tape Co. Ltd.

Add. 18 Shenli road, Zhongshan ward, Dalian, China.
Tel. 807461
Contact: Mr. Lu, Jian shen. Sales Manager.

Dalian Western Co. Ltd.

Add. 315 Tianyan Street, Dalian, China.
Tel. 641934
Contact: Mr. Liu, Rong Chang. Vice General Manager.

Dalian Weigeshi Hydraulic Component Ltd.

Add. 11 Xianzhou Road, Ganjingzi District, Dalian
Tel. 641118
Contact: Mr. Wen, Chuan Hou. Deputy Manager (Peosonnel)

Dalian XA Electronic Products Co. Ltd.

Add. 33 Bayi Road, Dalian, China.
Tel. 271936
Contact: Mr. Chen, J.X. Assistant Managing Director.

Dalian Xifang Medical Materials Ltd.

Add. 315 Tian jing Street, Dalian, China.
Tel. 241934.
Contact: Mr. Cheung, Alan K.L. General Manager.

Dalian Xinghai Marine Food Co. Ltd.

Add. 580 Zhongshan Road, Shahekou District, Dalian.
Tel. 402858
Contact: Mr. Zhao, Yiyuan, Vice General Manager.

Dalian Xingyuan Chemical Industry Co. Ltd.

Add. 2 Jing Wei Road, Zhongshan District, Dalian.
Tel. 804573
Contact: Mr. Gao, Hong Jun. General Manager.

Dalian Zhongde Control System Co. Ltd.

Add. 2 Yuguang Street, Dalian, China.
Tel. 803148
Contact: Mr. Gu, Dezhong. Deputy General Manager, Chief Engineer.

NCH Huanyang Ltd.

Add. 122 Stalin Road, Dalian, China
Tel 808668
Contact: Mr. Zhou Xiaoming. Manager of Purchase Department.

Tian Shi Plastics Ltd.

Add. 8 Har-er-bin Road, Economic and Technical Development Zone, Dalian, China.
Tel. 712131
Contact: Mr. Jing, Zhe Lin. Vice General Manager

TD Moulds Centre Co. Ltd.

Add. 7 Shenyang Street, Economic and Technical Development Zone, Dalian, China.
Tel. 707233
Contact: Mrs, Shi, Shu-hui. Office Manager.

Xin Kai Electronic Co.Ltd.

Add. 5 in 10 Building, C Section, Dalian Economic & Technical Development Zone, China.
Tel. 713559
Contact: Mr. Jia, Zhaoyu. Marketing Manager.

Wah-Da Machine Co. Ltd.

Add. 6 Mangling Road, Dalian Economic & Technical Development Zone, China.
Tel. 733433
Contact: Mr. Duan, Yong Guo. Manufacturing Manager.

APPENDIX III. OFFICIALS AND OTHER PEOPLE INTERVIEWED IN DALIAN

Mr. Cao, Nanzhao. Deputy Director, the Foreign Economic Division of Machinery Industrial Bureau.
Add. 50 Huanghe Road, Dalian, China.
Tel. 234420

Mr. Cao, Shi Fa. General Engineer, Deputy Director, Dalian Municipal Institute of City Planning and Design.
Add. 145 Xinkai Road, Xigang District, Dalian, China.
Tel. 338778

Mr. Cheng, Shao Fang. Deputy Director, The Division of Foreign Enterprises Managemen, Dalian Commission of Foreign Economy & Trade.
Add. 20 Baiyu Street, Dalian, China.
Tel. 331452

Prof.Deng, Yan Fang. Guang Hua Certified Accountants
Add. Hei Shi Jiao, Dalian, China.
Tel. 491006

Mr. Ding, Chu Yuan. Chairman, Chamber of Commerce, Dalian Economic Development Zone.
Add. Jing Ma Building, Dalian Economic Development Zone.
Tel. 700124

Mr. Fan, Guo Jun. Deputy Director, The Technological Renovation Division of Light Industrial Bureau.
Add. 27 Stalin road, Dalian 116001, China.
Tel. 234684

Ms. Fang, Lian Hua. Deputy Director, The Planning Division of Textile Industrial Bureau.
Add. 22 Chang Jiang Road, Dalian, China.
Tel. 239168

Mr. Gao, ChangFu. Director, Office of the Desining, Planning & Constructing Bureau of Dalian Development Zone.
Add. JingMa Building, Economic Development Zone, China.
Tel. 714857

Mr. Gao, Wen Quan. Manager, Senior Economist, Planning Department of National Technology Import and Export Corporation Dalian Branch.
Add. 126 Beijing Street, Dalian, China
Tel. 330082

Mr. Guo, Changhui. Vice Director & Chief Engineer, Dalian Municipal Commission of Urban & Rural Construction.
Add. 1 Stalin Square, Dalian, China.
Tel. 331422

Ms. Guo, Nan. Deputy Director, Administrative Office of Dalian High-Tech Industrial Zone.
Add. 443 ZhongShan Road, Shahekou District Dalian
Tel. 445787

Mr. Guo, Wang Ming. General Manager. Electronic Industrial General Corporation.
Add. 108 Yunshi Street, Zhongshan District, Dalian.
Tel. 237402

Mr. Han, Qiang. Economic Planning Commission of Dalian People's Government.
Add. 1 Stalin Square, Dalian 116012, China.
Tel. (0411) 337889

Mr. Jia, Yucheng. Director, Department of International Cooperation, Dalian Science and Technology Commission.
Add. Room 1-5 East, 1 Stalin Square, Dalian, China.
Tel. 331157

Mr. Jiang, David. Foreign Affairs Office of Dalian People's Government.
Add. 1 Stalin Square, Dalian 116012, China.
Tel. (0411) 332319

Mr. Kenji Umemura. Deputy General Manager, The Bank of Tokyo Ltd. Dalian Office.
Add. Furama Hotel 9F, 74. Stalin Road, Dalian, China.
Tel. 237259

Mr. Li, Lian Bin. Office Director, Economic Development Bureau, Dalian Economic & Technology Development Zone,
Add. Pob: No 14, Development Zone Dalian, China.
Tel. 713959

Mr. Ma, Chen, Director. Foreign Economic Division, Dalian Centre for Economic Research.
Add. 5 Stalin Road, Zhongshan District, Dalian,
Tel. 803831

Mr. Mo, Ji-Hao. Director, the Foreign Economic Division of No.2 Commercial Bureau.
Add. 25 Lu Xun Road, Dalian, China.
Tel. 236643

Ms. Nan, Wen Qing. Engineer, the Scientific and Technology Division of Pharmaceutical General Corporation.
Add. 9 YingHua Street, Dalian, China
Tel. 441372

Mrs. Niu, Xi Ping. Senior Journalist, Special Economic Zone Times.
Add. Level 8, Jinma Building, Dalian Economic Development Zone, China.
Tel. 715185

Prof.Rao, Hui Lin. Researcher of Dongbei University of Finance & Economics Research Institute.
Add. Hei Shi Jiao, Dalian, China.
Tel. 471101 Ext.510

Mr. Sun, Dawei. Liasion Office of the Administrative Committee of Dalian Development Zone.
Add. Dalian Economic & Technology Development Zone,
Tel. 711182

Mr. Sun, Lian Yun. Foreign Liason Office, Dalian Municipal Commission of Foreign Economic Relations & Trade.
Add. 1 Stalin Square, Dalian 116012, China.
Tel. (0411) 331831 Ext. 381

Mr. Sun, Tang Xian. Deputy Director, Comprehensive Section, Dalian Centre of Foreign Economic and Technical Co-operation.
Add. 94, Shenyang Road, Xigang District, Dalian, China.
Tel. 331425

Mr. Tang, Lin Xiang. General Engineer, Chemical Industrial Bureau.
Add. 82 Stalin Road, Dalian, China
Tel. 237402

Mr. Xia, You jing. Deputy Director. Regional Planning Division of Commission of Economic Planning.
Add. 1 Stalin Square, Dalian, China.
Tel. 333442

Mr. Wong, Michael S.C. Representative, Hong Kong Bank Dalian Representative Office.
Add. Room 604-606, Furama Hotel, 74,Stalin Road, Dalian, China
Tel. (411) 808196

Mr. Wu, Zhenshan. Research Fellow, Foreign Economy Division, Dalian Centre for Economic Research.
Add. 5 Stalin Road, Zhongshan District, Dalian, China
Tel. 803836

Mr. Yuan, Chen Liang. Deputy Director, Industrial Statistics Division of Statistic Bureau.
Add. 5 Stalin Road, Dalian, China
Tel. 236881

Mr. Zhang, Yandi. Vice Director, Foreign Affairs Office of Dalian People's Government.
Add. 1 Stalin Square, Dalian, China.
Tel. 331674

Mr. Zhao, Chun Pu. Section Chief, Economic Development Bureau, Dalian Economic and Technological Development Zone.
Add. Pob: No 14, Development Zone Dalian, China.
Tel. 712556