DEVELOPING THE INFORMATION INDUSTRY IN CHINA: A CASE STUDY IN GOVERNMENT LEARNING IN THE PLAN TO MARKET TRANSITION, 1979-1996

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Submitted for the degree of Doctor of Philosophy
February 2002

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ACKNOWLEDGMENTS

For eight years from 1988 to 1996 I worked for the Department of Industry Policy and for the Department of Machinery and Electronic Industry of the State Planning Commission (SPC) in China. In this role I was fortunate to be intimately involved in a series of policy-making and research processes during an important period in China's economic reforms, especially in the evolvement of the development strategy for the information industries. I would like to acknowledge the opportunity to work for the SPC, which gave me valuable insight into the economic transition process with regard to institutional changes and the shifting functions of government agencies. It also put me in a position to document in this thesis the crucial learning processes involved in economic transition, with special reference to the development of China's information industries.

I would like to express my sincere thanks to people who have helped and encouraged me through all the stages of working on this thesis. I am indebted to my supervisor, Professor Peter J. Sheehan, for the freedom of thinking, encouragement and kind support over the whole period. His knowledge and vision on the global knowledge economy and its impact on national development have greatly inspired this thesis. I would also like to thank my co-supervisor Dr Fiona Sun for her valuable comments on the drafts of all the chapters, her intelligence and patience, and her friendship.

I sincerely thank the Centre for Strategic Economic Studies, Victoria University for providing me with financial support as well as generous research facilities. My thanks also go to all staff and students of the Centre for Strategic Economic Studies and TradeData International for their friendship and help.

I also wish to thank Mr Zheng Minzheng, the Executive Director of Department of Part and Component Product, Ministry of Information Industry, China; Mr Yang Jiandong and Ms Wang Na, senior staff of the State Development Planing Commission, China, for

helping me in material collection in the early stage of this thesis; and Dr Qu Lin, for her help with undated information of Victoria University.

Finally, my gratitude goes to my family and friends, particularly my parents and my son, Songya. My parents helped me to look after my son in China in the first two years after this thesis started, when my son could not come with me due to visa problem. When I started to do the thesis, my son was six years old, and he has tolerated my busy schedule and encouraged me to finish this work in his own way.

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GLOSSARY OF ABBREVIATIONS

'863'	Domestic High Technology Plan Launched in 1986
AACOI	Aid Administration Commission for Overseas Investment
ATM	Asynchronous Transfer Mode
BIDC	Beijing Integrated Circuit Design Centre
BST	Bureau of State Tax
CAGR	Cumulative Average Growth Rate
CAIC	China Aerospace Industry Corporation
CAS	China Academy of Science
CCP	Central of Communist Party
CEIC	China Electronic Industry Corporation
CEIYB	China Electronic Industry Yearbook
CGC	China Great Wall Computer Company
CGD	Customs General Administration
CITIC	China International Trust and Investment Corporation
CKD	Completely Knocked-Down
CMEIYB	China Machinery and Electronic Industry Yearbook
COCOM	Co-ordination Committee for Export Control
COSGAMF	Controlling Office for Social Group Acquisition of Ministry of Finance
CPLOMEI	Coordination and Planning Leadership Office for Machinery and Electronic Industry
CTV	Color Television
DES	Data Earth Stations
DGT	Directorate General of Telecommunications
EILGSC	Electronic Industry Leading Group of the State Council
FELG	Central Finance and Economics Leading Group
FYP	Five Year Plan
GATT	General Agreement of Tariff and Trade
GDP	Gross Domestic Product

ICs	Integrated Circuits
IMF	International Monetary Fund
LSI	Large-Scale Integration
MAI	Ministry of Aerospace Industries
MBFT	Ministry of Broadcasting, Film and Television
MECCAS	Microelectronics R&D Centre
MEI	Ministry of Electronic Industry
MEP	Ministry of Electric Power
MITI	Ministry of International Trade and Industry
MMEI	Ministry of Machinery and Electronic Industry
MMI	Ministry of Machinery Industry
MOF	Ministry of Finance
MOFERT	Ministry of Foreign Economic Regulations & Trade
MOR	Ministry of Railways
MOUs	Memoranda of Understanding
MPT	Ministry of Post and Telecommunication
MR	Ministry of Railways
NBS	National Bureau of Statistics, PRC
NEP	National Economy Plan
OMCP	Office of Modern China's Planning
PBX	Private Branch Exchanges
PLA	People's Liberalisation Army
PPP	GDP Per Capita
PRC	People's Republic of China
PSTN	Public Switching Telephone Network
ROMs	Read- Only Memory
SBIC	State Bureau of Industry and Commerce
SDPC	State Development Planning Commission
SEC	State Economic Commission
SKD	Semi-Knocked-Down
SPC	State Planning Commission

SSTC	State Science and Technology Commission
TCP	Technology Commercialisation Plan
TES	Terrestrial Earth Stations
TV	Television
VLSI	Very Large Scale Integrated
WDR	World Development Report

Overview

China's Economic Performance as a Transitional Economy

Two striking features of China's economic development since the reforms of 1979 are the high level of sustained growth and the application of a gradualist 'plan to market' economic transition model. Between 1980 and 1998 China's GDP grew at an average annual rate of 9.8 per cent, and GDP per capita grew by 8.4 per cent per annum over this period, in real terms (NBS, 1999, p.55). These rates of growth are comparable to those achieved by the countries of the 'East Asian Miracle' in their periods of strongest growth, and have no parallel in other economies in transition.

In search of high growth rates, many former socialist economies have pursued a rapid process of change from command economic institutions, processes and values to those with market features. This rapid adjustment process has often been undertaken at the urging of Western advisers and governments, and the reforms in the USSR are a case in point. In China, by contrast, rapid growth has been achieved with a transition model notable for its gradualist and evolutionary character rather than for creating abrupt change. While it is clear that massive change has taken place over the past twenty years in the institutions, processes and values in the Chinese economy, this change has evolved as many pre-reform structures and institutions have been gradually phased out. Indeed, this gradualist process has often been criticised as being slow and incomplete by both Western and Chinese commentators.

The Issue and the Hypothesis

In much of the recent literature on economic growth, innovation and technological change are seen as the central drivers of growth. However, institutions and institutional change, together with the organisations that are associated with them, play a central role in the achievement of growth through innovation. One important network of institutions and organisations, through which effective innovation is delivered to the economy, is the national innovation system. While many innovations are small and incremental, there is sometimes the need for strategic innovation, which changes the institutional or organisational structure of the economy in fundamental ways. The innovations necessary for an economy in transition from plan to market are a classic case in which strategic innovation in the institutional and organisational structure is required. To ensure that innovation is achieved at all organisational levels within the economy, and given its strategic and economic wide nature, this process of strategic innovation needs to be strongly driven by government.

In this process, learning of various sorts (about technologies, market methods and practices, international experiences and markets) by all participants in the economy is crucial, and has been widely assessed in the literature. What is equally important, but has been rarely assessed, is the learning required of government. Critical questions about the process of government learning _ how does government learn, how does it assemble the knowledge, experience and practical awareness to guide the process of strategic innovation, in the unique circumstance of the country for which it is responsible _ have rarely been asked either in the development literature or the literature on plan to market transition. This is a particularly important but largely neglected issue,

and is a central focus of this thesis, with special reference to the information industries in China. It is also uniquely important, and difficult, when transition to a market economy is occurring in the midst of a major process of global change.

The hypothesis that this thesis explores is that the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning, both government learning and learning by other participants in the economy, in terms of innovation and institutional change. Learning by doing, especially by the government in its role of driving strategic innovation and institutional change, has been central to China's achievement. This is not possible in an abrupt transition process, but has been a key feature of China's evolutionary process of transition from plan to market.

In exploring this issue and this hypothesis, three main activities are undertaken in this thesis. First, relevant aspects of the literature on growth, learning and institutional change, and on plan to market transition, are reviewed (Chapters 1 and 2). Secondly, the evolution of China's planning system, as seen through the changing role of the State Planning Commission, is documented briefly in Chapter 3. Thirdly, four case studies of institutional and policy innovation in China's information industries are undertaken in Chapters 4-7, studying the evolution of these industries and of government policies at different planning periods. Conclusions are reported in Chapter 8. In this overview some of the main themes and conclusions are noted.

Plan to Market Transition, Strategic Innovation and Institutional Change

Plan to market transition itself is a strategic innovation, which consists of a series of innovations in policy making and in institutional frameworks

Strategic innovation undertaken by the government happens when critical economic, social and political issues are to be solved in innovative ways, which would fundamentally change the course of action of governments or the institutions of society in more than an incremental way. In the process of creating new institutional structures or interactions, and of creating the new forms of behaviour required by economic transition, organisational restructuring and policy innovations are of particular importance. Plan to market transition is a typical case of such a strategic innovation, or of a series of strategic innovations.

The efficiency of the strategic innovation depends on the structure, operating systems and human resources of an innovative government

The success of economic transition depends very much on how innovative and effective a government is in addressing various issues arising from the transition process. The generation of increased knowledge and skills within the society, and their effective application to the economic system, is crucial. This process in turn requires effective interconnection between many groups of people, both within organisations and across organisations, and, more generally, human resources are fundamental in transforming the stock of knowledge into sound policy and industrial development. Thus a central determinant of the efficiency of the transition process will be the quality of the structures, operating systems, human resources and learning processes of the government driving the transition process.

Institutions play a central role in the achievement of economic growth.

Although various strands of recent work on growth are not able to provide a consistent explanation of the different rates of growth of given economies in different circumstances, it is widely held that institutions have a fundamental impact on economic outcomes and on the long-term performance of economies. Institutional and policy failures have prevented poor countries from generating or using new technological ideas to reap greater economic opportunities. Thus, institutions are important in that they influence economic efficiency and provide the foundation for the achievement of growth through innovation.

Institutional changes call for a continuous interaction between institutions and organisations

Competition forces organisations continually to invest in new skills and knowledge to survive. The kind of skills and knowledge individuals and their organisations acquire will shape evolving perceptions about opportunities and hence choices that will incrementally alter institutions. The institutional rules that influence interaction among firms and between firms and other organisations in the field of learning and innovation are particularly important. Therefore, as the economic situation changes and firms and other organisations interact with each other in an unproductive way, a change of institutions is necessary.

The transition process is path dependent

As the process of plan to market transition has been interpreted as a process of strategic innovation in the institutional and organisational structures of a society, given the nature of institutions and organisations in both the public and private sectors this process is likely to be highly path dependent. A process is path dependent when its evolution over time is inherently influenced by past events, in that it cannot shake off the effects of those past events. The economies of scope, complementarities and network externalities implicit in an institutional matrix generate such feedback mechanisms, and make institutional change overwhelmingly incremental and path dependent. Therefore, we view the plan to market transition as a highly path dependent process.

Evolutionary Approaches and Government Learning

Institutional change in an evolutionary economic transition process is an unavoidably long process that requires government learning to take place

In an approach to transition based on strategic innovation and institutional change, the role of learning (especially government learning), and its inevitably protracted and path dependent nature, implies that:

- an evolutionary approach to transition can facilitate substantial learning exercises, which are necessary to generate positive results without disturbing the whole society in a dramatic way; and
- the most important learner is the government, for what the government learns can be incorporated in the new institutional and policy initiatives and therefore affect the direction of economic development.

The fact that China has diverged so sharply from other transitional economies both in the transition model and in economic performance gives us reason to investigate the existence of a positive relationship between evolutionary transition and development success, mediated in part by learning processes.

The learning process is a complex, dynamic movement

Government learning is inevitably a highly complex, networked or systemic activity, and therefore it is an iterative process, involving trial and error, feedback and revision. The efficiency of government learning depends on rich information sources and on sound cooperation in a whole series of complex iterative relationships, both within and external to the organisations involved. As an iterative process, both actual practice and the review of experience are significant features of learning. The learning processes can be extremely varied and complex, depending on the problems faced by particular industries, the growth of the external market, the state of competition and the ability of the economy to assimilate new technologies and institutions.

Strategic Innovation, Learning and Development _The Experience of China's Information Industry

Particular attention has been given in this thesis to the significant role that strategic innovation and government learning has played in the development of China's information industry. Two main themes can be found from the discussions. First, government learning has been a major feature of the process of institutional restructuring during economic reforms and, secondly, government learning has led to strategic change through innovative policy formation.

Government has learned that, without a proper institutional and agency framework, economic performance could not be substantially improved

Bureaucratic rigidity, inefficiency and irrationality were seen as the main barriers to Chinese economic development under the central planning system. However, the initial reform approaches employed by the Chinese government showed no indication that the government realised the need to change the rules of the game fundamentally, and the market economy was supplementary to the planned economy. Since the whole incentive system under central planning did not encourage rational resource allocation, the initial solutions could not be sustained and were soon suppressed by the unchanged system. Such problems were reflected in the earlier stages of electronics industry reforms. The government then realised that without a proper institutional framework and thoroughgoing reform, economic performance could not be substantially improved. To facilitate the change of the rules, shaping the player's behaviour became crucial and this required, among other things, organisational restructuring of government agencies.

The various organisational changes (documented in Chapters 4-7) also represent a learning process that the Chinese government has gone through. Government gradually gained an understanding of the appropriate roles for government and of its functions in shaping economic and social development in a market system.

Gradual institutional change and continuing innovation

The most crucial step in economic reform was the ending of the tight government control over the economy, and especially over industrial production and investment. Many of the Government's institutional and policy changes that marked the reform era can be seen as gradual responses to issues arising in this changing environment.

The first stage change was to shift the electronic industry orientation from military purposes to civilian purposes (Chapter 4). This helped to build a foundation for the development of the civilian based electronics industry, and was the starting point for the transition from plan to market in this industry. The nature of the restructuring could be described perfectly by Deng Xiaoping's caption: "Crossing the river by stepping from stone to stone". This is to say that continuing changes had to take place in the process of achieving the final goal, but in an incremental way. Because what is ahead of us is not clear, especially at the early stages, we need to learn and to adjust.

The second stage was mainly focused on technological choices (Chapter 5), including selecting the microelectronics industry as a driving force for technology development. Investment system reform and government restructuring were two important institutional changes at this stage, which had a major impact on the development direction of, and funding sources for, China's microelectronic industry. The institutional change again created a requirement of ongoing government learning, which was embodied in policy making procedures and their implementation.

When competitive advantage was building up, a serious policy issue emerged. This was what the government could do to create an environment of fair competition to facilitate the healthy growth of the information industry. The strategic choices of the government started from two steps: breaking the monopoly of the Ministry of Post and Telecommunications and introducing a second player. Again, an institutional change was involved here, to create a regulator and to separate the regulator from the players (Chapter 7).

The tentative nature of government policies

The Government's commitment to undertake economic transition sparked a series of policy innovations, aimed in part at relieving enterprises from unproductive and inefficient administrative systems. Because of the absence of clear goals initially, policy announcements from the central government remained tentative. In Chapters 4-7, the tentative and evolutionary nature of these policies is evident in each of the main policy areas.

Successful development of information industry had to be based on active learning and on technology development

The evolutionary transition model has given Chinese governments and firms the chance to experiment and to learn from their experiences. It became apparent to the government that developing a sustainable electronics industry required leading edge technology in areas where China could build competitive advantage. A series of innovative decisions were made in the late 1980s and early 1990s, including: (1) choosing computer and telecom equipment manufacturing as the focal point to lift up the technological capacity

of this industry in the Eighth Five-Year Plan; and (2) launching the "Golden Projects" to develop China's information infrastructure. These decisions were based on the knowledge and understanding of the market gained through developing consumer electronic products (both through importing technology and promoting export) and on the skills learnt through participating in international competition (both promoting consumer electronic product exports and exploring microelectronic technology imports). These experiences were interactive and pushed the industry towards building a more competitive capability.

From preferential policy to fostering fair competition

As China continued to seek fundamental ways to improve its economic performance, a number of further innovative policies were implemented in the 1990s. Those policies involved a substantial change in terms of policy direction from focusing on preferential policies, by giving financial support and tax benefits to some particular products and industries, to fostering fair competition. The shift of the policy emphasis underlined the transition of the role and function of government. In the beginning of the transition, the policy focus involved product targeting, as detailed in the case of CTV in Chapter 4. Moving into the Seventh Five-Year Plan period, more and more attention was given to selecting suitable technologies and products for catch-up in important areas. The case of the microelectronic industry shows the characteristics of the catching-up in new technology areas in China's information industry.

At these two stages, the policy orientation was shaped mostly by the requirement of transition, an internal need of China. It focused on building a national capacity for sound development. In the subsequent stages, detailed in the Chapters Six and Seven, the driving force of development come from both domestic industry and from international companies which had investment in China or had extensive business activities in China. In the third stage, a greatly increased number of foreign companies were involved. They not only brought in new technologies and skills to the industry, but also challenged the policy makers to set policies for domestic firms to meet international standard with regards to their products. This helped China to improve its position in world economic activities. The Government also came to the conclusion that, while technology is important to shape the future of the information industry, fair competition and a sound policy environment are often decisive considerations.

Evolving responses to international competition

If Chinese firms were to participate successfully in international competition, it was seen as necessary to build domestic capacity and to identify and strengthen comparative advantage. Perceptions in China of how these two goals are best achieved in relation to the information industries have evolved considerably over the period under study. Initially a simple approach was adopted _ enormous imports of both assembling lines and related technologies. But a more sophisticated strategy was soon seen to be necessary.

In most cases, competitive advantage was built in part through long-term learning in policy development. The policy evolution of the computer industry is a case of such a learning response. As a result of learning from domestic and international experiences, policy evolved from the protection policy in the early development stage to one of

encouraging domestic computer manufactures to compete and cooperate with leading international computer suppliers. Later, the open competition policy in the telecom industry demonstrated the importance of both firm capability and competitive advantage in the most competitive industry in the world. These experiences provided valuable lessons to enrich the policymaker's knowledge and experience.

Broader Aspects of Policy Related Learning in China's Economic Transition

The policy making process is a learning process, one which requires policy makers to have considerable experience and theoretical knowledge, together with a methodology that enables them to learn from _but not to copy without regard for national differences _ foreign policies and experiences. In this way they may produce high-quality policies appropriate for China's unique circumstances. Several broader themes about the nature and content of those learning processes emerged from this study.

The need to learn indirect methods of economic management

One requirement of the transition of economic management from direct controls to indirect methods of management is that government officials needed to learn to use policies rather than to rely on direct controls to regulate economic operations. Innovative policy and strategic innovation in the following areas, (1) using economic methods to manage economic issues and (2) changing the role and function of government according to the needs of social and economic development, were particularly critical in the process of institutional change to foster economic growth. These challenges in turn implied substantial learning requirements for government officials.

Innovative policy needs to break up current power structures

Promoting competition is critical in terms of improving efficiency (Chapter 7), but many difficulties were encountered in achieving this in practice. In relation to the telecommunications industry, government decision-making was hampered by the pursuit of different interests, different ministries, and the power struggles to which this gave rise. Experience showed that any innovative policy initiatives would need to break up current power structures and overcome vested interests associated with old policies. This case exemplifies the fact that for competition to become established as a viable institution it was necessary to shape the behaviour of the various organisations participating in the industry. Such change requires extensive bargaining with various interest groups and a high degree of experimentation, as progress is made slowly from the idea of a new institution to the reality of an institution built.

Learning is constrained by political factors and power structures

The process of learning related to policymaking in China was much constrained by its political environment, even though the reforms were intended to improve economic performance. In a highly controlled environment, it was necessary to ensure that any learning occurring in a policymaking area was such that the result did not challenge the existing structure of power and authority. In the early stage of the transition process, when the principle of "planned economy is primary, the market economy is supplementary" prevailed, any possible technical or policy change had to be in line with

this principle. Another important constraint on learning was the need to comprehend and follow the indications from the upper level authorities, especially the national leadership.

Thus government learning in China has typically followed a path of uneven development, based on self-conscious action in which the learner struck a precarious balance as a result of pressures, incentives and compulsions. The evolutionary transition process enabled learning to occur in such a complex environment, consistent with policy development and a fairly stable economic environment. This seems to have been a key factor in the development of the industry.

Changes in policymaking are limited by adherence to project specific approaches

The dominance of the project specific approach was also an important constraint on government learning relevant to the case of policy making. Effective project assessment in an environment of competition and changing technology required extensive learning by government officials who had previously been schooled in the old ways. But the approval rights for major projects were a powerful force, symbols of a leader's political position, as well assisting his or her ability to build political connections. Thus leaders at various levels paid a great deal of attention to influencing the approval process for major projects.

As a consequence, it was not surprising that, in the functional transition from detailed controls to more macroeconomic management, the practice of government agencies changed only gradually, for the leaders of the agencies were reluctant to change their way of doing things accordingly. It was a common phenomenon that "leaders grasp micro, subordinates lay hold of macro" (lingdao zhua weiguan, xiaji zhua hongguan). This meant that project specific policy making was still a highly favoured form of management for many leaders.

Conclusion

The hypothesis explored in this thesis is that the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning, both government learning and learning by other participants in the economy, in terms of innovation and institutional change. Learning by doing, especially by the government in its role of driving strategic innovation and institutional change, has been central to China's achievement.

In respect of this hypothesis, we have shown that, in the information industry at least, learning by doing by the government in terms of policy innovation and institutional change has been both pervasive and of great importance for the development of the industry. In our view this provides strong evidence, but not of course decisive proof, that 'the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning'. Given the tortuous, trial and error learning processes that we document in this thesis, it is quite likely that, had an abrupt process of transition been attempted in China, it would have had consequences as disastrous as those in many countries of Eastern Europe.

1. Innovation, Institutional Change and Learning

Introduction

China's growth performance in its process of transition from a planned economy to a market economy since 1979 has been exceptional, as detailed in Chapter 2. That process of transition in China has also been virtually unique among centrally planned economies in the extent to which it has been gradualist or evolutionary in nature. There has been much debate, both in the literature and in public discussion, about the relative merits of abrupt ('big bang') and evolutionary approaches to plan to market transition. The aim of this thesis is to understand some of the ways in which this evolutionary approach to transition, and the processes of learning in terms of innovation and institutional change that it made possible, have facilitated rapid growth in China. It is hoped that this analysis will not only throw light on the nature of China's recent economic growth and of its transition process but will also provide evidence relevant to the continuing debate about models of transition. As a starting point, this chapter reviews key aspects of the contemporary literature on innovation, institutional change and learning.

The basic argument of the chapter is as follows. In much of the recent literature on economic growth, innovation and technological change are seen as the central drivers of growth. However, institutions and institutional change, together with the organisations that are associated with them, play a central role in the achievement of growth through innovation. One important network of institutions and organisations, through which effective innovation is delivered to the economy, is the national innovation system. While many innovations are small and incremental, there is sometimes the need for strategic innovation, which changes the institutional or organisational structure of the economy in fundamental ways. The innovations necessary for an economy in transition from plan to market are a classic case in which strategic innovation in the institutional and

organisational structure is required. To ensure that innovation is achieved at all organisational levels within the economy, and given its strategic and economic wide nature, this process of strategic innovation needs to be strongly driven by government.

In this process, learning of various sorts (about technologies, market methods and practices, international experiences and markets) by all participants in the economy is crucial, and has been widely assessed in the literature. What is equally important, but has been rarely assessed, is the learning required of government. Critical questions about the process of government learning – how governments learn, how they assemble the knowledge, experience and practical awareness to guide the process of strategic innovation, in the unique circumstances of the country for which each is responsible _ have rarely been asked either in the development literature or the literature on plan to market transition. This is a particularly important but largely neglected issue, and is a central focus of this thesis. The process of learning is also uniquely important, and difficult, when transition to a market economy is occurring in the midst of a major process of global change.

The hypothesis that this thesis explores is that the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning, both government learning and learning by other participants in the economy, in terms of innovation and institutional change. Learning by doing, especially by the government in its role of driving strategic innovation and institutional change, has been central to China's achievement. This is not possible in an abrupt transition process, but has been a key feature of China's evolutionary process of transition from plan to market. This hypothesis is explored not by considering innovation, institutional change and learning throughout the whole economy, but by studying in detail some key episodes in a particularly important set of industries, the information technology industries.

1.1 Innovation and Growth

1.1.1 Innovation, Institutions and Growth

Innovation and technological change as the central drivers of growth

That innovation and technological change are the central drivers of long-term economic growth has been recognised by economists in many traditions of economic analysis, and in empirical studies. Only some of the main themes can be briefly mentioned here.

In recent neoclassical theory, for example, there are two standard ways of viewing the process of economic growth. One is focused on the outcome of capital formation and technological and organisational progress, including progress made possible by the enlargement of scale (Abramovitz and David, 1996; Carter, 1996). The other way emphasises the process of transformation in the use of a country's resources, principally in the size, intensity of use, and training of its labor force and its occupational and industrial structure (Abramovitz, 1989). Both of these approaches have been represented in the new growth theories based on endogenous innovation (Romer, 1990; Lucas, 1988; Grossman and Helpman, 1990, 1991).

In some models of growth based on endogenous innovation (eg. Romer, 1990) the innovation takes place in the intermediate goods sector and drives both long-term growth and long-term capital formation. The capital stock is used to produce final output in combination with labour and the innovative components produced in the intermediate goods sector. Assuming that R&D in the intermediate sector makes the greatest use of skilled labor, then the accumulation of human capital leads to faster long-term growth by accelerating the process of innovation. A country that has a greater steady-state supply of the factor most essential for industrial research will allocate more resources to R&D in equilibrium and will experience faster innovation and growth as a consequence (Romer, 1990; Grossman and Helpman, 1993).

Innovation is one of the principal elements of vitality as well as one of the most important conditions for the success of national economies. Summarising some of the results of a wide range of new growth theories, Sheehan concluded that 'when growth is driven by innovation, learning by doing or other externalities and these effects are geographically concentrated, initial conditions can generate major long-term differences between countries in comparative advantage and in growth potential.' (Sheehan, 1993, p.58). Grossman and Helpman also argue that as the countries in the world economy become increasingly more open and interdependent, technological innovation is becoming a more important contributor to economic growth (Grossman and Helpman, 1993).

A wide range of empirical studies have confirmed the role of innovation in long-term growth. Maddison (1982, 1987) identified a number of quite distinct 'phases' of the economic growth of nations over the past century or more. Enlarging the economic data collected by Maddison with technological performance data, Pavitt and Soete (1981) found strong evidence of a relationship between those phases of economic growth and different patterns of innovative performance. The well-known studies of Abramovitz (1986), Denison (1962) showed that technical change is closely related to productivity levels. Similar research undertaken by Freeman, in his historical and theoretical analysis of the relationship between innovation and growth at the level of the firm and of the economy, who concluded that periods of rapid growth were closely linked to the outcomes of industrial innovation (Freeman, 1994).

A related argument is that the accumulation of innovative and technological capabilities is basic to international competitiveness (Soete, 1996). Pavitt (1979) analysed the economic performance of the OECD member countries, noting that from 1960 there have been significant differences in economic performance among the OECD member countries. Even though many of these changes are closely correlated with macro performance and world export shares, the ability to embody new technology in production systems and in products has been a very important factor in determining competitiveness. This is so even

though it is difficult to separate technology from other non-price factors influencing economic performance.

As an essential condition of economic progress and a critical element in the competitive environment, innovation is important not only for increasing the wealth of nations in the narrow sense of increased prosperity, but also in the more fundamental sense of enabling people to do things in a new way. Thus Freeman and Soete argue that 'innovation is critical, therefore, not only for those who wish to accelerate or sustain the rate of economic growth in their own and other countries, but also for those who are appalled by the narrow preoccupation with the quantity of goods and who wish to change the direction of economic advance, or concentrate on the improving the quality of life' (Freeman and Soete, 1997, p.2).

Institutional Change and Growth

Institutions and institutional change, together with the organisations that are associated with them, play a central role in the achievement of growth through innovation. Here we follow the usage of these critical terms established by Douglass North (eg North, 1990). In his terminology, the simplest way to think of institutions and organisations is as the rules of the game and the players in the game respectively. 'Institutions ... are the humanly devised constraints that shape human interaction' (North, 1990 p.3). By contrast with institutions as the rules of the game, organisations are the players in the game. Organisations 'are groups of individuals bound by some common purpose to achieve objectives' (North, 1990 p.5).

As previously noted, endogenous growth models have contributed to the debate over the role of technological innovation in economic growth and development. The brief discussion of endogenous growth models above is focused on the basic determinants of growth, but it neglects the background and the mechanisms through which the basic elements operate and in which growth takes place. Some argue that the various strands of recent work on growth are not yet organised into a useful hypothesis providing a consistent explanation of the different rates of growth characterising given economies in different

circumstances. These different circumstances may cover different periods in time, different contemporary economies with similar institutional frameworks, or economies with different institutions at the same or different times. Nevertheless, it is widely held that institutions have a fundamental impact on economic outcomes and on the long-term performance of economies. A further widely held view is that institutional and policy failures prevent poor countries from generating or using new technological ideas to reap greater economic opportunities (Barbier and Homer-Dixon, 1996). Even within some endogenous growth models, the institutional and policy failures in poor economies are seen as an important explanation of their inability to innovate sufficiently to achieve higher long-term growth rates (Barbier and Homer-Dixon, 1996). Thus institutions and institutional change, together with the organisations that are associated with them, play a central role in the achievement of growth through innovation (Sheehan, 1993; Abramovitz, 1989).

Factors Influencing Institutional Change

The continuous interaction between institutions and organisations, in the economic setting of scarcity and hence competition, is seen by North as the key to institutional change. 'Organisations and their entrepreneurs engage in purposive activity and in that role are the agents of, and shape the direction of, institutional change' (North, 1990, p.110). Competition forces organisations continually to invest in new skills and knowledge to survive. The kind of skills and knowledge individuals and their organisations acquire will shape evolving perceptions about opportunities and hence choices that will incrementally alter institutions. The institutional rules that influence interaction among firms and between firms and other organisations in the field of learning and innovation are particularly important. 'The specific institutional constraints dictate the margins at which organisations operate and hence make intelligible the interplay between the rules of the game and the behaviour of the actors. If organisations devote their efforts to unproductive activity, the institutional constraints have provided the incentive structure for such activity' (North, 1990, p.110; see also Edquist, 1999).

To address the ways in which institutions, institutional change and organisational change affect economic growth through innovation, North (1996) stressed that it has to be the incentive structure embedded in the institutional and organisational structure of economies that is a key to unravelling the puzzle of uneven growth. Accordingly, the primary source of economic growth for him is the institutional and organisational structure that determines incentives. The second point is that it is necessary to create impersonal political and economic markets for sustained economic growth. The third and central point is that the belief systems of societies, and the way they evolve, are the underlying determinant of institutions and their evolution.

Path dependence in technological and institutional change

Thus many authors hold that technological change and institutional change are the basic keys to societal and economic evolution, and both of these processes of change exhibit the characteristics of path dependence. A process is path dependent when its evolution over time is inherently influenced by past events, in that it cannot shake off the effects of those past events. In many different types of situation, feedback mechanisms operating over time will generate path dependence. The economies of scope, complementarities and network externalities implicit in an institutional matrix generate such feedback mechanisms, and make institutional change overwhelmingly incremental and path dependent. Increasing returns is an essential ingredient to both technological and institutional change. The path of institutional change is shaped by increasing returns and imperfect markets characterised by significant transaction costs. Further, the role of the institutional framework in reducing transaction costs at different times and places has an important impact on differences in performance.

Organisational change and the evolution and design of new institutions has been very important in the development strategies of the successful Asian economies as well as in the ongoing transformation of Eastern Europe (Edquist, 1999). Liberalisation, stabilisation and privatisation have been important trends in institutional change in many transition countries but these trends vary from country to country. In this interpretation, Third World

countries are poor because the institutional constraints define a set of political and economic activities that do not encourage productive processes. According to North, many countries have begun to appreciate that the underlying institutional framework is the source of their current poor performance. As a result, he asserts that they are attempting to grapple with ways to restructure the institutional framework to create incentives that will direct organisations along productivity-increasing paths (North, 1990). Some policy-makers have chosen to seek to change the organisational actors and the institutional rules, to develop the ability of the public sector to pursue innovation policy. Such a creation or redesign of organisations and institutions might be more important policy instruments than subsidies and other financial instruments.

1.1.2 National Innovation System

Innovation is thus a central element in the economics of growth, and Schumpeter and others have stressed that open markets and sound macro economic conditions are among the requirements for successful innovation. But innovation also involves a whole series of factors: technical, productive and commercial, economic, political and social. In certain cases increased innovation requires a parallel or prior occurrence of social innovation, for an excessive social stability may hamper interest in innovation. Thus, for example, both local technical achievements and society's attitude toward innovation are important elements that not only open the door to innovation but indeed also stimulate it. More generally, an important structure through which effective innovation is delivered to the economy is the national innovation system.

The Concept of the National Innovation System

The expression 'national innovation systems' has been used to describe the complex mixture of institutions, organisations and policies that influence the innovative process at the micro-level in any particular national economy. That is, it covers all parts and aspects of the economic structure and the institutional set-up affecting technological change, learning and searching and exploring for information (Lundvall, 1992; Nelson and Rosenberg, 1993). According to Nelson and Rosenberg (1993), the term 'innovation' here

is to be interpreted not only to encompass processes related to the creation and application of new ideas, product designs and manufacturing processes, but also to cover innovative capability related to economic performance in broader terms. In earlier analyses of the factors influencing national technological capabilities, the analysis was undertaken in terms of the behaviour of firms and institutions doing the most advanced scientific research, and more generally in terms of R&D.

The broader concept of innovation is intended to focus on much more than the activities of the actors doing research and development. Innovation within a single firm has been defined as 'applying ideas new to the firm in products, processes, services, organisation, management or marketing' (Ruttan, 2001), and innovation in a larger unit (an industry, a region, a nation) can be defined by extension. This approach makes clear that innovation is not only about big changes but also about 'the million little ideas', which lead to increased efficiency (Romer, 1993). The term 'system' here encompasses a set of institutions whose interactions influence the innovative performance of national firms and a set of organisations that play the major role in influencing innovative performance. The changing management techniques and skills, government policies and organisations also have an important role in the national innovation system (Freeman and Soete, 1997).

The Role of the National Innovation System

The national innovation system provides a linkage between institutions and growth (Lundvall, 1992). The institutions comprise the social context in which industry operates and innovates. Therefore, the national innovation system approach argues that the impact of the relationships and institutions on learning and innovation can only be understood within a broader system of innovation. The national innovation system approach explains the link between learning, innovation and growth through a process of descriptive exemplification. Proponents of the national innovation system take an inclusive approach that argues that historic and current factors constitute a system of institutionalised social structures that affect the learning and innovation that are associated with growth. The entire system needs to be understood in order to understand either innovation or growth. Thus,

the national system of innovation approach views learning and innovation as issues to be explained as an integral part of the explanation of growth. Overall, this approach seeks to describe learning, innovation and growth through the exemplification of a real situation in a real period, and in terms of the specific institutions and relationships which exist at that time and place. By contrast, for example, the new growth theories model growth within a highly stylised and abstracted theoretical context.

This chapter can not provide a systematic overview of the resurgence of interest in growth and innovation. Rather, the point here is simply to stress that the impact of both innovation and institutional change on growth take place in the systemic context of the national innovation system. The institutions within that system create the social context in which industry operates and innovates, and the environment in which the firm operates plays a major role in determining the rate and direction of innovation. Among the many institutions that contribute to economic performance, the national innovation system approach focuses particularly on those that relate to the technological capability of industry.

1.1.3 Strategic Innovation and the Role of Government

While many innovations are small and incremental, there is sometimes the need for strategic innovation, which involves fundamental change in the institutional or organisational structure of a given economy or in policies relating to that economy.

The Context of Strategic Innovation

Strategic innovation involves the development of institutional, organisational or policy initiatives to implement innovative ways of solving critical economic, social and political problems or of responding to major economic, social and political opportunities. Such innovation is strategic in the sense that it fundamentally changes the course of action of governments or other organisations in society in more than incremental ways (Rondinelli, 1995). Strategic innovation is innovative in the sense that it introduces new ideas or ways of doing things that strongly depart from convention or that require new or unfamiliar

forms of behaviour and interaction. By creating new institutional structures or interactions, and by requiring new forms of behaviour, innovative policies can have a substantial impact on society (Rondinelli, 1995; Orme, 1995a and 1995b; Johnston and Park, 1995). Strategic innovation in turn leads to the reassessment and revision of other policies and can suggest incremental improvements in such policies that will lead them to be more effective (Montgomery, 1995).

Each country has unique historical circumstances and distinctive economic, social and political characteristics. These distinctive features obviously limit the extent to which it is appropriate or even possible to borrow and apply policy, technological and institutional innovations that were successful in another country. Strategic innovation directly influenced by the experience of other countries may be beneficial or disastrous depending on their appropriateness to the immediate circumstances of the implementing country (Johnston and Park, 1995). But there is at least a possibility that an understanding of the experience of other countries will foster a readiness in leaders of developing countries to rethink past policies and previously held strategic positions. Certainly, given their under-developed status, strategic innovations are more likely to be required in developing than in developed countries, although changing circumstances (such as the rise of the global knowledge economy) can force developed countries to undertake strategic innovation also.

The critical significance of political constraints and opportunities as well as economic ones is essential to strategic innovation. Strategic innovation is often shaped by influential individuals, but always takes place in a broader social context characterised by limited information and uncertainty. Because of the complexity and uncertainty of the development process, policy makers usually have only a dim vision of the policies and programs that will catalyse development (Johnston and Park, 1995; Englesberg, 1995; Gan, 1995; Edgar, 2000).

To achieve strategic innovation, innovative ideas must be transformed into specific action and new policies must be proposed to undertake them, while significant problems and

opportunities are identified and recognised among a large enough segment of society to stimulate action. In nearly all political systems, strategic innovations must be legitimised before they can be implemented and, in order for them to be implemented effectively, broadly based support within the society is necessary.

Innovations are motivated by dissatisfaction with existing conditions or conventions. Whatever the sources of policy innovations, they require both the introduction of new ideas and their translation into specific courses of action. The transformation of new ideas into action, and the generation of this broadly based support, usually requires wider recognition in society of the problems and opportunities that inspired a much smaller group of policy innovators. Thus promoting social learning, both in terms of the problems to be addressed and the innovations proposed, is necessary for the new idea to be accepted widely (Rondinelli, 1995).

Given recognition of the need for innovation, a ready flow of ideas and the ability to adapt to a changing environment are critical features of an innovative organisation. Innovative people need to have access to a wide range of information, and there needs to be much interchange between different scientific disciplines and between different business functions. In particular, technological possibilities need to be linked to market opportunities and to production economics. Leadership has a key role in forming cultural attitudes, through influencing by the example of their own behaviour and networking within their organisation, and by creating an environment of flexibility and learning.

As an illustration of the dynamics of strategic innovation in policy making in different political and economic systems, there seems to be strong evidence from a number of quite different countries (for example Taiwan, China, Japan, the USA and Korea) that strategic innovation has played a vital role in stimulating economic development (Johnston and Park, 1995; Englesberg, 1995; Gan, 1995; Ramachandran, 1995). For example, to describe the forces that shaped future actions and influenced the outcomes of government policy, Johnston and Park (1995) addressed the strategic innovations in terms of land reform and

other matters that proved remarkably successful in Taiwan in stimulating impressive increases in agricultural productivity.

More generally, the cases examined by a set of authors (Hobday, 1995; Lall 1987), offer a wide display of experiences with strategic innovation in East Asia and provide a rich source for comparative policy analysis. There is a strong tendency for those who assess innovative policies, however, to focus primarily on their substance and outcomes, which is necessary but not sufficient for a comprehensive analysis. One critical aspect of these cases is the underlying process through which innovative policies emerge. Comparative analysis in this area depends on the ability to identify patterns of decision making and to derive lessons from the dynamics of policy evolution that provide greater insight into how and why the policies evolved as they did (Rondinelli, 1995).

Government's Role in Economic Growth through Strategic Innovation

Governments play a crucial role in determining economic performance. The basic role is the provision of infrastructure and the maintenance of macroeconomic stability (Redel, 1988). Governments striving for national economic growth are also often driven to assume investment functions, as well as some current service functions, that private enterprises cannot or are not impelled to taken on (Abramovitz, 1989). Although many governments make no explicit claim to strategic innovation, they take action in areas that fundamentally influence national economic conditions in a strategic way. In addition, strategic innovations in government policy-making might pressure firms to innovate to adjust to competitive pressures, and might also influence the speed with which such an innovation is diffused throughout the economy. Government strategic innovative action in various fields of policy can help to create a general climate for technological innovation throughout the economy. More generally, to create a dynamic and innovative environment, government has a role to play in enhancing the degree to which local and overseas firms compete with each other on costs, quality and variety. To enhance competition, the government may act by removing barriers to rivalry, and providing incentives for cooperation among customers and suppliers. In addition, the government could improve the law, order and general

compatibility of the economy by strategic innovation, to facilitate change and economic growth (Edquist and Johnson, 1997; Pelikan, 1988).

From the OECD's (1966) point of view, direct government action may be necessary in the science-intensive sector, such as nuclear energy and integrated circuits, where firms are aware of the possibilities for technical innovation, but are not big enough to devote personnel and financial resources to innovation on a scale large enough to be effective. Korean activities to develop integrated circuits are a case in point. The strategic innovation in such sectors tests the government's capability to judge and react to rapid technological change. In such cases, government may act as a 'catalytic agent' through financial support, by encouraging cooperation between various firms and agencies, by using civil development contracts and by implementing a deliberate policy for the procurement of technically advanced products (OECD, 1966). The government's role in financially supporting longer-term and higher-risk research activities may be even more important in the future than it was in the past, and future government policies in this area may need to be more innovative to support programs in advanced technologies on a large scale (Grossman and Helpman, 1993).

Some economies seem to be able to accommodate change better than others (Sheehan, 1996). This is due to the flexibility of their firms and the capacity of public organisations _ in economic management, science and technology, education and training _ to absorb, develop and disseminate innovations, thus accelerating the process of adaptation. So we again come back to the role of institutions, and their associated organisations, in facilitating growth.

1.1.4 Application to an Economy in Transition

Transition as a Process of Strategic Innovation in Institutions and Organisations

The transition from a planned economy to a market economy a classic example of strategic innovation in institutions and organisations. There are some important parallels between Asia and European transition economies in the relationships between liberalisation,

stabilisation, and growth (Richard, 1996; WDR, 1996). In both regions growth has resulted from the lifting of restrictions and from a surge of previously repressed activities, especially in services and in export industries. This process has, however, varied greatly across countries.

The transition economy involves the challenge of the transition from central planning to the market and from a centralised economy to a decentralised one, and well as the liberalisation of prices and the process of 'abolishing state orders and procurement, state production and trading monopolies, and centralised allocation of foreign exchange'(WDR, 1996). There is a need, in the transition economy, not only for a new economic system and for new attitudes, ideas, policies and strategies, but also for stable growth in the economy, to enable the accumulation of basic infrastructure, human resources, capital and technology. Given the scale of economic and social change under way, growth in the transition economy is likely to be painful and unstable, but the development of infrastructure, human resources, capital and technology is a necessary aim of the transition process.

Institutional innovations that have regard to the emerging realities of the global economy, and which take account of the changing context of the particular economy in transition, are likely to be most successful. The nature of transition policy can also change with the development of markets, as economies develop and markets grow more competent and sophisticated. In all cases, however, an innovative institutional management system is required to realise the growth potential of the new economic system (Freeman and Soete, 1997).

The required institutional change is a totally new and systematic social innovation, and as such it requires the various players in the society to undertake change accordingly. This is because 'transition is not simply the adoption or modification of a few policies or programs but a passage from one mode of economic organisation to thoroughly different one. Thus, for transition to succeed it must transcend economic engineering, restructure the

institutional basis of the social system, and develop civil society _ an enormous agenda that will take many years to complete' (WDR, 1996).

These facts mean that countries in transition face challenges not only from role changes as a result of the adoption of market-based systems, but also in terms of development of the capabilities required to drive the transition (WDR, 1997). For the transition countries, according to World Bank analysis, capabilities in the form of qualified people and useable equipment can be retained from the planned economy, but they must be organised to perform new roles. Overall, it is clear that the tasks of promoting and facilitating institutional and organisational change are strategic innovations to be guided by government.

Need for Government to Drive Strategic Innovation

Thus transition involves a restructuring of the institutional basis of the social system, and this requires government to drive strategic innovation to facilitate this restructuring. The interaction between the changing framework of social institutions and the government's initiatives can sometimes affect and facilitate, and sometimes retard, the process of economic and structural change. A self-reinforcing and path dependent process can then be established, in the manner suggested by North and others. The transition needs some mechanisms of dynamic adjustment in terms of both technical change and institutional change, which are radically different in nature from those allocative mechanisms postulated by traditional economic theory (Ruttan, 2001). Because transition is a systemic social process that needs to expand the adoption and diffusion of new ideas, values and attitudes, policy for transition must be innovative and address multiple policy priorities

To reach the objective of a viable market economy, the government of the country embarking on transition has to make a choice in terms of the direction, speed and scale of the transition. In this sense, the government engages an innovation in a very strategic sense. Confidence with the experience of innovation itself can help governments think afresh

about complex problems whose solutions lie beyond current traditions of policy making (Montgomery, 1995).

In order to drive the transition process, government has to maintain a reasonable rate of economic growth and some stability in policy. The situation of the transition economy is inherently turbulent because of the changing economic and social environment, and continuing reform is difficult to sustain without a reasonable rate of growth. In this sense, keeping a reasonable economic growth rate is vital to improving living standards and the quality of education, which can encourage people's positive attitude to the transition process.

In this situation, governments need to have a well developed capacity for driving economic change, and this capacity rests upon: (a) a powerful set of policy instruments; (b) a certain kind of organisation of the state, and of its links with other major economic institutions in the society; and (c) superior economic performance notably with respect to rapid restructuring of the economy towards higher technology production. Governments without these capacities are likely to have difficulty in achieving the required level of strategic innovation in both instruments and institutions.

Because policy in the transition economy needs to be radically innovative, this implies risk and the possibility of instability and of contradictions between the policies issued at different times and by different bodies. Almost certainly the application of innovative policies is riskier than the transfer of more routine policy and administrative operations, through standard conventions of technical assistance. But the study of innovations will offer more guidance for transition economies than the bureaucratic models and static formulas that dominate many current studies of public policy in this era of rapid change (Montgomery, 1995). Thus both learning and innovation have a close link with growth in an economy in transition. The transition process is a dynamic, long-lasting one that needs to be accompanied by learning in the successive stages of strategic innovation. Thus we

need to consider the role of learning, and especially of government learning, in the process of transition and growth.

1.2 Government Learning

The foregoing discussion interprets the process of transition in terms of strategic innovation, driven by government, in the institutional and organisational structure of society. The following sections will focus on issues to do with how government learns and how it assembles the knowledge, experience and practical awareness to guide the process of strategic innovation effectively.

1.2.1 Learning and Policy in East Asia Growth

In the context of technological development, the concept of learning has been widely used in diffusion theory, where it concerns mainly the learning behaviour involved in the process of diffusion of technological innovations (Hanna, 1995; Soete, 1994; Scherer, 1986; Freeman 1982). The sources of learning are believed to be based partly on the experience of practice, partly on importing 'ready made' knowledge from industrial countries and partly on a deliberate process of investing in the creation of knowledge (Lall, 1987). Much attention has been given to the learning process within firms and to its impact on a nation's relative economic position.

As far as government learning processes are concerned, two types of literature are relevant: (a) technological learning paths, including industrial policies; and (b) country or regional economic development experiences in association with government policy making.

Efficient development of industry requires a broad range of technological capabilities and a sound industry policy, which can only be acquired by a long process of learning. A sound industry policy, in turn, is actually a result of a government learning cycle and is one segment in a whole dynamic learning process of government. This was broadly implied in

Hobday's work, where the issue of the role which government policies played in the process of technology diffusion and firms' learning was intensively discussed (Hobday, 1990). It was argued that during the course of adopting new technologies, effective learning by firms, backed by government policies at the same time, was vitally important and is to be considered as one of the major driving forces behind the East Asian economic success (Hobday, 1995). It is observable that, although the focus is still on the technology side of learning, government as a key player in this learning process is recognised. By using institutional, cultural and sociological approaches, other researchers have made sustained efforts to explain the characteristics of business practices and related learning behaviour in East Asian countries (Johnson, 1982; Teck-Wong, 1993; Thomas, 1993; Petri, 1993; Kim, 1993; and Salleh, 1993). Discussions about the quality of policy-making and its role in East Asian technological development and economic growth also have some implications for the importance of government learning (Johnson, 1982; Haggard, 1990; and Vogel, 1991).

In some country specific studies, especially on the technology learning experiences of Japan, Korea, and Taiwan, a sustained process of government learning has in fact been found over the whole period of their industrialisation (Hanna, 1996; Kim and Leipziger, 1993; Wade, 1990; Johnson 1982).

Japanese industrial and trade policy formulation is characterised as the government setting rules and influencing decision-making in the private sector (Vinod, 1993; Leipziger, 1993; Teck-Wong, 1993). Johnson has displayed an interesting relationship between a Japanese government agency _ the Ministry of International Trade and Industry (MITI) _ and the economic performance of the country. After 1949 the Japanese forged the institutions of the high-growth system, drawing in doing so on their national experiences in the pre-war decades. MITI exercised full control over the commercialisation of the products of chosen industries and over the regulation of domestic competition before 1952. But it then freedup its absolute controls in these areas after that year, while forcing firms to face foreign competition in the 1960s. What MITI learned was to employ indirect, market-conforming methods of intervention in the economy. Johnson commented that 'although it is obvious

that MITI could not have accomplished what it did without a mobilised people, without innovation and competition in the private sector, nor without the supplementary programs of other agencies of the government, it is equally true that the developmental effort itself required management. This is what MITI supplied' (Johnson, 1982, pp. 240-1).

The superiority of the economic performance of Korea is believed by some to derive from 'government-led development'. The more general role of government was to coordinate investment decisions and to support infant industries, with the ultimate aim of penetrating world markets. Its industrial policy has gone through several stages: aggressive export promotion and classic protection in the 1960s and the early 70s; emphasis on the promotion of heavy and chemical industry in the 1970s, and a more neutral attitude based on functional incentives and focusing on more balanced economic development in the 1980s and beyond (Kim and Leipziger, 1993). Government learning in the process of Korean economic development has been presented through these policy modifications, and this was especially obvious when emphasis on the heavy and chemical industries led to an unbalanced industrial structure and a policy redirection was initiated in 1980. Thus, one reason that 'separates Korea from other developing countries is not only the fact that it was largely successful in its efforts, but more importantly that it was conscious government policy from outset to be internationally competitive' (Kim and Leipziger, 1993, p. 18).

The so-called 'government-led growth' is often argued to be exemplified in cases like Taiwan, Hong Kong and Singapore, where the high quality of government institutions is claimed to be ultimately responsible for their success (Petri, 1993). Taiwan is considered as a successful example. In the course of promoting the free market economy, it has been argued that the Taiwanese government led the market in a coherent rather than an ad hoc way (Wade, 1990). The government assisted high levels of productive investment and the fast transfer of newer technology into actual production, and forced the exposure of many industries to international competition. These arguments imply that effective government policy making is a key to rapid economic growth in many developing countries, and hence

that quality government learning must be embodied in the process of effective policy making.

The works cited above have argued that, although growth rates differ among these countries, industrialisation has come about as a process of learning from experience and from others rather than simply by the generation of new inventions or innovations. Government interventions in East Asia were pragmatic and flexible. A distinct feature of government policy-making associated with such a pattern is that 'governments are repeatedly able to distance themselves from past policies that have failed or are no longer useful' (Kim and Leipziger, 1993, p. 22).

The key role which government learning has played in economic development has been implicitly, but not explicitly, discussed in much of the literature relating to technological learning and to the development experiences of different countries. The primary focus has tended to be on learning by firms, and the role of government in facilitating that learning, rather than on the learning process within government itself. In this literature the analysis of policy making has been focused more on policy initiatives, their effects and the resulting policy modifications. How the actual policies emerged as a result of effective government learning process is overlooked.

In spite of its importance to East Asia and elsewhere, little serious analysis of government learning is to be found in the economic literature. More specifically, the gaps in the literature relating to this study are: (a) explicit and comprehensive analysis of government learning as a process, particularly in policy making for the information industries; and (b) Government learning in China, facing both plan to market transition and the task of catching up with the rapid expansion of the global information industries.

1.2.2 Some Sociological Literature on Government Learning

By contrast with its absence from the economic literature, there are several different explanations of policy change based on notions of learning in the sociological and policy

literature. These include the notions of 'political-learning' developed by Heclo, 'policy-oriented learning' developed by Sabatier, 'lesson-drawing' analysed by Rose, 'social learning' discussed by Hall and 'government learning' identified by Etheredge[1] (Bennett and Howlett, 1992). These conceptions of learning and its role in public policy formation are used by many analysts to describe a common tendency for some policy decisions to be made on the basis of knowledge of past experiences and knowledge-based judgments as to future expectations.

'Government learning' has been used to describe the process by which governments increase their intelligence and sophistication and in this manner enhance the effectiveness of their actions (Etheredge, 1983). Etheredge's study is located firmly within the formal institutions of the state, while the other authors mentioned above opt for more complex views of the relationships existing between social actors and state official. Etheredge asserts that learning is an activity that can take place at both the individual and organisational levels, but does not address who is the agent of learning in a government in any detail as it pertains to specific government officials or institutions. Government learning, in this sense, is bureaucratic learning and the agent of learning is the bureaucrat (Lloyd S. Etheredge and James Short, 1983).

'Policy-oriented learning' is a major determinant of policy innovation and change, according to Sabatier (1987). Sabatier argued that policy-oriented learning involves 'relatively enduring alterations of thought or behavioural intentions that result from experience and that are concerned with the attainment or revisions of the precepts of one's belief system' (Sabatier, 1987; p.672). In his view, learning is more about ideas than organisations.

'Lesson drawing' (Richard Rose, 1988, 1991) is a particular type of learning in which policy-makers learn from both the positive and negative experiences of others. It is to help describe the process by which programs and policies developed in a particular country are

[1] For details see a review in Bennett and Howlett (1992).

emulated by others and diffused throughout the world. Policy makers can learn from how their counterparts elsewhere respond to similar situations. More than that, it raises the possibility that policy-makers can draw lessons that will help them deal better with their own problems.

Based on these and other research studies, Bennett and Howlett presented a framework for understanding the various characteristics of learning, encompassing the various types of learning _ policy learning, government learning, lesson drawing and social learning _ distinguished by the authors cited above (Table 1.1). This framework provides a useful basis on which to elaborate further the approach to government learning being adopted in the current study. In particular, it brings out the diversity of types of learning, of learning agents and of the content of learning.

Table 1.1 Three types of learning

Learning type	**Who learns**	**Learn what**	**To what effect**
Government learning	State officials	Process-related	Organisational change
Lesson-drawing	Policy network	Instruments	Program change
Social learning	Policy communities	Ideas	Paradigm shift

Source: Bennett and Howlett (1992, p.289).

1.2.3 Government Learning in the Current Study

We have seen that government learning has indeed played an important role in strategic innovation and in facilitating economic growth in a number of East Asian economies, and it has undoubtedly been of central importance elsewhere. In this sense the learning process needs to be integrated into the decision-making process (Forary and Lundvall, 1996), and flexibility, adaptation and innovation are coming to be seen as critical ingredients in the success of economies. These aspects of economic responsiveness can be captured in the notion of learning by individuals, by organisations and by institutions (Mathews, 1996; Storper, 1996), to employ a somewhat different categorisation of learning agent than that

used by Bennett and Howlett (1982). Learning plays key role in long-term strategies, which require flexibility, responsiveness to change and the creation of a learning culture in all organisations (Rothwell, 1992a). Thus learning and knowledge at the government level come to be seen as central activities and resources of successful economies, particular for economies in transition.

The Conditions of Government Learning

Government learning is defined in a broad sense in this thesis in that it covers all the elements covered in Table 1.1, including both lesson drawing and social learning as well as the broad coverage shown in terms of who learns, what is learned and to what effect. The primary subjects of government learning are state officials. They undertake learning not only about process-related matters but also about instruments and ideas to focus organisational change and program development. But learning also takes place on a shared basis in organisations, policy networks and policy communities, and social institutions are reshaped by the learning that takes place within them.

In this framework, government learning is experiential learning. Learning approaches generally hold that governments can learn from their experiences, and that they can modify their present actions on the basis of their interpretation of the results of previous actions. Even so, many of the fundamental elements of such learning remain conceptually unclear and the entire phenomenon of experience-induced policy change is not well documented. It is likely that an acquaintance with the experience of strategic innovation itself will help governments think afresh about complex problems, whose solutions often lie beyond current traditions of policy making.

In spite of this limited empirical documentation and theoretical exploration of learning by governments related to institutional change and policy, it is possible to identify some of the key conditions for successful government learning, and some of the main processes involved in that learning. The following seem to be some key conditions of sound government learning:

(1) Organisational structure and institutional structure:

While learning is primarily undertaken by individuals, creating a sound organisation structure and environment to enable them to adapt intelligently to changes in their operating environment is very important to the learning process. The structure of an organisation is its framework of formal roles and procedures, usually outlined in an organisational chart with responsibilities and relationships. The efficiency of government learning depends critically on the structure of its key organisations, and on the environment within them. The broader institutional framework is also critical, because the institutional structures affect the operations and strategies of organisations (Mathews, 1996; Carter, 1996; Miller, 1996; Sheehan, 1995, 1997).

The concept of learning has been advanced to capture the sense of continuous adaptation to a changing commercial environment, drawing on a repertoire of skills and routines that can be brought to bear on any particular circumstance (Mathews, 1996). To the economy in transition, a requirement critical for appropriate government learning will be to initiate an inquiry into the means and purposes of adaptation to changing circumstances at the macro level. The institutional framework within which government learning operates will be as important as government's own internal procedures in responding to this requirement.

(2) Culture

The dominant culture of a country defines behaviour, bounds individuals and defines values (Hampden-Turner, 1990). If a country's culture values activities which are critically important to innovation, like learning, openness or risk-taking, the innovators will feel supported within that culture. Readily accepted transitions between organisations and the external environment, such as universities, trade associations and other agents, are also widely believed to be particularly important to effective government learning (Andreason and Kolind, 1996; Stern, 1996; Dosi, 1996; Storper, 1996).

(3) Sound communication

The success of government learning also depends on the establishment of sound internal and external communication, effective linkages with external sources of information and accessible means of deriving external ideas (Lall, 1987; Andreason and Kolind, 1996). Treating learning as an organisation-wide task that requires effective functional integration involves all departments in whole stage from its earliest stages. An implementing careful planning and decision making procedures will commit resources to new projects and regular appraisal of learning sources (Carter, 1996). Efficiency in development and high quality policy, implementing effective quality decision making procedures, taking advantage of up-to-date information technology are also essential factors to successful government learning (Rothwell, 1992a).

The Processes of Government Learning

Case study will be used to see the effect of (1) institutional change and (2) organisational change to the development of China information industry. From the development path of the Chinese information industry within the period of economic transition, we could see the influence of institutional context and changing function of government organisations on the development of the industry.

The learning process is a dynamic movement, because of the changing environment, the uncertainty of conditions, accumulating experience and improving capacity. As an iterative process, both actual practice and the review of experience are significant features of learning. It is necessary to compare policy mechanisms, strategies and outcomes as well as the plurality of government policies and development models available to the decision maker, drawing on their own and on international experience. The learning processes can be extremely varied and complex, depending on the problems faced by particular industries, the growth of the external market, the state of competition and the ability of the economy to assimilate new technologies and institutions. Learning processes in decision making can influence the efficiency of the allocation of resources, appropriate government

policies and the capabilities of local firms in the industry development process. Therefore, the effectiveness of government learning is particularly important in (a) making sound decisions on development strategies and related policies, and hence (b) avoiding expensive costs resulting from poor decision making. Through learning, government policy effectiveness and capabilities of ensuring effective and sustained structural adjustment will be improved.

However, government learning inevitably involves costs, occurred not only in the learning process, but also through the failure of government learning. It is important to take into account the cost of learning and failures in the learning process when we assess the effectiveness of government learning.

Government learning is undertaken within the framework of a set of government organisations and proceeds through several stages: decision making, consultative practice, assessment and feedback or revision.

1. Decision Making

The decision making process offers a conceptual framework for comparing and assessing the learning elements of institutional change and organisational change what remains a rare phenomenon in government learning. This framework can be employed to describe how learning occurred in the institutional change and organisational change. There are several levels of decision-making involved in the process, in both the public and the private sectors. At the national level, these processes identify economic information and communication needs and target larger-scale application areas for strategic and demonstration effects. Decision-making embraces collective efforts and democratic consultation, the determination of learning reference points and of assimilation capabilities relative to other countries and to China's own experience. This determination must have regard both to the scarcity of public resources and to the need to focus national resources for rapid learning and maximum impact.

2. Consultative Practice

To reach the objective of an effective decision with support from relevant parties, government-business cooperation and consultation are very important. A government-business coalition can help in focusing national resources, speeding the learning process, demonstrating IT applications, building information networks, exploiting linkages and externalising results. Through government-business partnerships the response to opportunities, emerging technological changes and global competitive challenges can be hastened, and the risks of failure of targeted policies can be reduced.

3. Assessment

The outcome and efficiency of decision making should be compared with expectations and with experience of related areas and countries. Dynamic assessment of learning should be undertaken by decision-makers, business bodies and public organisations. The policy should consider following factors: the preferences and bounded rationality of the ruler, ideological rigidity, bureaucracy and the agency problem, group interest conflicts, and the limitation of social science knowledge (Lin, 1989, p25). The long-term objective of learning should be to improve decision-making capacity, including capacity for scanning the global environment and developing national economy. In this study, the effectiveness of learning will be assessed by evaluating the impact of policy initiatives in upgrading the structure of China's information industries, and by their ability to assist China to catch up with the rapidly changing global information technology.

4. Feedback or Revision

Feedback is a continuing active series of steps which supply valuable learning resources and which help make learning dynamic. Based on the feedback message, existing decisions may be revised or new decisions made. Positive feedback is a key step to recognising and revising the performance and the efficiency of learning. Without feedback the particular policies or strategies selected, from among the many alternatives, may become entrenched regardless of the advantages of the alternatives. Assessment from business and public

organisations is helpful in improving decision-making capacity, and provide lessons for a new learning process.

Conclusion

The concepts of government learning, strategic innovation, and the national innovation system have been employed to build the linkage between learning, innovation and growth. To understand the relationship between learning, innovation and growth, strategic innovation is an important concept, and the national innovation system offers a framework to build a linkage.

Strategic innovation in institutions and organisations, as well as in technology, is crucial for growth. It is particularly important in an economy in transition. The outline of the framework of the experiential study of the learning and policy in East Asian growth is presented by the examples of Japan and Korea, showing that these processes of strategic innovation are typically path dependent.

Transition can be interpreted as a path dependent process of strategic innovation in institutions and organisations. Such a transition process must inevitably be driven by government. In such processes learning will be crucial, and this will include (particularly in transition) learning by governments.

Government learning was addressed to explain the specific feature of strategic innovation and government learning is itself inevitably a complex and iterative process, involving trial and error, feedback and revision.

The profound role of government learning in driving strategic innovation was addressed through drawing a dynamic learning process and strategic innovation process that offer a framework for the case study in government learning. Government learning emphasises the extent to which it is a highly complex, networked or systemic activity. There is a wide

range of factors affecting strategic innovation. These factors range from the institutions and relationships that characterise the national system of innovation. The efficiency of government learning depends on the rich information, and sound cooperation in a whole series of complex iterative relationships both within and external to the institution.

2. Two Paths for Plan to Market Transition

2.1 Interpreting Transition: Abrupt and Evolutionary Models

Economic transition in previously centrally planned countries is the process of transforming the centrally controlled economic management system to a system where private ownership of the means of production prevails for the most part. The key economic objectives of the transition process are to raise economic efficiency and to promote growth. The major areas of reforms taking place in the transition process include macrostabilisation, price and market liberalisation (including international trade liberalisation), restructuring and privatising of state enterprises, and refining the role of the state. In addition to political differences, there exists enormous diversity among transition economies in terms of physical and population size, level of development (as measured by GDP per capita), natural resource endowment, cultural and historical background and preferred reform strategies. Reflecting these and other factors, the duration and intensity of the reforms undertaken has differed greatly across countries.

There are two dimensions to the massive change in structure implicit in the transition process: the wide range of structural and institutional reforms implemented by governments and the resulting changes in the economic behaviour of individuals, firms and other organisations (IMF, 2000). In Chapter One the process of plan to market transition has been interpreted as a process of strategic innovation in the institutional and organisational structures of a society. It has been argued that, given the nature of institutions and of organisations in both the public and private sectors, this process is likely to be highly path dependent, so that future outcomes are heavily influenced by past realities. The path dependent nature of the transition process parallels, and is likely to be intensified by, path dependence in technological change. Thus we view plan to market transition as a highly path dependent process of strategic innovation in the institutional and organisational structures of a society.

When the paths actually followed in a plan to market transition in different countries over the past twenty years are reviewed, two main approaches can be observed. In some countries the process has involved a single burst of reforms, aiming to bring about abrupt change in the economy over a short period of time, while in others it has involved gradual or evolutionary change (World Bank, 1996). The former approach involves 'rapid price and trade liberalisation, accompanied by a determined stability; a quick move to current account convertibility; the immediate opening of markets to entry by new private businesses; and initiating, at least, a wide range of other changes, ...' (Word Bank, 1996, p.9). Abrupt transition has been attempted in most of the transition countries in eastern and central Europe, with the support of prominent academics and institutions such as the IMF (IMF, 2000). For example, in Poland in 1991 and in East Germany and the Czech Republic after 1992, reform strategies aimed to minimise 'the duration of the inevitable pain and quickly sever the links between the state and the productive system, to guide against backsliding and stagnation' (World Bank, 1996, p.9).

By contrast, the evolutionary approach involves these changes occurring over a much longer period. It 'might start with localised experiments, which are expanded as perceived successes emerge. A few repressed sectors such as agriculture are liberalised up front. After these first steps, markets are slowly but steadily extended to other parts of the economy as the institutional building blocks of a market system are put in place' (World Bank, 1996, p.10). The most striking example of such an evolutionary approach is China.

It is important to note that our interpretation of transition as a highly path dependent process of strategic innovation in the institutional and organisational structures of a society does not prejudge the relative merits of the abrupt and evolutionary approaches. That is, while it might seem that such an interpretation highlights the merits of an evolutionary approach, it could also be argued that abrupt change is the only way to cut through the complex set of linkages between traditional institutions, organisations and incentives.

However, the argument of this thesis goes beyond this interpretation of the transition process. As outlined in Chapter 1, the hypothesis that this thesis explores is that the

evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning, both government learning and learning by other participants in the economy, in terms of innovation and institutional change. Learning by doing, especially by the government in its role of driving strategic innovation and institutional change, has been central to China's achievement. This is not possible in an abrupt transition process, but has been a key feature of China's evolutionary process of transition from plan to market.

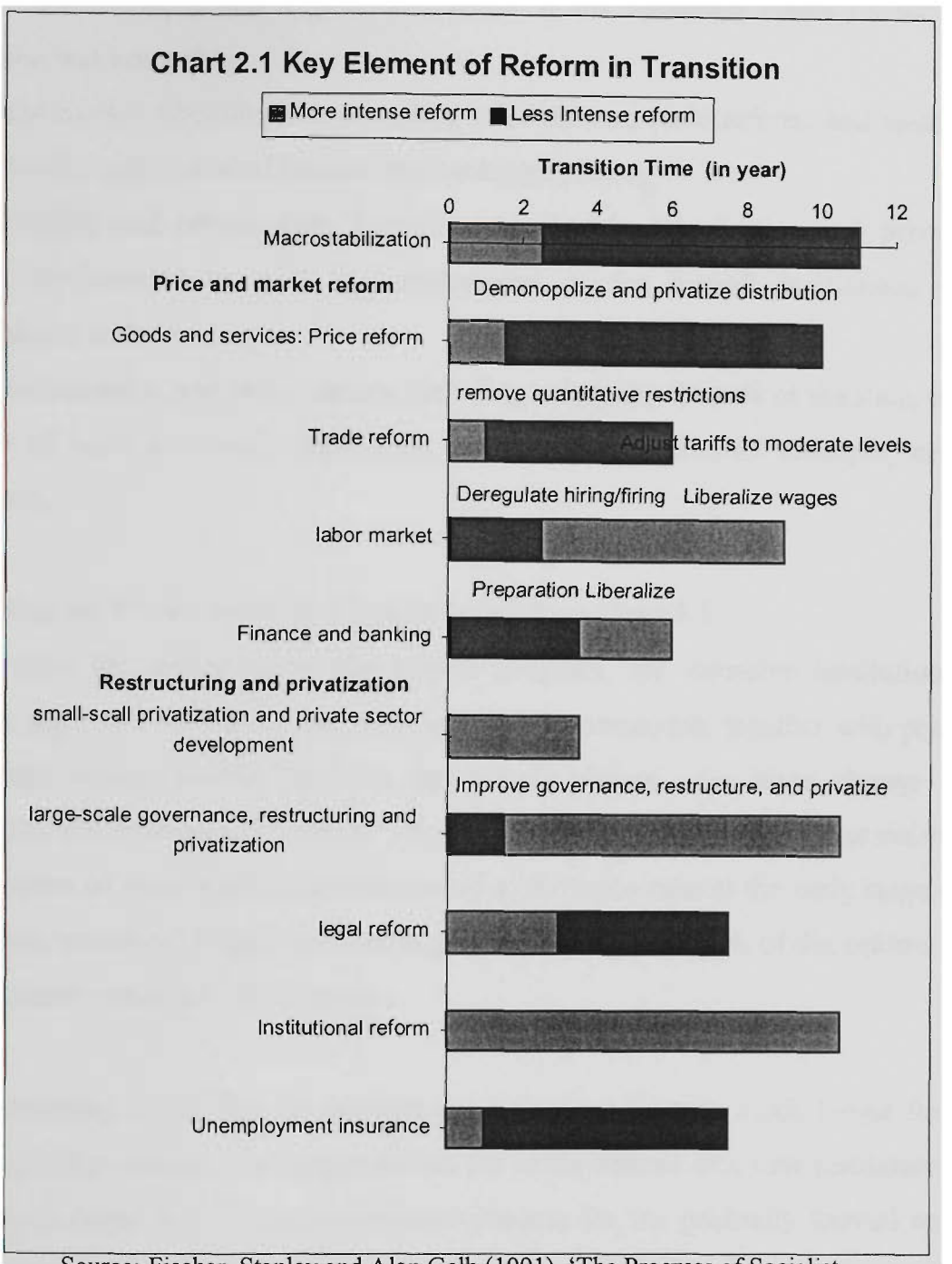
This hypothesis, if correct, may have broader implications for the debate between abrupt and evolutionary models of transition. For if learning in terms of innovation and institutional change, both by governments and by other participants, is essential to an effective transition process, and if this is inevitability an extended, path dependent process involving trial and error and learning by doing, then there may be strong reasons for supporting the evolutionary approach. If learning is central, and if learning takes time, then an evolutionary process has much to recommend it.

2.2 The Two Approaches to Transition: Profile and Analytical Foundations

In this section some brief background on the application of the two approaches (in countries in Eastern Europe and in China respectively) is provided, and the rationale for the two approaches is reviewed.

Abrupt Transition in Eastern Europe

In the context of reviewing transition models and approaches, Fischer and Gelb (1991) outline some of the key elements of the reform process. The major areas of reform they identified from Eastern European countries' experiences are shown on the left-hand side of Chart 2.1. This chart provides a valuable tool to use in documenting the transition process and contrasting the two transition paths.



Source: Fischer, Stanley and Alan Gelb (1991), 'The Progress of Socialist Economic Transformation', *Journal of Economic Perspectives,* vol. 5, no. 4, Fall, pp. 91-105.

The reform process in each of the area is presented by the bars, of which two broadly defined reform stages are described as intensive and less intensive reforms on a scale of 0-12 years. The bar structure in the Chart 2.1 depicts a typical Eastern European country's reform, with initial conditions somewhere between those of Poland and Czechoslovakia. In this framework the reform areas can be grouped into four types of transitional activities:

(1) Macrostabilisation, which is a critical factor if the transition country's initial condition was not stable;
(2) Price and market liberalisation, including price reform, trade reform, and reform of the labour market and of finance and banking systems;
(3) Restructuring and privatisation, including small-scale privatisation and private sector development as well as development of the overall institutions of governance; and
(4) Other restructuring and privatisation, including redefining the role of the state, the reform of legal and other institutions, and the introduction of unemployment insurance.

The following are the few points that can be drawn from Chart 2.1:

- Right from the beginning of the reform program, the intensive institutional reform, legal system reform, and macrostablisation measures, together with price and trade system reform illustrate the overall picture of a huge change in economic and institutional systems. The chart shows that within ten major reform areas, seven of them would start intensively at the same time at the early stage of economic transition. It goes without saying that the initial shock of the reform to the economy would be very dramatic.

- It is interesting to see that the institutional reform would take much longer time than any other reforms. This suggests that the establishment of a new institutional framework requires a vigorous adaptation process for the gradually formed new institutions adapting to the change of new economic environment and vice versa, and this is a long and iterative process.

- Intensive privatisation programs begin from a small scale and aim at incubating the private sector in the economy, then launching large-scale privatisation program. The sequence of such reforms seems sensible. However, the long period of time required for large-scale intensive privatisation processes do tell that it is not an easy task especially with an overwhelmingly large public sector in transitional economies. This has been evidenced throughout all the Eastern European countries.

- Intensive labour market reform happens at the same time as the intensive large-scale privatisation program. In fact, labour market reform is a must when large-scale privatisation is in progress. However, this to a large extent would generate big side effects on social stability, at least at the early stage of reform.

- As indicated in the chart, in a typical 'big bang' approach to transition in Eastern Europe it was envisaged that major progress would have been made in all of these areas within ten years, with substantial implementation of price and market liberalisation changes within three years.

Evolutionary Transition in China

With regard to each of these factors, the situation in China shows some similarities to, but many differences with, the Eastern European pattern, in which the differences mainly reflect the gradual, evolutionary approach. China's reforms to date are normally outlined in official statements involving three stages. The first stage, from December 1978 to September 1984, began with the Third Plenum of the Eleventh Congress of the Chinese Communist Party, held in December 1978 and the reform programs from this were formally started in 1979, which marked the starting point of the reform process. The central focus over the first five years was on the agricultural sector, although tentative steps were also undertaken in other areas.

The second stage extended from October 1984 to December 1991. After the successful reform in the agriculture sector, the central government announced a shift in the focal point of the economic reform process at the Third Plenum of the Twelfth Congress of the Chinese Communist Party in late 1984. The decisions taken at this meeting shifted the focus from agriculture to the broader economy, and gave birth to a series of more comprehensive reform programs in areas of the trade management system, the price system, the financial system and the management of industry.

In these first two stages, there were four institutional reforms which were significant:

(1) Regional decentralisation of government

From 1979, government authority had been devolved from central to local levels. Local governments were given significant regulatory rights regarding local economic development, much more authority in their expenditure structure, as well as the responsibility in providing local public goods. They would also be rewarded financially as they promoted local development. The fiscal arrangement between local governments and higher-level governments were formalised when the fiscal contract system was introduced in 1980. Decentralised authority together with the fiscal incentives has provided strong motivation for local governments to take care of local matters.

(2) Entry and expansion of non-state (mostly local government) enterprises

As the local governments enjoyed much higher authority in dealing with their development issues, they also set up new firms, which contributed to the high growth of the non-state sector in China.

(3) Financial stability through financial dualism

Financial dualism is described by Bai and others (Bai et al. 1999 cited in Qian, 1999) as financial repression with 'anonymous banking'. Financial repression refers to government control over international capital flows and domestic interest rate and private financial activities. The 'anonymous banking' is the combination of almost unrestricted cash transactions and the permission to use anonymous household savings deposit. This dualistic feature of the financial system is considered as providing a financial stability through certain controls while anonymous banking generates private incentives for the development of the non-state sector (Bai, Li, Qian, and Wang, 1999).

(4) The dual-track approach to market liberalisation

China's market liberalisation started with a dual-track price reform under which the market was liberalised at the margin initially. 'The government initially maintained planned prices and quotas, phasing them out later. Under the plan track, economic agents were assigned rights to and obligations for fixed quantities of goods at fixed plan prices, as specified in the plan. Under the market track, economic agents participated in the market at free market prices, provided that they fulfilled their

obligations under the plan'(Qian, 1999, p.384). Gradually, the proportion of the planned prices dropped and the proportion of the market price increased accordingly. Then the market mechanism was finally established.

Qian argued (1999, p.379) 'Although China did not establish uniform rules or international best-practice institutions during its first 15 years of reform, it nevertheless underwent dynamic and fundamental institutional changes' in the above four main areas.

The third stage started from Dong Xiaoping's southern China trip in the spring of 1992 and in October of the same year, the Fourteenth Party Congress endorsed the 'socialist market economy'. From this point onward, the essence of economic reform had been clearly identified as the creation of a new economic system and stimulating institutional innovation (Zhuanjiazu, 1995). In the third stage of reform, establishing a rule-based market system was clearly and consciously targeted. China unified the foreign exchange market and made its current account convertible, overhauled the tax and fiscal systems, centralised the central bank, downsized the government bureaucracy, forced the military to give up its commercial operations and started privatising state-owned enterprises and laying off their workers.

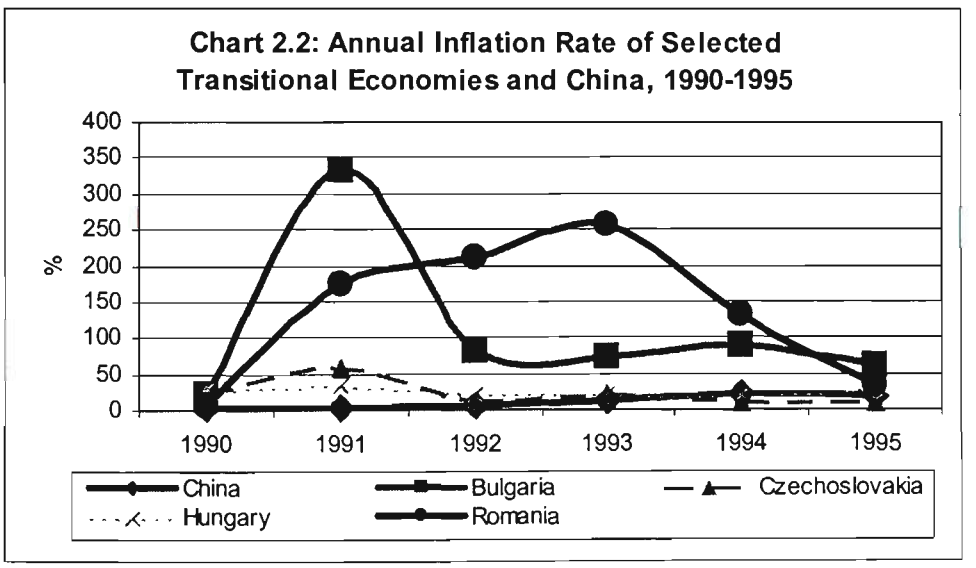
The gradualist nature of China's reform process can also be seen in terms of Fischer and Gelb's four elements of the reform process, summarised in Chart 2.1 for a typical Eastern European country. Macroeconomic stability and the control over reform progress have always been key elements in the past two decades of China's transition. The central government has remained active and cautious in supervising the development of the reforms, making use where appropriate of both variations in microeconomic incentives and in fiscal and monetary policies. The inflation rate in China over this period has been controlled to a relatively low level, by comparison with the countries of the Eastern Europe and Russia (see Table 2.1 and Charts 2.2 and 2.3[1]).

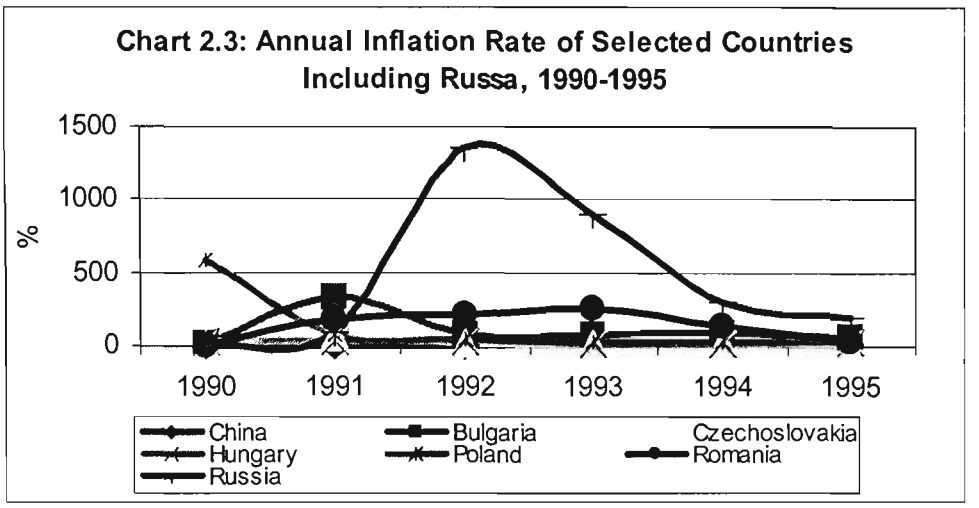
[1] Because the inflation rate of Russia is too high which obscures the inflation differences between China and other European Countries, two separate charts are constructed for better viewing of the relative state of each selected country.

Table 2.1: Selected Characteristics of Transition Countries

Transition Country/Group (1)	Year Transition Began	Real Output Ratio 1999/1989	Average Inflation 1989-99	PPP GDP Per Capita 1999
EU accession countries (excluding Baltics)	1991	0.95	35.5	10,009
Baltic countries	1992	0.68	33.5	6850
Other south eastern European countries	1990	0.77	3331.8	3651
Commonwealth of Independent States (2)	1992	0.53	149.1	3337
East Asia	1986	1.78	17.1	2042
China	1978	2.52	8.1	3709

Source: Table 3.1, p89, *World Economic Outlook 2000.*
Note: 1. Data for country groups are simple averages of group member data.
2. Data include Mongolia.





Sources: Data of Chart 2.2 and 2.3 are edited from *World Development Report 1996.*

In terms of price and market reform, China's price reform was undertaken by releasing price setting processes for products from the planned system to market on a step by step basis. This product by product approach did not cause a sharp increase in commodity prices, and contributed to the fact that China's inflation rate was relatively low. Enterprise reform generally, and the reform of ownership, has taken a long time in China. It started with a limited introduction of private ownership, and then subsequently a substantial increase in the role of the private sector was encouraged. However, it was not until the late 1990s that fundamental reform to the state owned enterprises began.

In the transition process 'redefining the previously all-encompassing role of the state is one of the greatest challenges for reform' (Fischer and Gelb, 1991, p.100). It is true that, as Qian argues, 'in the past two decades, China has been undergoing highly dynamic and profound yet smooth internal institutional changes that have unleashed the forces of incentives, hard budget constraints, and competition for growth' (Qian, 1999, p.378). Yet only limited progress has been made in redefining the role of the state in China. For example, as documented in Chapter 3, it was not until the reforms of 1998 that the central role of the State Planning Commission in the Chinese economy was radically changed. This is partly because of a realisation that system reforms to reshape the role of government need to be complemented by investment in human capital to upgrade management skills, and in other changes to implement

institutional changes. Restructuring government organisations periodically according to requirements to support market development has also been seen as critical to the efficiency of the economy.

The reform of the investment system, and of the financial sector more generally, has been critical to China's reform process, but has also been undertaken gradually. The initial phase involved releasing the banks from their previous role as tellers of the planning system to become real banks, borrowing from and lending to both the public and the private sector on a commercial basis. This took place in a gradual and indeed tortuous process over nearly two decades (Fong, 1998). Foreign investment reform provided rules for treatment of foreign investment, and also assisted in freeing up the financial system. However, China has not yet moved either to the convertibility of its currency on the capital account or to the floating of that currency, nor to allow the widespread entry of foreign firm into its financial system. To many observers, the wisdom of this cautious approach was apparent in the East Asian financial crisis of 1998.

It can perhaps be argued that a fourth stage of reform, one which the Chinese Government deliberately allows to be driven by forces external to China, began in 2001, with China's formal entry to the World Trade Organisation (WTO). Under this agreement China has agreed, for example, to:

- the elimination of quotas on imports, and of import tariffs on computers, semiconductors and related products, by 2006;

- the reduction of tariffs on vehicles from 100 per cent to 25 per cent by 2006, and the substantial reduction of most other tariffs;

- full market access for foreign banks within five years, and permission for them to conduct local currency business with Chinese enterprises within two years; and

- access to up to 50 per cent foreign ownership of telecommunications and insurance (World Bank, 2001).

These and other changes implicit in China's accession to the WTO will inevitably lead to further changes in China's economic system, perhaps at a more rapid rate than has occurred to date. But even so, it will be at least thirty years from the start of the reform process in 1979 before China has in place many of the reforms that are listed in Chart 2.1. This is a measure of the gradualist or evolutionary nature of the Chinese transition process.

The Rationale for Abrupt Transition

The principal intellectual support for the abrupt transition model has been the idea that the elements of reform are 'interlinked and complementary', so that a rapid and comprehensive program of reform is necessary (IMF 2000; Fischer and Gebb 1991). This approach is also referred as the 'market-fundamentalism' or 'big bang' reform strategy, which has been followed by most of the transition countries of central and Eastern Europe, the Baltics, and the former USSR.

According to the work cited from Stiglitz (1999), and Feltenstein and Nsouli (2001), the main arguments in favour of an abrupt transition process can be summarised as follows:

1 Because reforms are complementary, most reforms need one another. Full-scale reform implementation is necessary to enable the private sector to relocate resources rapidly and to increase investment. To achieve this result it is also necessary to separate firms and the state, which involves ending the planning system and phasing out state subsidies. Because price liberalisation often leads to a once-off jump in prices, macroeconomic policy must prevent the price adjustment from triggering inflation.

2 Abrupt transition could reduce uncertainty. Given the many actions to be taken, any lag in their implementation creates uncertainty and impedes restructuring. The delay may lead to inefficiencies, and even to perverse behaviour such as asset stripping by managers before privatisation, lack of investment by agencies scheduled for privatisation, and so on.

3 A rapid introduction of reforms can overcome the political resistance to major and prolonged change, leading to an effective implementation of the reform package. Proponents of this argument also suggest that it is during a brief period of 'extraordinary politics' that reforms can be decided and implemented most easily.

4 Rapid reform increases the incentives to reallocate resources, resulting in a more rapid reallocation of resources and, therefore, lower adjustment costs than if the relocation was prolonged.

5 A fast reform process affords better coordination in the implementation of the reforms (Stiglitz ,1999; Feltenstein and Nsouli, 2001).

The Rationale for Evolutionary Transition

While these arguments are not without merit, there are also powerful arguments for pursuing a gradual approach to change in different sectors of the economy. Such an approach would allow different markets and different sectors to adjust to policy changes and price signals at different speeds. The opposing case to the abrupt approach argues that rapid change is likely to destroy valuable institutions and organisations, while not allowing sufficient time to create the institutions and structures necessary to underpin the market economy. The importance and difficulty of creating new and effective institutions should not be underestimated (IMF, 2000; Stiglitz, 1999; World Bank, 2001).

The main arguments in favour of a gradualist or evolutionary approach to transition can be summarised as follows:

1 The emphasis on speed may destroy still valuable organisational arrangements among existing enterprises and that the resulting 'disorganisation' may contribute significantly to the collapse in output. In a number of cases, Russia in particular, badly sequenced and very rapid reforms led to vested interests becoming entrenched and blocking further reforms, as well as to very sharp falls in output (IMF, 2000).

2. The importance and difficulty of creating the institutional infrastructure needed to underpin the operation of market economies must not be underestimated. Creating effective institutions is a lengthy process requiring much trial and error, implying that reform should occur in an evolutionary manner that adapts existing institutions to new needs pragmatically and gradually. To the extent that the use of certain instruments can be incompatible with certain targets, a phased approach to reforms is needed (IMF, 2000; Feltenstein and Nsouli, 2001).

3. It is not practical to introduce many reforms at once, and each particular reform needs a period of time for implementation and consolidation. Most reforms require the accumulation of both human and physical capital, the adoption of complex legislation and the creation of an appropriate institutional framework. Gradual and successful reforms enhance credibility, while broad and drastic reforms carry the danger of overall failure if there is a problem in one area. Moreover, trying to move too fast leads to policy mistakes (Fischer and Gelb, 1991).

4. The cost of rapid changes can be too high, and can even threaten the transition process. For example, the costs of closing down inefficient and uneconomic firms include an instant destruction of much physical and human capital, as well as social costs such as the pain of sudden unemployment and the dislocation of established ways of life. The power of this argument rests on the identification of empirically relevant adjustment costs. These costs have been summarised by a number of authors as follows:

   - Firstly, workers cannot move instantly from old state-owned firms to new private ones. The best approach is to close or restructure inefficient firms as new firms emerge and can absorb laid-off workers.

   - Secondly, and more generally, there is inconsistency over time between the destructive effects on the existing system of abrupt change and emergence of market based capability and economic benefits. This time

lag between incurring the costs and realising the benefits can undermine the reform process.

- Thirdly, abrupt change results in big movements in relative prices that also affect the real exchange rate. Large fluctuations in the exchange rate create massive uncertainty and can deter investment in the traded goods sector. Phasing in reform, by contrast, allows for smaller and more predictable price changes.

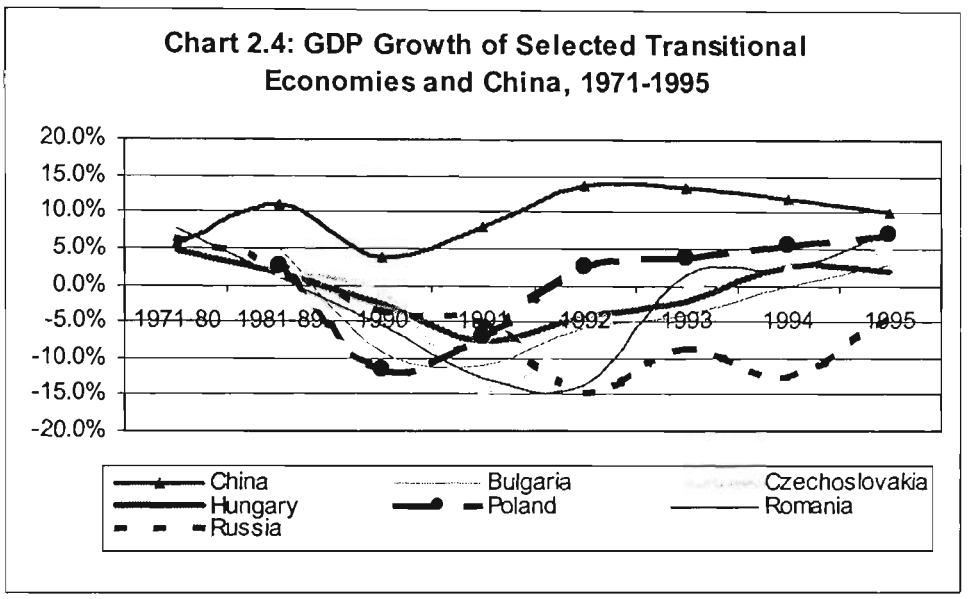
- Finally, there are possible political costs because transition involves winners and losers. Losers are likely to form coalitions that try to block aspects of a coherent transition. Proceeding step by step makes it possible to compensate each group of potential losers, at least to some degree. To the extent that the costs of adjustment can be spread out, there is likely to be more political support for a phased approach (Stiglitz, 1999).

Thus arguments of apparent merit can be mounted in favour of both abrupt and evolutionary approaches to plan to market transition. In such situations, it is appropriate to turn to the empirical record.

2.3 The Empirical Record: China and the Economies of Eastern Europe

In a recent paper, Feltenstein and Nsouli have suggested that 'in the economic literature, no consensus has emerged on whether the big-bang or the gradual approach is the superior one' (Feltenstein and Nsouli, 2001, p.3). This is consistent with our review of the arguments above. Nevertheless, the comparison between the performance of China and of many of the countries that have pursued the 'big-bang' approach is very dramatic. As is shown briefly in Table 2.1 and Charts 2.2 to 2.4, in terms of standard economic outcomes, China has performed much better than other transitional economies. This sharp difference in economic outcomes must have some relevance to the debate about transitional models.

China's reform experience appears particularly impressive when compared with the average performance of the transition economies in Eastern Europe and the former Soviet Union. Over the decade beginning in 1989, China's real GDP nearly doubled, while Russia's fell by almost half. Russia's GDP, which was more than twice that of China after the beginning of the decade, was one third smaller by the end of the decade. The ratio of real output in 1999 to its level in 1989 for China and other country groupings was as follows: Commonwealth of Independent States, 0.53; Baltic countries, 0.68; East Asia, 1.78 and China 2.52 (see Table 2.1).



Sources: Data is edited from *World Development Report 1996.*

Table 2.1 compares China's performance with that of a number of groups covering virtually all transition countries, to see the significant difference among different groups. Charts 2.2 to 2.4 are more selective, comparing China with a small number of transition countries in Eastern Europe, to get a clearer view of macroeconomic developments during the transition process, focusing on GDP growth and the rate of inflation. The outstanding feature of this diagram is the difference in output growth across these countries. Except for China, Russia and other transition economies suffered a substantial output contraction at the start of the transition. From Chart 2.4,

[2] Data for country groups are simple averages of group member data.

[3] Data include Mongolia.

the GDP growth rate of Russia is as high as 6.5%, to 1992, it dropped to a low of -14.5%; after three years fluctuation, the GDP growth rate recovered to -4% in 1995. Poland reached positive growth in 1992, Romania in 1993, Czechoslovakia and Hungary in 1994, and Bulgaria in 1995.

The surge of inflation was particularly severe in these countries. Charts 2.2 and 2.4 showed the striking change of the countries other than China. Russia's average inflation rate reached as high as 1353% in 1992, Bulgaria 333.5% in 1991, and Romania 256% in 1993.

Comparatively, China presented a different picture, starting from 5.5% of GDP growth rate in 1971-1980, which was 1% lower than Russia, it climbed to the highest point of 13.6% in 1992, which was 28.1% higher than Russia, and kept the high growth rate of 10.2% in 1995. China's inflation rate started from 3% in 1990, and reached the top point of 21.7% in 1994, which was 10 to 60 times lower than the above comparing countries, then dropped to 17% in 1995.

The reform experience of China has to some degree been undervalued in mainstream economics, it being sometimes claimed that reform was easy in China because it was a poor agricultural country. It is true that China was much less developed than Eastern Europe or the former Soviet Union at the outset of reform, but it was also challenged by many of the problems faced in those countries, such as excess industrial capacity and the attempt to use the economy to provide comprehensive welfare coverage. Furthermore, China 'faced many problems that did not exist in other transition economies, such as enormous population pressure, severe shortages of human capital and natural resources, very poor industrial and infrastructure bases' (Qian, 1999, p.377).

Two facts are clear, however. One is that China has followed a classic gradualist or evolutionary approach to plan to market transition, in sharp contrast with the abrupt transition attempted in many other countries. The other is that China's economic performance has been strikingly better, over the reform period, than virtually all other transition economies, and especially those that have attempted the 'big bang' approach. The question underlying this thesis is whether these two facts are connected

and hence whether there is something inherent in the evolutionary transition process which has contributed to China's recent growth.

2.4 Structural Innovation, Government Learning and China's Relative Performance

While it is widely accepted that China created its own transition model and succeeded not only in growing rapidly but also in creating a vibrant collective enterprises sector that was not state owned (IMF, 2000), the implications of China's experience for understanding the transition process have not been widely explored. However, Stiglitz (1999) has drawn on China's experience and Qian (2000) has provided an institutional interpretation of China's relative success.

According to Qian, China's experience illustrates the following general principles:

- First, institutional change that creates incentives, imposes hard budget constraints, and introduces competition should apply not only to firms but also to governments. Indeed, reforming government is an important component of economic reform.

- Second, successful reform depends on political support, which in turn depends on delivering tangible benefits to a large majority of the populations.

- Third, successful institutional change requires appropriate, through not necessarily optimal, sequencing.

- Fourth, one general lesson is that considerable growth is possible with sensible but imperfect institutions, mainly because some transitional institutions can be more effective than best-practice institutions for a period of time. Transition economies lack basic market-supporting institutions (such as the rule of law) and the human capital to operate them (such as law enforcement officials). Both usually take years to develop. This often means that international best-practice institutions may

not work well initially. It also means that some existing institutions can be useful to market-oriented reform before they eventually vanish.

- Unlike macroeconomic stabilisation policy, institutional change is an unavoidably long process. It is important to avoid an institutional vacuum. Existing institutions should be dismantled only after new ones are in place, or new institutions should be allowed to emerge from the old. The most important point is to avoid fatal mistakes rather then to fine tune solutions.

Qian's interpretation is consistent with the hypothesis being explored in this thesis, that the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning, both government learning and learning by other participants in the economy, in terms of innovation and institutional change. In an approach to transition emphasising strategic innovation and institutional change, the role of learning (especially government learning), and its inevitably protracted and path dependent nature, provides a reason why an evolutionary approach to transition is effective. The fact that China diverged so sharply from other transition economies both in the transition model and in economic performance provides powerful prima facie evidence that factors such as these are central to an effective transition process. The body of this thesis explores this hypothesis for the case of China, by examining the contribution of strategic innovation and institutional change, enhanced by government learning, to China's growth.

2.5 Studying Strategic Innovation and Learning in China: The Case of the Information Industries

It is not possible, however, to explore the role of strategic innovation, institutional change and government learning across the whole economy, and it is necessary to narrow the focus of study to something of manageable proportions. This is best achieved by selecting a particular sector or group of industries for a detailed case study.

China's economic transition has coincided with the rapid development, modernisation and globalisation of communications networks around the world and the diffusion of powerful new information technologies. As Mueller and Tan point out 'the increasing mobility of businesses and the relentlessly expanding powers of computers are creating a new, global information infrastructure' (Mueller and Tan, 1997, p.1). The information and communications industries are growing at twice the rate of other industries, and investment in information goods and services has become a key source of productivity improvement and economic growth (Mueller and Tan, 1997). All countries are facing challenges to implement policies that are innovative and pro-active to follow the rapid changes, as well as challenges to form an effective institutional environment in this new information age. Different countries have adopted different strategies and have pursued different ambitions.

The revolution of information infrastructure and telecommunications is institutional as well as technological. China started to realise the importance of information technologies from the 1980s, at the beginning of the period of this study. After several earlier initiatives, the Number 122 Executive Conference of the State Council stressed in 1986 the essential role of electronic information technologies in national defence and the economy, and decided that integrated circuits, computers, switches and software would be promoted as priority industries supported by 'Four Kinds of Favourable Policies.' Later, the government attention was given not only to technology development but also to institutional reforms to promote the growth of the information industry. In 1993, the State Council set the electronic industry as a national backbone industry and formed the National Economy Informatization Joint Conference in the State Council to oversee and facilitate the development of the National Economic Information Network. Later, in 1996, this Conference had been named as the State Council Informatization Leadership Group, and has been given the responsibility for policy making, development strategy and planning, major project coordination and for the setting of technological standards nationwide.

Thus the information industries are both at the heart of modern economic growth and have been the focus of government policy and institutional change in China, as in many other countries. For these reasons the information industries have been chosen as the source of case studies of strategic innovation, institutional change and

government learning in China. After further consideration of the nature of China's institutional framework in Chapter 3, Chapters 4-7 are devoted to four cases studies of the development of the information industries in China, and the overall conclusions are presented in Chapter 8.

3. The Planning System: The Heart of China's Institutional Framework, 1978-1996

Introduction

The first two chapters have emphasised the importance of strategic innovation in institutions and organisations to the economic transition from plan to market in China. To be able to track and analyse this process of strategic innovation, it is important to understand the institutional framework within which change takes place. At the heart of this institutional framework in China, even in the transition economy after 1979, is the planning system. This system has fundamentally shaped China's economy since 1949, and the organisations that manage the planning system have played important roles in the process of the transition since 1979. Thus to assess institutional change and economic growth in the period of economic transition, it is necessary to have a clear view of the nature of the planning system, how it operates and how it has changed since 1979. The central organisational player in China's planning system has been the State Planning Commission (SPC), so we trace the evolution of the Chinese planning system in terms of the changing roles of that agency.

SPC has had a direct role in the development of the information industries in China, so for that reason alone it is directly relevant to the overall topic of this thesis. But the experience of SPC also illustrates in its own right the central theme of this study. This is that the strategic innovations and institutional changes which are characteristic of the plan to market transition are essentially evolutionary in nature, in part because they imply complex learning processes within government and its agencies as well as within the non-government sector. Such a process of evolutionary change, requiring extensive learning and conditioned by broad institutional and political forces, is well illustrated by the case of SPC.

The State Planning Commission was founded in November 1952 and, over a period of nearly fifty years, the functions of the Commission have been adjusted in the light of each government restructuring. Its broad role has been to maintain overall economic balance consistent with relative price stability and to optimise the nation's economic structure to achieve sustained, rapid and sound economic development. The SPC, which has drawn up China's five-year plans, has also been known as the progenitor of red tape and official quotas, and as one of the most powerful among the State Council's agencies (Chai, 1997). Following another substantial restructuring of government agencies, the role of the SPC was further revised in March 1998, and it was renamed as the State Development Planning Commission at that time. As this thesis covers the period from 1978 to the late 1990s, the SPC will be our major concern.

To understand the direction of the Chinese information industries it was necessary, for much of the period, to study the economic planning documents, especially the five-year plans, because these documents signalled the important areas to which public investment would flow. The public sector was still the main provider of infrastructure and social services in China, although the private sector had been growing rapidly. Government and the state sector were the biggest buyers in the information market of China, and the direction of their future spending was determined by the public investment projects. Thus, major opportunities in this market were closely related to national projects proposed by the government and expressed in the five-year plans.

Thus, this chapter will review briefly the planning system in China, its framework, functions and role in relation to economic and social development. This task will be undertaken by focusing particularly on the evolution of the structure, function and role of the SPC.

3.1 The Changing Role of the State Planning Commission

3.1.1 SPC and its Functions

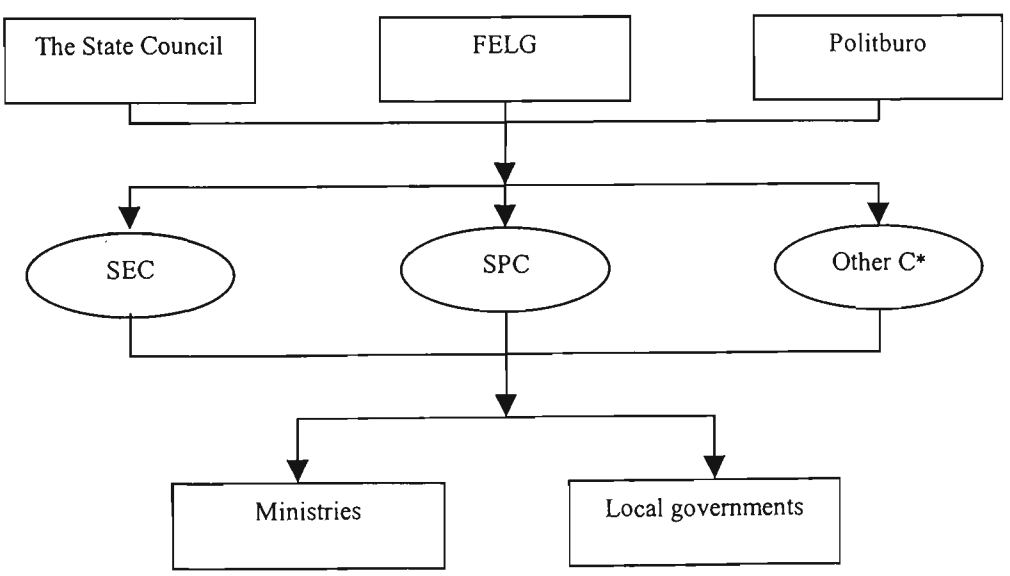
The SPC has long been an important government organisation responsible for administering national economic planning and for undertaking research on various issues that affect economic development. Altogether, in 1993, the SPC employed about 7,000 people, in three groups according to their different types of work. There were about 1,000 people engaged in planning work, which was organised into 140 divisions under 26 departments. About 4,000 people were involved in policy research, such as gathering information, forecasting, providing advice, and drawing up policy designs and so on. About 1,600 people were employed by other government organisations affiliated with the SPC. Those organisations, including the State Development Bank and the six national-level investment corporations established by the State Council, were entrusted to the SPC to manage on behalf of the State Council.

When the SPC was formed in November 1952, it was based on the central planning model of the former Soviet Union. As a result, the SPC was at this time the largest, most powerful and most comprehensive economic policy-making organisation in China. The broad scope of the SPC's functional authority has remained largely intact throughout the reform period, although efforts were made at various times to reduce its power.

In practice, the SPC was responsible for working out detailed social and economic development plans according to the development targets set out by the State Council. The most important and influential plan was the five-year plan. In the central planning period, the five-year plan controlled the distribution of national resources through economic planning and through monitoring the implementation of the plan. Under the central planning system, the distribution of national resources was highly centralised, so that the five-year plan had to cover everything from financial arrangements, social security and industry development to the disposition of human resources. Before the economic transition, the economic structure of China was largely shaped by such a centralised

economic administration system. Many would argue that highly centralised resource distribution did indeed contribute to the development of China and to the formation of the industrial structure of China in the 1950s and 1960s, when the Government's financial capacity was very low. However, the lack of economic signals and the complexity of highly centralised planning increasingly led to the misallocation of resources and to other problems. When, after 1979, economic reforms required the establishment of an efficient system for resource allocation, one thing that needed to be done was to reduce the power that the SPC had been enjoying for nearly 20 years. However, because of the unique position of the SPC in controlling economic activities, this redistribution of power as part of the reform program proved to be difficult to achieve (Zhao, 1999; Chen, 1999; Liu, 1993).

Chart 3.1: The Position of the SPC in the Authorities of China in the Period of the Seventh FYP



* Other Commissions.

The position of the SPC within the governance system in China is summarised in Chart 3.1. As a 'little State Council' and as the executive of the Central Finance and Economics

Leading Group[1] (FELG), the SPC was required to respond to the reform requests of different parties, and to balance the interests of different ministries and provinces, in the process of economic planning. Thus, the SPC was in a strong position to influence reform outcomes and to protect its own position.

3.1.2 The Changing Role of the SPC

During the economic reform period, the planning system has been undergoing considerable change. The changing system required the players to reshape their roles accordingly. What role the SPC should play, and how it should respond to the requirement for undertaking government learning to drive institutional change, were important issues in the transition stage. There were two significant functional challenges to be addressed. The first was to reshape the structure and operations of government by government organisational reform, while the second was to shift from detailed micro economic intervention in the operations of agencies and enterprises to influencing outcomes and controlling their operations by indirect macro economic management.

The essence of economic structural reform was precisely to reduce the concentration of authority at the centre, that is, to weaken the planning system and the authority of the SPC. In 1986, for example, the SPC issued documents reducing mandatory quotas in the state plan from over one hundred to around sixty. Reducing the mandatory quotas gave localities and enterprises more autonomy, benefited the overall economic structural reform, and helped open and enliven the national economy.

Nevertheless, the SPC continued to exert great control over the economy throughout the 1980s. The primary planned quotas that affected the essentials of the national economy continued to be implemented through mandatory planning and were accompanied by direct administrative interference in the economy. The power to distribute natural resources, electric power, steel, lumber, cement, nonferrous metals, grain, cotton and

[1] Central Finance and Economics Leading Group, is the highest economic policy organ. It is a joint organ of the Politburo of the Communist Party and the State Council, and generally has between five and seven members. Its main responsibilities are entrusted to the SPC.

other essential products remained in the hands of the SPC. Moreover, central finances, central capital construction investment, and credit and monetary powers continued to be under the control of the SPC. Nearly one thousand major construction projects in every sector of the economy continued to be directly controlled by the SPC.

Organisational Change

The Chinese government has been handling organisational reform as an important part of, and a long-term task of, administrative reform for many decades. Since the foundation of the People's Republic of China, government organisations have been restructured and reduced in size many times (see Table 3.1). The principle of doing this was based on the view that administrative efficiency was to be achieved by the rationalisation of administrative structure and a reduction in the number of government bodies. The result was that, as shown in Table 3.1, each restructure reduced the number of central government organisations significantly, but their number soon increased again. There were two large-scale government organisational restructures over the 1979 to 1996 period: one was in 1982, and the other was in 1988. The significant point was that, in spite of the general thrust towards decentralisation, both organisational reforms stressed the need to strengthen the central organisations in charge of complex economic issues, such as the SPC. Thus, the SPC's position in economic and social development was not weakened by the reforms. In addition, each organisational reform reinforced the SPC's position at the top of the economic administration. In fact, the SPC benefited in some ways from both of these organisational reforms. In 1982, the number of central government organisations directly under the State Council was greatly reduced from 100 to 61, and in 1988, the reduction was from 72 to 65. The recent reform in 1998, reduced the number of central government organisations from 40 to 29, it is the least in terms of number of central government organisations in the history of People's Republic of China. In addition, it was a new circle of government organisation reform (Liu, 1998). Unlike the past three attempts, the recent restructuring has some distinct features. It is aimed at changing the way government operates while separating it from the management of state-owned enterprises. Government functions will shift to macro-control, social management

and public service. The management of production will return to the state-owned enterprises (Chen, 1998).

Table 3.1: China's Government Organisational Reforms from 1949 to 1997

Circle of restructuring	Organisational reform	Restructuring time	Number of organisations under the State Council
First round		1949	35
	First	1952-1953	42
		1954	64
		1955-1956	81
	Second	1958-1959	60
Second round	Third	1960-1965	79
		1970@	32
Third round		1971-1975	52
		1976-1978	76
		1979-1981	100
	Fourth	1982	61
Fourth round		1983-1984	65
		1985-1986	72
	Fifth	1988	65
		1989 - 1993	86
	Sixth	1993	59
New round	Seven	1998	29

Note: In 1970, there were 32 organisations under the State Council, 13 of them supervised by military and Central Group of Central Revolution, so the real number of organisations under the State Council was 19.
Sources: Data edited from '*The Seventh Revolution 1998 China's Government Organisational Reform Memo*' p.290 to 309; edited by Liu Zhi feng, published by Economic Newspaper Publication House (Jingji Ribao Chubanshe), 1998.

The significance of these two keys reforms for the functions of the SPC can be seen by examining changes in the statements of SPC functions provided by the State Council at various times. The functions of the SPC as specified by the State Council in the spring of 1983 are summarised in Box 3.1. Although this was an effort to define and limit the power of the SPC, it still remained an extremely large and powerful organisation in the state planning system. Furthermore, although this was four years after the launching of the economic reform process in 1979, the functions defined by the State Council were still predominantly of a central planning nature. That is, the emphasis was still primarily on formulating aggregate plans and their counterparts by industry, and on directing, controlling and regulating economic activities to give effect to those plans.

In December 1987 a proposal to reform government administration was prepared by the State Council, and was approved by the National People's Congress at the First Session of its Seventh Conference on 9 April 1988. This reform was to reconcile the functions of government agencies, reduce the number and size of government agencies, improve the efficiency of, and manage the relationships between, government and enterprises, among ministries, and between central government and local governments. The focus of the reform was to accelerate the change in management approach away from direct economic management and control, with the economic agencies paying more attention to indirect management and to management at a more macro level.

In particular, the State Council proposal approved in April 1988 placed emphasis on the following points:

(1) To make government agencies concentrate more on policy development, and to allow firms to have more autonomy in relation to their production activities, the proposal was designed to separate government management from their previous involvement in firms' activities. The principle was that government agencies should give up the function of direct supervision of firms, such as directly arranging capital and operating funds and the provision of materials used in the production.

(2) To enhance indirect management functions, the following areas were designated for further strengthening:

- the process of decision making should be enforced by a scientifically systematic monitoring system, which had not been sufficiently established due to the practice of hands-on supervision of the firms and projects;

- central government agencies should provide consulting services to industries and local governments on economic development and policy issues;

- industrial policies and local development policies should be readjusted in accordance with national development policy;

- there was an urgent need to establish a data and information feedback system, so as to better understand and monitor industrial and local development; and

- an information channel needed to be created to feed industries and local governments with information on national policy intentions, market information on technology and product development, and guidance for regional and industrial development.

Functional changes

The economic plans usually expressed the major objectives of socio-economic development and specified industrial policies and investment sources. The state economic plan and economic policy were closely related, and they were always formulated at the same time. For instance, in 1979 the state plan emphasised the development of the electronics industry, and the targeted growth rate of the industry in the period of the sixth five-year plan was 20% to 25%. In order to reach this goal, as the SPC was drawing up the plan it also formulated the economic policies that were essential, in its view, to its realisation.

Policy and sector or project specific plans were key characteristics of the national plan formulated and implemented by SPC. In the 1980s, economic restructuring relied heavily on the priority sector development policies. The development strategy during different five-year plans was to give priority to various industrial sectors, such as the production of raw materials, energy and so on. Preferential policies were also given to major manufacturing sectors. In the 1990s there was a shift in policies fostering economic structure change from policies supporting preferred sectors to policies supporting preferred projects, indicating a strategic movement of policy orientation from the sector approach to the project approach. The major concept behind the revised

Box 3.1: The Functions of SPC (1983)

- Formulating long-term (ten years or longer), medium-term (five years), and short-term (one year) national economic and social development plans.
- Determining the target rate of national economic growth.
- Setting major economic and technological policies.
- Regulating public finances, bank credit, materials, import and export.
- Maintaining a balance between the amount of commodities and the size of the labour force.
- Approving and evaluating major capital construction projects.
- Overseeing the construction and distribution of national defence industries..
- Determining development plans for industry, agriculture, communications, transportation, science and technology, culture and education, sports and sanitation, commercial foreign trade, import of technology use of foreign funds, population, and so forth.
- Formulating price policy.
- Distributing the state's fiscal funds and materials.
- Participating in the work of economic structural reform.
- Managing overall distribution of the nation's personnel, material resources, and fiscal resources.

Source: Edited from *China, Modernisation and the Goal of Prosperity - Government Administration and Economic Policy in the late 1980s,* Kate Hannan (Edited), (1995) Cambridge University Press.

development strategy was 'project', contrary to the previous concept of 'sector'. For example, the content of the new policy for structural change in the electronic industries involved a reorientation toward an export-oriented development: exports were considered a major factor in accelerating development. Support was offered for specific programs and projects, which should then be evaluated through investment criteria in order to ensure social and entrepreneurial economic efficiency. The best projects would be chosen accordingly. The project approach assumed that projects were available in sufficient number and quality, so that all that was needed was to select the best ones, with the criteria at hand, and put them into practice. The policies of structural adjustment were

intended to encompass and bind together short-term economic policies and longer-term development policies.

The main routine duties of the SPC in the 1980s and early 1990s were in dealing with the approval and evaluation of specific projects. Since the SPC would go through the budget and technical details for each project, the project approval process was very long, and this attracted a lot of criticism from the public. The complicated procedure for a project approval process in the SPC - it was common for a project approval process to take three to six months - was criticised for its low efficiency. It was common that when a company started to plan a project, the product was at the beginning of the product life cycle, but after a long approval process, the product was already at the mature stage of the cycle. Such a hands-on control and inefficient system clearly needed to be changed. Instead of intervening in particular projects in detail, the SPC needed to readjust its role in economic development to conduct more research, make efficient economic policies, release industry information, form long-term industry and social development plans, and so on.

Management at the macro rather than the detailed level was a new task for the Chinese government and it required a great deal of practice and learning to make it work. It needed practical experience and knowledge of economic management, efficient information channels, and reliable and systematic statistical data. A sound understanding of macro management instruments was also critical, so that they could be applied efficiently to the economic system of China. This was a new mission for the SPC, and it brought about pressure not only on its internal operating systems but also on the individuals who worked in the system. Because they were facing new tasks, staff members needed to upgrade their knowledge and capabilities. In reality, this upgrading was difficult, as there was no clear definition of the required knowledge and capabilities and there were limited information channels available.

The reform required not only thoroughly new ideas at the top but also a totally different daily pattern of responsibility through the whole operating system. An effective indirect

control system, however, needed to be built upon a sound and comprehensive monitoring and regulation system, which unfortunately were not in place in the early stages of reform. Thus to operate the new system was a challenge in terms of the way that the economic administration operated and the way that individuals ran the system (Liu, 1991; Gui, 1991; Wei, 1991). There was a difficult learning task of how to use indirect tools to adjust economic behaviour to be performed during the period (SPC, 1989).

In order to meet the reform requirements, a functional conversion of the SPC was planned (Liu, 1998). One of the important tasks in reshaping the SPC's daily functions was to intensify macro management and to learn to use economic levers to monitor the development of the economy in the period of the Seventh FYP. Switching to macro management meant that the SPC would shift its function from management focused on micro matters (particular projects), which the SPC was mostly interested in and which made the SPC very powerful, to management focused on macro matters. The new functions of the SPC were changed accordingly in 1988, to those summarised in Box 3.2.

At the level of function, at least, the changes were substantial. There were three main characteristics of the functional changes. Firstly, the SPC kept its essential function of setting up strategic targets for national economic and social development and drawing up long-term, medium-term and annual plans. Thus the preparation and implementation of five-year plans, for example, remained at the heart of the Chinese economic policy process. Secondly, the reform proposal stressed:

- analysis at the broad economic level and in terms of economic returns, to support the use of policy instruments, such as market prices, tax, credit, interest rates, exchange rates and wages, to regulate the development of China's national economy;

- enforcing, guiding, overseeing and inspecting the enforcement of plans, rather than directly controlling the implementation of those plans; and

- emphasising science and technology development and social development policies.

Thus, in formulating and implementing plans and in managing the national economy, priority was to be given where possible to the use of broad policy instruments rather than to detailed control, and increased emphasis should be given to the role of science and technology and to the social implications of policy. Thirdly, the function statement included a number of new functions for the SPC: promoting conservation through rational utilisation of natural resources, promoting economic reform policies and promoting the establishment of economic and technological legislation.

It is one thing, of course, to issue a new functional statement for an agency and quite another to bring about the changes in attitudes and in operational practices implicit in the new set of functions. As will be discussed briefly in Section 3.3 below, there is evidence that these changes were resisted to some degree in the SPC. Nevertheless, after the 1988 reforms the next process of administrative reform that had a major impact on the role of the SPC did not take place until 1998. Thus for the time period being used for this study (1979-1996) the relevant planning process was that driven by the 1983 and 1988 functional statements, and by the extent of their implementation in practice. It will be useful to look at the operation of this planning system in more detail, in the next section.

A typical perception of the SPC was that it was able to distort various situations for maintaining its own power or to oppose reform in the name of restoring economic order, particularly when economic reform had an adverse effect on the planned economy (Wang and Fewsmith, 1995). In some cases, this appearance was generated because of the particular position that SPC held. As new ideas had to be practical to be blended in the whole economic system, some reform proposals were deemed to be not workable when taken as a part of an overall policy approach, or when tested in practice. From the SPC's

Box 3.2: The Functions of the SPC (1988)

- To set out strategic targets for national economic and social development; to draw up long-term, medium-term and annual plans; and to ensure a balance between overall demand and supply, including a balance between finance, credit, materials, foreign exchange, market and labour force.
- To study and analyse major macro-economic management issues such as imbalance between national distribution, accumulation and consumption.
- To use economic levers - price, tax, credit, interest rates, exchange rates and wages for regulation of the national economy.
- Guiding the planning work undertaken by departments and localities and overseeing inspection and supervision and enforcement of plans and inspecting production and key construction projects.
- Analysing economic returns.
- Compiling relevant policies and measures for the medium- and long-term development of science and technology, including promotion of technological progress through assimilation of imported technologies and through production of Chinese-made parts and spare parts.
- Analysing the policies concerning social development in areas such as population, labour, culture, education, public health and social security and insurance.
- Promoting conservation through rational utilisation of natural resources. *
- Promoting economic reform policy, including promotion of the fund system for capital construction, overseeing the work of special investment companies, and supervising and inspecting bidding activity and the submission of tenders for major fixed asset construction projects. *
- Promoting the establishment of economic and technological legislation. *

Source: Edited from the book *China, Modernisation and the Goal of Prosperity-Government Administration and Economic Policy in the Late 1980s,* Kate Hannan (Edited), (1995) Cambridge University Press.
* New functions.

point of view, a new idea might be viable in an academic sense or be mature in theory, or work well in certain individual contexts, but they might not be suitable for application to

China as a whole, or for application at a particular time. Many predictable and unpredictable factors could impact on the outcomes from implementing a new idea. These could include technically incorrect operations, due to lack of proper training and experience of the staff, or mismatches between the new idea and other existing policies. Such considerations often led to negative responses from the SPC, which made it appear to be a conservative force in relation to reforms. While the SPC performed this role within the reform processes, it was likely to gain a reputation as a more conservative force than it actually was, but it was also possible for it to use situations to maintain or strengthen its position.

In fact, the SPC was able to take advantage of particular periods of economic overheating to reassert its tight planning indicator control over the economy. Although the essence of economic structural reform was to reduce the concentration of power at the central government level, which really meant, at the national economic administrative level, to weaken the central planning system and authority of the SPC, its supervisory role was in deed enhanced through a number of episodes. In the 1980s, there were two periods of economic overheating, the first one was from the latter part of 1984 to 1986 and the second one was from 1988 to mid-1989. From 1986 to1988, the growth rate of GDP was 10.1%, which was 2.6 percentage points higher than planned rate. The growth rate of annual national income was 9.7%, which was 3 percentage points higher than planned rate. The rate of annual fixed assets investment was 20.2%, which was 17.2 points higher than planned rate (NBS, 1991). In the first period, the scale of capital construction greatly exceeded the investment scale that was set by the national plan. Local governments and enterprises benefited greatly from decentralisation in the area of investment, and used this new freedom to construct a number of 'out of plan investment projects.' Some used bank loans to invest in such projects. This surge in investment lifted the prices of major raw materials greatly. In order to control the situation, China began to carry out readjustment policies in 1989. As part of the readjustment program, an investment system reform was pushed forward, which largely demonstrated that the progress of the SPC reform was pushed ahead further.

In the second period, the main features of the overheating duplicated those of the first period. The central government was widely criticised for not playing a significant role in handling the disorder. The government's intention of adjustment of the economy needed measures that were more powerful. So the SPC was expected again to embody top authorities wishes (Gui, 1991). 'They have sought to reinvent themselves as guardians of the public interest and agents of a national industrial policy, based on their interpretation of Japanese and Korean experience' (Naughton, 1996, p.132). One of the endeavours to embody the intention of adjustment was to test the power of policy instruments, that was to test whether a particular intention of central government could be effectively carried out nationally. After a few trials, the initiative of the test was developed as part of 'Industry Policy[2]' later.

Overall, and in spite of the effect of these episodes, as the reforms proceeded in all aspects of the economy after 1985, the SPC's traditional position met increasingly greater challenges, of which two were the most important. The first was the challenge, described above, to redesign the main functions of the SPC. Above all, this involved shifting the daily routine work from mainly micro management, such as detailed project planning and approval, to mainly macro management. The second was the challenge to respond properly to the reform calls from inside and outside the SPC. Here, the reforms of the investment system and of the planning system reform were the keys to facilitating the broader functional changes.

[2] Industry Policy refers specifically to the policy issued by the State Council in 1989. The policy covered the period of 1989-1991 (Department of Industry Policy of SPC, *Industry Policy Manual,* Economic Management Publishing House, 1989, Beijing, p.1)

3.2 The Planning System in Operation

The changing role and functions of the SPC are, as noted earlier, of interest in this study both because SPC was the central player in the planning system within which the information industries developed, and also because the SPC itself embodies our central theme of the role of learning in evolutionary processes of institutional innovation. To study the information industries in more detail, it will be useful to have a more detailed understanding of how the planning system actually operated. The functions of the SPC manifested the centralised and unified characteristics of the economic planing system of China. The following discussion covers three main matters over the period in this study: the main agents involved in the planning process (3.2.1), the various types of plan employed (3.2.2) and the process for plan and project approval (3.2.3).

3.2.1 Administrative Planning Agencies

The planning system covered all the country, and administrative planning agencies were built up from local governments to central governments (Chart 3.2). The SPC supervised the business of local planning commissions (PC), and the local government appointed leaders of its local PC, thus local PCs were responsible to local governments.

The most important decision-making forum within the SPC was the Chairman's Conference. Participants included the chairman, the vice chairmen of the SPC, the general directors of departments and related economic and technical specialists within or outside the SPC. Generally, the conferences were called to:

- discuss and decide on important issues in the formulation and implementation of a particular plan;
- discuss and approve draft reports and documents which were to be submitted by a department of the SPC to the Central Finance and Economics Leading Group and the State Council;

- discuss and approve investment plans which were submitted by the department of the SPC responsible for fixed asset investment and for important national capital construction projects; and

- transmit downward the directives of the highest leaders and formulate ways of implementing them (Hannan, 1995).

The main participants in the planning process, the administrative planning agencies, are noted briefly below:

(1) The SPC: as discussed earlier, its brief was to manage the national economy and to oversee social development. Its main duty was to lead the overall planning process, specifically in terms of macro management. The SPC supervised the work of the subordinate planning commissions in other ministries, the provinces, municipalities, and autonomous regions throughout the country. Thus, the SPC formed the hinge that controls the network of the entire nation's economic operation.

(2) Apart from the SPC, planning departments were established in various ministries, commissions and bureaus that were under the direct administration of the State Council.

(3) Provincial Planning Commissions (see Box 3.3).

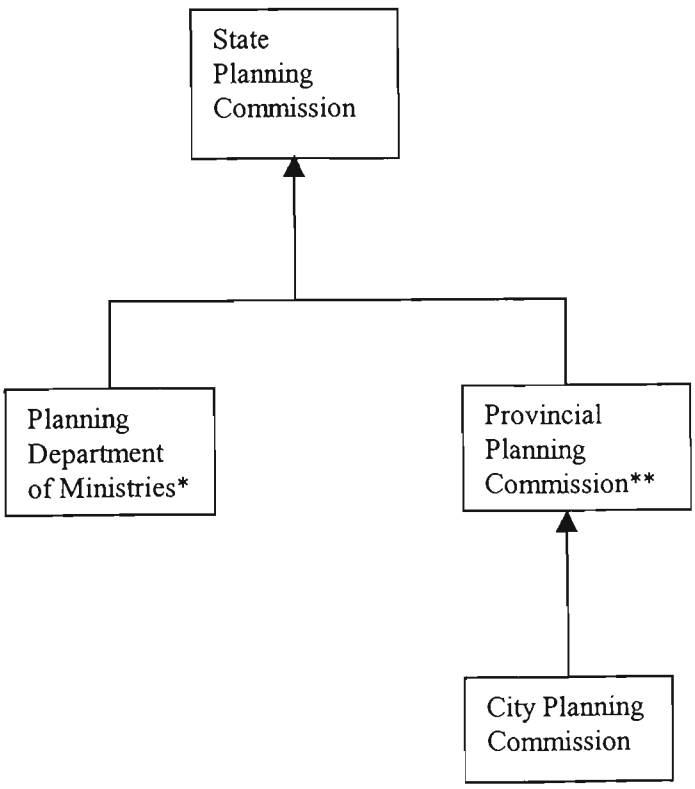
(4) Local planning agencies: the major functions of local planning agents were to investigate and study the economic and social development of their own situation and to make suggestions for making full use of local advantages.

Box 3.3: The Functions of Provincial Planning Commission (PPC)

- To study development and important and economic and technological policies for departments under their jurisdiction.
- On the basis of investigations and studies carried out and on the premise of overall economic balance, work out draft plans for departments under their jurisdiction.
- To examine the implementation of department plans.
- To study and improve their own planning work; to train planner for their own departments.

Source: Edited from the book *China, Modernisation and the Goal of Prosperity - Government Administration and Economic Policy in the late 1980s,* Kate Hannan (ed.), (1995) Cambridge University Press.

Chart 3.2 Administrative Planning Agencies



* Including various Ministries, Commissions and Bureaus under the State Council.
** Including provinces, municipalities, and autonomous regions through out the country.

The SPC oversaw the work of the various economic ministries with which it had a 'professional leadership relationship'. Thus, each specialised division in the SPC directly interacted with a counterpart specialised ministry or subordinate bureau of the State Council. For instance, the Electronic Division of the Machinery, Electronic, Light and Textile Department of the SPC interacts with the Ministry of Electronic Industry; the Post, Telecommunication and Civil Aviation Division of the Communications Department with the Ministry of Post and Telecommunication, and General Administration of Civil Aviation of China. In the interaction between, for example, the Electronic Division of SPC and the Ministry of Electronic Industry, each party had considerable independent influence, but ultimately the major initiatives of the Ministry in terms of the Ministry plans for the electronic industry required the approval of SPC.

The SPC claimed that its work was for the national interest, but individual ministries often had strong ministerial views, as did the provincial governments. Thus, it was quite common that, when an issue involved different ministries or provinces, the SPC played a role as a coordinator and referee, to coordinate the outcome in a way, which balanced the different interests.

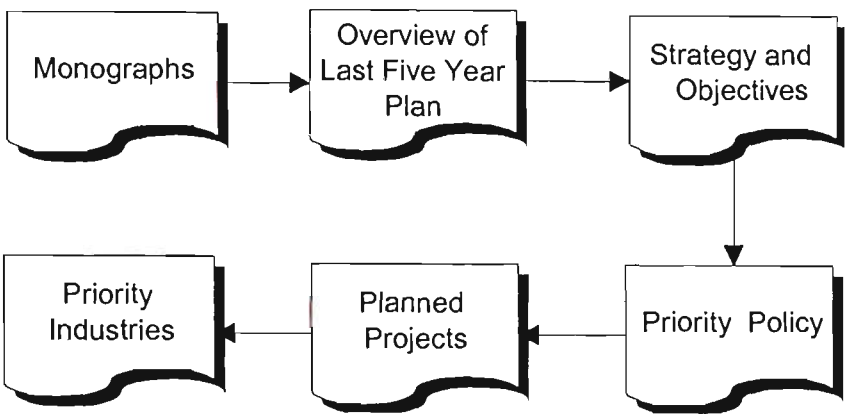
3.2.2 The Planning Categories

Long-term plans: comprehensive plans that are used for plotting economic and social development, and solving important problems. It covered a period of over ten years. The strategic targets and priorities were set as the basis of industrial policy and the distribution of the national resources. It was also vital for the direction of science and technology development and for the planned use of natural resources. A specific long-term plan for S&T that has been formulated is the outline of the Long-Term Plan for the Development of Science and Technology up to the Year 2000.

Medium-term plans: covered a period of five years and was instrumental in setting the speed of growth, regulating proportions within the national economy; specifying demand for improved economic returns; arranging key fixed asset construction projects;

promoting of scientific and technical results; and for stipulating the growth rate for people's living standards. The framework of the Five-Year Plans is summarised as Chart 3.3:

Chart 3.3 Framework of Five Year Plan



Short-term plans: covered one year and were more specific than medium-term plans. They set the output level of principal industrial and agricultural production for the year, stipulated measures for increasing economic returns and sought a balance between finance, credit, foreign exchange, materials, markets and available work force (Hannan, 1994).

Special plans: were plans formulated for a special purpose, such as critical technologies to national security and/or national economic development. Generally, they attracted heavy attention and intensive investment of work force and finance from central government. They could be draw at anytime, and as soon as they were ready, they would be incorporated into the following five-year plan.

Mandatory plans: were must do plans made by the SPC for State-owned companies. They were the principle method of planning management. The content of mandatory plans was about production and distribution of critical material for production and

consumption purposes. The major materials the plan needed and the sale of the products were generally arranged by top management agents to ensure material supply, production and sale connected smoothly. The product prices were in the mandatory plans made by the government.

Guidance plans: were one of the important tools for undertaking planning management. They were not enforced plans but required companies, which undertook these plans to follow the direction of the plan. The plan implementing units could adjust the plan according to their circumstances, the materials of the plan needed and sale of the products partly arranged by government, partly arranged by companies through the market. The prices of the guidance plan products generally were partly based on government prices, and partly based on market prices.

Integrate balance: was to harmonise total social reproduction in a certain period. The principle of integrate balance was reasonable distribution of the social work force, materials and finance to ensure a balance between social production and social requirement. It was a principle method for making national economic and social development plans (SPC, 1989).

3.2.3 Plan Formulation and Approval

The SPC approval was required for all projects that received funding and allocations of materials from the central government, and the PPC approvals were required for provincial projects above specified limits.

Projects approved by the SPC were included in the mandatory investment plan, which formed the basis for the mandatory credit plan. At the state level, the SPC decided which bank was going to finance which project as part of the mandatory credit plan. The fact that investments were switched to finance via bank loans tended to obscure the source and nature of these commitments. The SPC made up the guidance plan for very large important projects, and according to the plan, the banks allocated loans for the projects.

Plan Formulation Procedures for formulating plans: the procedures for plan formulation can be roughly divided into four stages (see Chart 3.4):

- The first stage consisted of submitting suggestions to higher authorities. All ministries under the State Council and all provinces, autonomous regions and municipalities directly under the jurisdiction of the central government submitted their planning suggestions in terms of investment scale and projects to the SPC.

- The second stage was that of transmitting controlled figures to lower levels. Based on the plans of various departments, provinces, autonomous regions and municipalities directly under the jurisdiction of the central government cities, the SPC investigated and studied, collected information and expert opinion and then made predictions and attempts to attain an overall balance between economic, scientific, technological and social development. It then presented these predictions in the form of the controlled figures. Controlled figures contained two parts: literal directives and controlled targets. It contained such important information as analyses of the national economic situation, tasks for economic, scientific, technological, and social development, major economic and technical policies and measures to be adopted and important planned targets.

- The third stage in formulating a draft plan was to submit sub-authorities plans upward to the National People's Congress for examination. Those sub-authorities normally include ministries under the State Council, local governments, such as governments of provinces, autonomous regions, and municipalities directly under the jurisdiction of the central government. The process was as follows: firstly, the ministries and local governments

formulated their draft plans; then, the SPC collected all of them to make an overall balance and to formulate a draft plan for the nation's economic and social development.

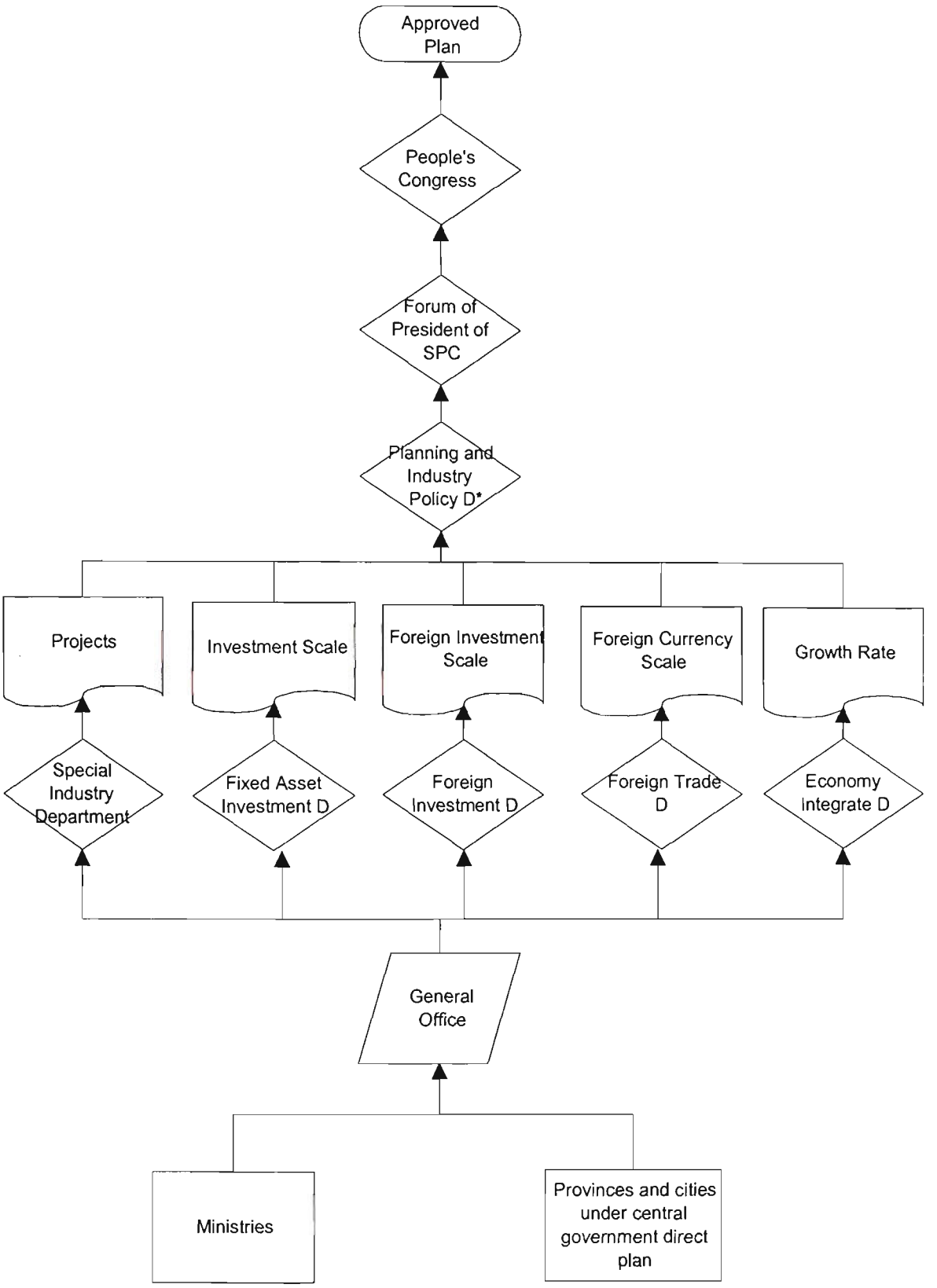
- The forth stage consisted of transmitting formal plans downward again. After approval of the National People's Congress, the draft plan was transmitted as a formal national economic and social development plan.

The process of formulating and implementing the long-term, medium-term, and short-term national plans for economic and social development plans was closely linked with both policy-making and the bargaining process between the central government and local government and/or ministries.

Planning indicators and targets: were key parts of the plan to show quantitative targets; to distribute the plan from level to level, from central governments to local governments; and to assess the plan. China's planning indicators could be divided into the following types:

- Quantitative and Efficiency Indicators: Quantitative indicators were targets that reflected the scale of national economic development. They mainly covered gross industrial and agricultural output value, national income, GNP, output of industrial and agricultural production and investment in fixed assets. Efficiency indicators were targets that reflected production and management levels and economic return. They covered productivity, rate of cost reduction, utilisation rate of equipment, utilisation rate of fixed assets, duration of construction and investment in terms of recouping cycles.

Chart 3.4: The Planning Formulation



* D: Department.

- Product Indicators: Used measurement units such as weight, capacity, length and number of units.

- Financial Indicators: Included wage, profit, financial revenue and expenditure, income and credit payments. A value index could be calculated according to constant prices used for comparison information and for analysing different periods, and it could be calculated according to current prices. The latter was used when seeking information on changes in their magnitude of value of commodities and for comparison during the same period.

- Decomposition of Planned Indicators: were transmitted level by level, from the SPC to the PPC then to the Local Planning Commissions, or from the SPC to ministries/companies directly under the SPC. They were the basis for assessing the sub-level plan implementation.

Conclusion

This review of the operations of the Chinese planning system and the changing role of the SPC provides evidence for three main conclusions. First, throughout the period under study, and in spite of the developing pace of market-oriented reform, the planning system remained a fundamental institution within the Chinese economic system. As a result, it was a central factor conditioning the development of the information industries over that time. In spite of many organisational reforms since the establishment of the People's Republic of China, in the late 1990s the SPC was still in a position to oversee economic development. Nevertheless, given the extent to which the Chinese Government sought to restructure its government organisations to ensure the policy switch smoothly, the changes in the role and functions of the SPC are indicators of the economic transition of China.

Secondly, the history of the position and function of the SPC over the period demonstrates the essentially evolutionary nature of institutional change. Powerful forces operated to protect vested interests and to require effective change to be achieved by perseverance over an extended period of time. Thirdly, this history also illustrates the crucial role of learning in strategic institutional innovation. At many points in the evolution of the SPC, individuals in both leadership and support roles had to learn how to pursue new goals in new ways, and to acquire new skills and capabilities to do so. The most important example of this was the requirement to shift from detailed programs and project approval processes at the micro level to the achievement of planning and broader economic objectives through more strategic tools and management processes.

The five years plan is the most important plan in the social and economic development of China. Starting from 1950 (see Table 3.2), the objectives of each five-year plan reflected the reform requirements of the time, so, it is significant to see the policy changes in the five-year periods. This thesis selects four cases to present institutional changes, policy development, and government learning in China's information industry during 1979-1996 by five year plan period. The first case presented in Chapter 4, emphasises initiatives of institutional transformation in the electronic industry by consumer electronic products mainly based on the 6^{th} five year-plan. The second case, showed in Chapter 5, demonstrates innovation in economic institutions and the microelectronics industry in the 7^{th} five-year plan. The third case, Chapter 6, explains how competitive advantage of the industry had been built by examining the computer and switch industry and the last case discussed in Chapter 7, focuses on the deregulation process of the telecommunications sector in the 7^{th} five-year plan.

The objective of industries varied by the five-year plan period, therefore, the assessments for the practice of each period at the end of these chapters (4-7) make the study have a comparative parameter.

Table 3.2 Five - Year Plan and Planning Period

Five-Year Plan	Period
Starting medium term plan	1950-1952
First FYP	1953-1957
Second FYP	1958-1962
Three-year difficult time	1963-1965
Third FYP	1966-1970
Fourth FYP	1971-1975
Fifth FYP	1976-1980
Sixth FYP	1981-1985
Seventh FYP	1986-1990
Eighth FYP	1991-1995

Source: China Statistical Yearbook on Investment in Fixed Assets (1950-1995), Department of Fixed Assets Investment, Bureau of State Statistic, 1997, China Statistic Publishing House, Beijing, p182.

4. The Emergence of the Consumer Electronics Industry, 1979-1985

Introduction

The year 1978 was an important turning point for the People's Republic of China. At the end of this year, the Third Plenum of the Eleventh Congress of the Chinese Communist Party decided to undertake major economic reforms. It was the fundamental strategic innovation in the history of the PRC that created a new era and marked the beginning of the economic transition from plan to market in China.

Since then, China has been seeking a way to change the basic elements of its previous policies, economic structure, social and political culture. It questioned almost everything that went before in the reform era. The leaders and people have been in search of creating new forms of political authority, economic activity, social organisation, and cultural expression that have no precedent in China. Ongoing government learning is required to facilitate these fundamental changes.

The electronics industry in China, without doubt, experienced vital challenges as a result of the transition. There are two key policy innovations that were undertaken in the industry in this period: the choice of consumer electronics and the reorientation of the electronics industry from serving military purposes to being a consumer focused industry. At this early stage of the economic transition, the immediate impact on the electronics industry was the sharp drop in government orders for military products. In 1978, 70 per cent of the output of the electronics industry was military products; the decline in government orders meant that the military companies had a huge excess of production capacity. On the other hand, the transition brought increased demand for consumer electronic products, which created an opportunity for the military companies. These strategic innovations required government officials to learn how to develop a market-

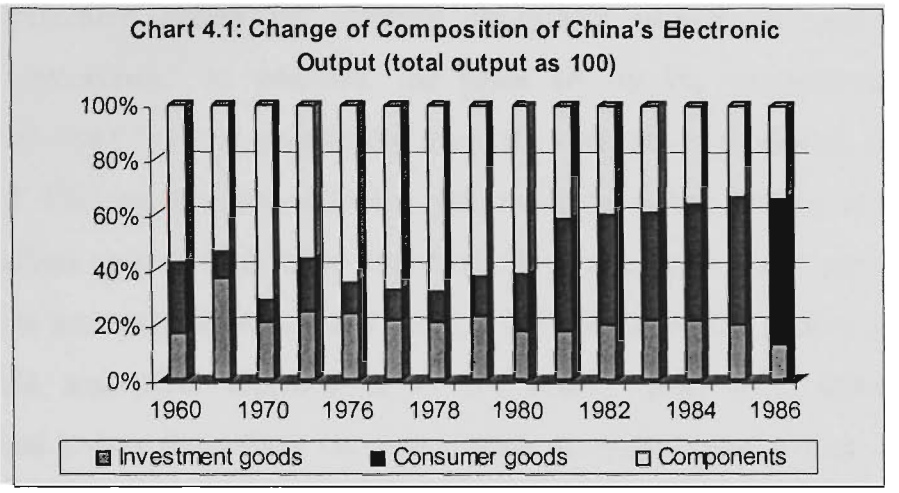
oriented consumer industry, to put forward new policies and to foster institutional change.

In the past 20 years, consumer electronics has experienced rapid growth and technological change around the world. China learnt, from Japan and other countries, that consumer electronics is a generator of wealth, jobs, exports, and technology. The policy decisions that identified consumer electronics as a growth point for the electronics industry in this early stage also built the foundation for the industry's further growth.

This chapter will start with the re-orientation of the military companies, then discuss policy considerations focused on building the competitive capacity of China's electronic industry, such as through importing technology and key equipment to build domestic capacity and to promote exports. Special attention is given to the production of television, because of its unique position in the early development of the electronics industry of China. TV production accounted for 45% of the electronics industry gross output during 1984-1985. In this chapter, the discussions will be focused on the evolution of policy, on learning factors in the policy making process, and on the impact of the policies and actions of the Central Government.

4.1 Surviving Military Oriented Companies

The electronics industry of China produced a high percentage of electronic components in its total output (see Chart 4.1). From 1960 to 1978, the share of components in total output stood between 57.4% and 67.2%. In 1978, consumer electronic products accounted for 11.3%, and investment products accounted for 21.5%, of total output respectively. The components and parts produced at this time were low-end, low quality and high priced compared to imported goods (Yu, 1986). This situation was the initial condition of the electronic industry of China in the pre-transition period. However, as the chart also shows, by 1986 consumer goods provided over 50% of total industry output.



Source: edited from *China Electronic Industry Yearly Book,* Beijing, Electronic Industry Publishing House (1987).

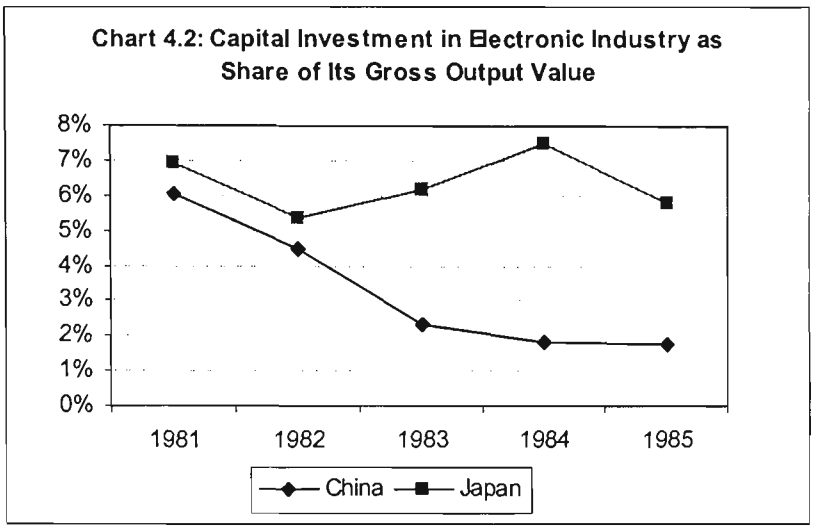
The transition from plan to market in the electronics industry started by reorienting military companies to serve civilian purposes in the early reform period. The prime drive behind the conversion of these military companies was political, and was closely linked to economic and strategic factors. In peacetime, the demand for weaponry was dropping. In China, based on the judgment of the international peacetime environment and the truce in the cold war, the Chinese government switched its development strategy from building a strong defence sector to pursuing overall economic growth. Therefore, the military companies in China, particular in the electronics industry, had to take steps to reorientate their production.

Such reorientation from military to civilian production was both an opportunity and a challenge to the electronics industry. The shock and pain from the reorientation pushed the companies into uncertainty. The critical problem for these companies was the lack of a sense and tradition of cost efficiency. They were used to receiving orders from government, to do whatever government wanted them to do at whatever price was set. This insensitivity to the market need for cost efficiency was a real obstacle to the reorientation of their functions.

The increased financial stringency was also vital to the military oriented companies. The drop in government orders for military equipment brought a reduction in direct government investment. In addition, the price set by the government for military equipment had been too low, so that the more the enterprises produced, the more losses they incurred. This was because military equipment prices had always been calculated to cover production costs, which were based on the low input product prices fixed in the plan, plus five per cent profit (Lu and Tang, 1997). Because the quality and quantity of raw materials and parts supplied under the central plan were unsatisfactory, the companies had to buy them from the free market at much higher prices. This generated serious losses arising from the process of materials acquisition.

The restructuring of the market in terms of the shares of the three kinds of electronic products[1] in total output (Chart 4.1), created a market opportunity for these companies. Starting from the Sixth FYP, more attention was paid to adjusting the structure of electronic products and more emphasis was given to the consumer electronic products. The military oriented companies normally had relatively advanced technologies nation wide, together with better quality human resources and equipment. This technology and human resource base gave them the potential to make the transition to the new products. However, the lack of a sense of market and of cost effectiveness in these firms made the transition hard to achieve. The insufficient investment made it difficult to a successful transition (Chart 4.2). Thus policy choices at this stage were aimed at promoting consumer electronic products and improving efficiency.

[1] Three kinds of electronic products: were categorized according to the final purpose of electronic products. All products were divided into: ones used in Household, called 'consumer electronic products', ones used as parts and components for other products, and ones used as equipment for business purposes.



Notes: (1) 1982-1985 investment of capital construction exclude technical updating; China electronic industry gross value based on 1980 prices.

(2) Japanese firms include 75 major electronic enterprises.

Source: China data from '*Electronic Industry Statistics Year Book*', 1987, Electronic Industry Publishing House, 1987, Beijing. American data from '*Electronic Market Data Book 1987*'; data from 1984 to 1986 include other products and services, so total is not equal to 100%; and a new statistic method is being employed, the output of consumer excludes import. Cited from *China Electronic Industry 2000 Year Plan*, research report, the MEI Internal Report. Other data from *China Electronic Industry 2000 Year Plan*, research report, the MEI Internal Report.

4.1.1 Initiatives in Institutional Transformation

In the pre-reform period, China had seven engineering industrial ministries[2] to take charge of military weapons research and manufacture, and two bodies responsible separately for overall planning and decision making and R&D activities: the National Defence Industry Office, and the National Defence Science and Technology Commission. In 1982, to combine the responsibilities of the latter two bodies for research, development and production, they underwent a major restructuring and merging. The restructuring involved the merger of the National Defence Industry Office and the National Defence Science and Technology Commission, together with the Science and Technology Equipment Commission, to form the Commission of Science, Technology and Industry for National Defence.

Under the system of military control, there were no available funds to produce civilian products, so there was a need to transfer the Ministry of Electronic Industry to civilian control, Compared to other industries, such as the aviation industry or the space industry, the electronic industry was much easier to transfer to civilian purposes. In 1980, one decision made by the State Council was that the Ministry of Electronic Industry was to transfer from the military system to the civilian system, and the Machinery Industry Commission of State Council took over administrative control (Li, 1986). The transfer created the right environment for the military firms to recover, and provided an opportunity for them to improve their productivity. It also contributed to overcoming the investment problem mentioned earlier.

In the early stages of reform, these companies experienced unique and different problems compared with companies in other industries. This is mainly because of the special responsibilities of military-oriented companies. They undertook research, development, and the production of weapons necessary for national defence. There were two considerations when the decision of restructuring was made. One was to fully utilise high quality human resources and advanced equipment available in the military companies, and to produce technologically advanced civilian products (Lu and Tang, 1997; Jiang, Zhang and Ji, 1988). Another was to meet market demands, to produce products that had a large current and ongoing market demand.

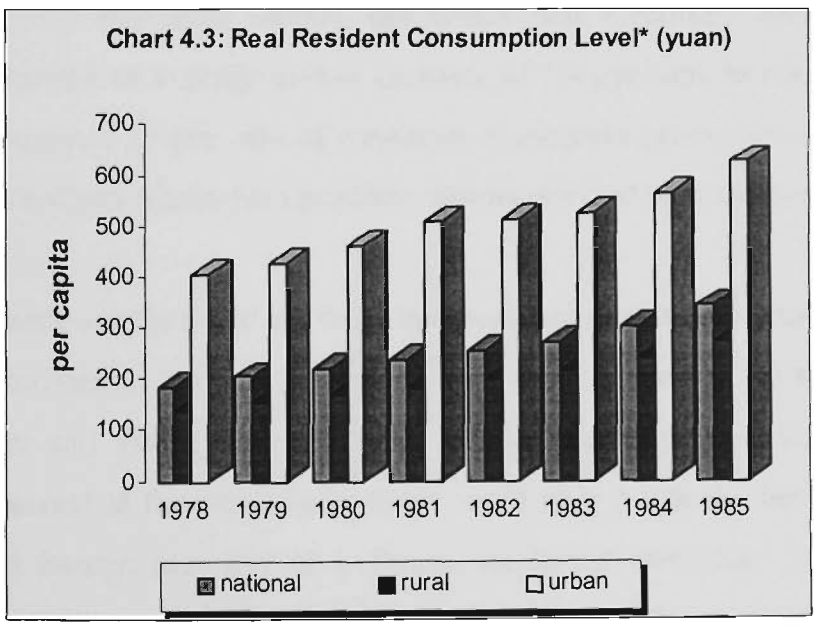
In summary, the large excess capacity of the defence industry, resulting from declining orders from the People's Liberalisation Army (PLA), meant that there was not sufficient demand for military products. This in turn meant that nearly all military enterprises faced the problem of surviving, but also made possible the rapid growth in civilian output. Under the system of military control, the companies were not concerned by the demands of the market. Production was mandated, in terms of inputs, outputs and prices. In this sense, military companies were not in a cycle of economic operation. There was not awareness of economic efficiency and of scale economies in the military system (Xiang,

[2] The seven engineering industrial ministries were divided by the industry and technology, such as aviation, spaceflight, shipbuilding, engineering, electronic products, etc.

1986), and this made the challenge of the conversion substantial. But the reform brought about an expansion of the market for consumer products, and meeting this market demand was a matter of survival for the military-oriented companies. Finding ways to fill the huge demand for civilian products, especially for consumer electronic products, was critical to their successful transition from military to civilian purposes (EILG, 1985; NBS, 1986).

4.1.2 Emerging Needs for Consumer Electronic Products

The period from 1979 to 1985 was remarkable for the Chinese consumer electronics industry. There was a substantial increase in the quantity of production that marked a new era in China's consumer electronics industry. But there was also a substantial improvement in terms of management skills and in the ability to access new technologies and markets, which came about with the increase in specialised, large-scale production of electronic products.



Note: Deflated by the overall retail price index, which is a measure relatively close to the commonly used CPI and available in statistics of China.
Source: State Information Centre of China, http://cedb.cei.gov.cn

Since 1978, increased consumer consumption had been playing an important role in the national economic development of China. An improved standard of living was seen as an incentive for management and worker initiative. The government started to seek to raise the population's purchasing power and to increase the supply of consumer goods on the domestic markets. The annual average growth rate of residential consumption in real terms increased from 4.8% in the Fifth FYP to 8.8% in the Sixth FYP (NBS, 1986). The growth in real residential consumption is shown in Chart 4.3. The urban resident consumption experienced significant growth from 405 RMB Yuan per household a year in 1978, to 626 RMB Yuan in 1985. Rural resident consumption also grew rapidly, although it remained at a lower average level.

As a result of this rapid growth, the consumption structure underwent substantial change. As housing, medical treatment and education were all heavily subsidised by the government; the increased income was more likely to be spent on household electronic products. These trends generated an average annual growth of the gross output value of China's engineering and electronics industries of 4.7 per cent from 1980 to 1985 in the Sixth FYP. Of this total output, machinery and electronic products for production purposes showed an average annual increase of 1.4 per cent, in contrast with an average annual increase of 13 per cent of consumer electronics production (CEIYB, 1986). Thus output of consumer electronics products almost doubled over the period of the Sixth FYP.

Since domestic supply could not meet the increased demand in terms of both quantity and quantity, consumers turned to imported goods, and colour TVs, washing machines, refrigerators and video recorders were in high demand. However, with tight foreign currency control at the time, individuals could only purchase these imported electronic goods with foreign currency or a foreign exchange certificate[3] and with an imported goods purchasing quota[4]. This meant that only those who had the opportunity to work

[3] Foreign currency exchange certificate (waihui duihuanquan): imported goods can be bought with foreign currency and its exchange certificate in China.

[4] Imported goods purchasing quota: certain imported goods, such as CTVs, CTRs, etc, were tightly controlled through the purchasing quotas. The quota was distributed to the Chinese who visited overseas, the amount depending on the period of the overseas stay. For example, if you stayed in overseas for over a

overseas, or who had overseas relatives sending hard currencies home, could buy these imported goods. In March 1980, the State Council authorised the China Bank to issue foreign currency exchange certificates, for intensive controls on the spending of foreign currency. Later in December 1980, the State Council released a new regulation to regulate foreign currency the 'Temporary Regulation for Foreign Currency Management of PRC' (Zhonghua Renmin gongheguo waihui guanli zhanxing tiaolie) (Zhuanjiazhu, 1995). Government regulation of the spending of foreign currencies directed the demand for consumer goods to domestically produced products. To a large extent this protected the domestic manufacturers, who were totally new players in the consumer electronic products area. At the initial development stage, the protective policy was very helpful to the domestic manufacturers (Zhang, 1986).

4.1.3 Resolution of Supply Constraints

Nevertheless, there were many difficulties for the industry in generating sufficient supply to meet the market demand. One obvious reason, apart from the fact that the industry was at an infant stage, was the institutional hurdle. The electronic industry had long been subordinated to the needs of the military, and there were no funds available for civilian products in the military system (Li, 1986; Yu, 1986). In addition, if the Ministry were to remain under the control of the Central Military Commission, it would have been extremely difficult to carry out such a shift in production. It would have been impossible to attract foreign capital and technology transfers or to enter into any form of cooperation.

As early as 1978, the Chinese government was aware of such a problem and initiated a policy of integrating civilian and military industry more closely, in order to promote overall civilian economic development (Wang, 1985). It was aimed at encouraging the defence industry to produce civilian goods, particularly consumer goods, and to transfer technology from the more advanced defence sector to the civilian sector of the economy.

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year, you got a quota for one big item, say a CTV, and two small items, say a camera and a microwave. The details of the policy varied from time to time.

Following the formulation of regulations and mechanisms for such transfers, the defence industries began to transfer technology to civilian industries on a large scale in the mid-1980s (Anupam, 1986). Technology transfers provided defence enterprises with additional, lucrative sources of income and furnished civilian enterprises with a wide range of useful, advanced technology to modernise production.

Consequently, the electronics industries of China successfully transformed their focus from military electronics to consumer electronics. The defence industry manufactured a variety of goods for civilian purposes, including motor vehicles, optical equipment, television sets and electronic appliances. Many of these products were consumer goods in high demand. In 1975, civilian goods accounted for 6.9 percent of the total output of the defence industry. This rate rose to 18 percent in 1980, and further jumped to 41.8 percent in 1985. For the electronics industry, the share of military electronics in total output was estimated to have fallen from 70% in 1980 to about 10% in 1985 (CEIYB, 1986).

The conversion from military to civilian products not only enabled these companies to survive but also facilitated the development of the civilian electronics industry. In the 1980s, a number of large factories under the Ministry of Electronic Industry came to produce only civilian goods, and other electronics factories also significantly increased civilian goods production (Jing, Zhang and Ji, 1988). Many of them became important players in the electronic industry later on. Between 1981 and 1985, civilian output in the electronics industry grew 129 percent, and the Ministry of Electronic Industry contributed a large share of civilian output. For these reasons, the output shares of the three kinds of electronic products changed sharply between 1978 and 1986, as shown in Chart 4.1.

4.2 Institutional Structure and Decentralisation

Following the initial reform stage, many problems become more obvious, one of which was the crisis of efficiency. Producing goods without having to think about cost and

market needs had been the normal behaviour of Chinese companies (Chen, 1982). Accordingly, there were no efficiency requirements for managers to monitor output, and this resulted in a huge waste of resources. A consensus view among government agencies in the early 1980s was that the 'crisis of efficiency' should be directly targeted (Chen, 1981). It was critical to the national economy, and especially critical to the electronic industry. Therefore, a series of adjustment measures were announced by the central government. The policy orientation at this stage was to improve efficiency through restructuring the industry, and this was seen as a process of administrative restructuring (Chen, 1981; Zhuanjiazu, 1995).

Two major changes were undertaken in this policy evolution. The first one was an administrative restructuring, to facilitate the transition from military to civilian purposes. This action was aimed at reorienting the investment channel for civilian goods production, as mentioned earlier in this chapter. The second one was a decentralisation of decision making power and administrative power, so that the industry would be more flexible in dealing with its production and administrative issues, and will be discussed in the following subsection.

4.2.1 Institutional Structure

The administrative reform of China was believed critical to its economic development because of the nature of the Chinese economic and social system (Zhuanjiazu, 1995). This can also be seen from the discussion of the SPC in Chapter Three of this thesis. The huge administrative system in China suffered from many bureaucratic problems and dysfunctions (MEI, 1986). Since the late 1970s, China has developed and implemented a number of administrative reform measures designed to assist economic reforms and development. Based on official documents and many studies of administrative reforms (Liu, 1998; Zhuanjiazu, 1995; Liou 1998), one of the earlier reform measures to strengthen the development of the electronics industry was the restructure of the administrative system in the industry.

There were two main problems in the administrative system of the electronic industry at the early reform stage. One was that the leadership of the industry was overseen by the military system, which was an obstacle to production for civilian purposes. This problem was specific to the electronic industry. Another problem, which was more general, was that decentralisation went too far. This resulted in an economic system in confusion, although the purpose of this reform measure was to improve the quality of decision making.

From the time of the founding of the People's Republic of China to 1978, most electronic firms were under the administration of the Ministry of Electronic Industry, which accounted for 90% of the output of electronic products. About 10% of the output of electronic products was from other electronics factories.

The highest authority in the administrative hierarchy of the industry was the Electronics Industry Leading Group of the State Council, which was established on 4 October 1982, and was formally called the 'Leadership Group of Electronic Computers and Large Scale Integrated Circuits'. Its main responsibility was pushing the Ministry of Finance, the Bureau of State Tax, SPC and SEC to support the goals set by the group. The heads of these agencies were involved as members of the group. A higher authority than those ministries and commissions was necessary to handle and coordinate any issues and requirements in relation to any of these agencies. Later, the Government extended the role of this group to cover all of the electronics industry. In September 1984, this group was re-named as the Electronics Industry Leading Group of the State Council (EILGSC) (CEIYB, 1986). So the whole electronic industry was given priority by the State Council under the umbrella of EILGSC. Setting up an organisation to handle a specific task is not new in China, but it is remarkable to give a whole industry priority under the State Council for intensive central planning for the provision of financial and human resources. The major task of the group was to strengthen and coordinate policy-making concerning the development of the electronics and information industry. Following listed were its key functions:

- to formulate strategies, guiding principles, policies, and major measures related to electronics industry development;

- to examine and approve key developmental plans and to supervise the implementation of these plans;

- to bring the principal task forces undertaking scientific research and production in the electronics industry together for a cooperative relationship among specialised units;

- to examine and approve major projects requiring items which need to be imported; and

- to coordinate various departments and localities with respect to major problems arising in the course of developing the electronics and information industries, especially concerning scientific research and the building of major projects (Liu, 1998).

4.2.2 Decentralisation of Decision Making Power

After 1979, the management system of the electronics industry had gradually transferred their control over factory administration from a high degree of centralisation down to local authorities, as a result of government concerns about poor administrative efficiency. Enterprises were encouraged to form corporate groups or to enter associations that were organised in accordance with the division of labour, channels of supply, scientific and technological partnership and so on. What this meant was that at the same time as factory administration had been decentralised, the major function of relevant central government ministries would be to focus on the formulation of policies, laws, regulations and plans.

The decentralisation approach was evident in both economic and administrative activities. Local governments had more authority in issues relating not only to supervisory and coordinating functions within their jurisdiction but also to local economic planning, resource management, and even foreign trade.

As a measure of decentralisation, the administrative control over certain electronics enterprises was decentralised from the Ministry of Electronic Industry to local government. That meant that the MEI did not oversee the company's operations, with local government taking over these responsibilities. For example, the plan of the investment, production and raw material procurement of these companies would go through local government. The intention of doing so was to improve the quality of government decision making in both economic and administrative activities at the local level, and to allow local governments to have flexibility in determining their administrative activities according to their specific needs (Yu, 1986).

In the old administrative system, government agencies controlled every detail of the activities of companies. This resulted in the problem of over-administration, which confused and disrupted the allocation of resources and caused system-wide problems of inflexibility and non-accountability. This was particularly so in the military system. Many of the problems were related to the military system control mechanisms over its affiliated companies, and were mainly political. For example, they tended to undertake promotion based on political considerations rather than on economic achievements.

Although by the late 1970s, the extent of political motivation in the administrative system had been weakened to a large extent, the military system was still struggling with the inertia of its political legacy more than any other sector. After decentralisation, a new problem emerged, with the military companies imposing a heavy burden on local government. Local government found the burden particularly onerous, as they were responsible for providing the enterprises with backup services and underwriting them financially, while the military plants brought them little return in terms of taxes (Lu and Tang, 1997).

Thus the administrative system changed and evolved along with the transition in the electronics industry. However, for successful development, further action was needed to

promote the transition as new circumstances emerged, and this action needed to be based on a proper understanding of the impact of the previous initiatives.

4.3 Policy Initiatives

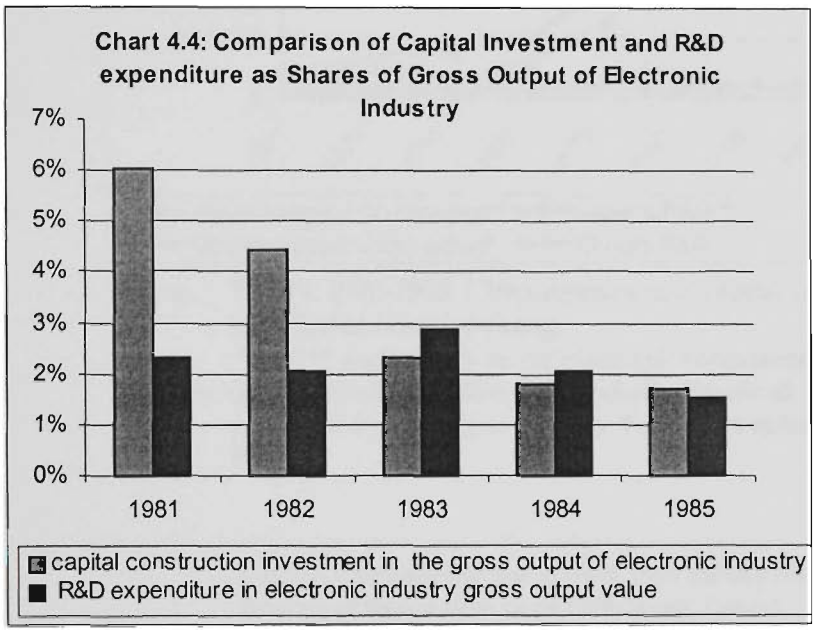
4.3.1 Products Targeting

As outlined above, in the Sixth FYP period, the emphasis of policy initiatives had been put on to the strategic priorities for the Chinese electronics industry. Thus policy sought to set out an overall strategic direction for the industry, in terms of the market, product and technology positions to be adopted. The potentially large Chinese home market and the low cost of labour provided great advantages to attempts to grow the consumer electronics industry rapidly.

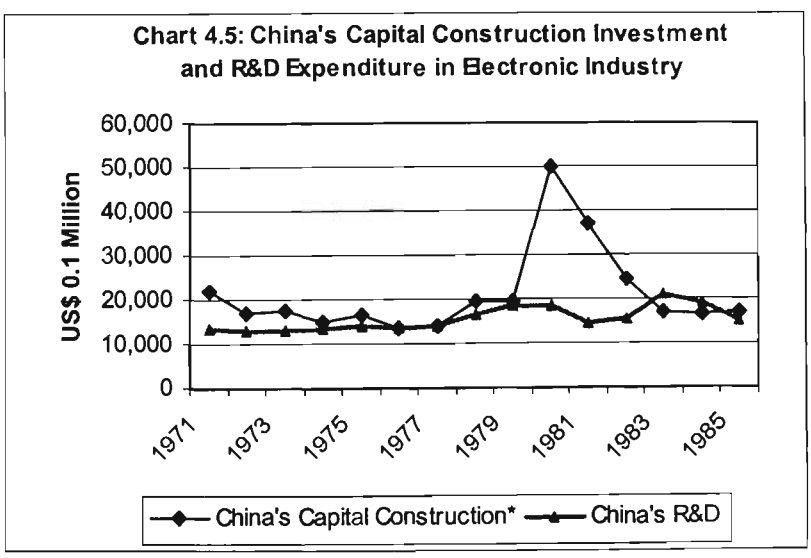
However, investment in China was largely financed through the central budget before the economic reforms. After those reforms, budgetary revenues were not sufficient to finance the central government's investment program and the government had to resort to mandatory bank loans and, more or less voluntary contributions by provincial governments. Investment in the electronics industry jumped to US$501 million in 1980, but this level could not be sustained. It fell to about US$168 million in 1983, before increasing marginally to US$170 million in 1985 (see Chart 4.5). As is evident from Charts 4.5 and 4.6, in 1983-85 investment in China's electronics industry was back to pre-reform levels in spite of the massive increase in production, and was at a very low level relative to investment in Japan.

Lack of sufficient investment in R&D was also one of the major weaknesses of this industry (see Chart 4.4 and 4.5). China's R&D investment in the electronics industry was at quite a low level, and actually declined between 1979 and 1985. For example, in 1979 total R&D investment in the industry in China was about US$186 million, while in the same year Japan invested nearly US$2 billion in R&D in the industry. Another indicator, the percentage of R&D investment in electronic industry gross output value, also shows

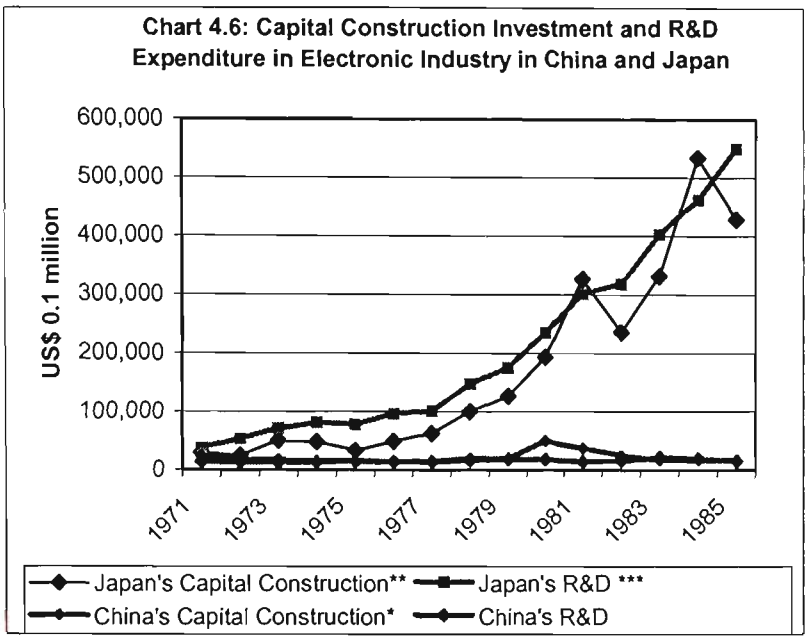
this low relative level in China. Compared with the two developed countries, China's investment in R&D was quite low (see Chart 4.6 and 4.7). In 1981, for example, China's investment in R&D in this industry was about 2.5 % of output, whereas the rate for Japan was about 6.5% and the American rate was more than 7%. This low rate of R&D investment in the electronics industry was not sufficient to support the industry's sound growth.



Source: Data is edited from *Electronic Industry Yearbook 1987*, published by Electronic Industry Yearbook Publishing House, Beijing.

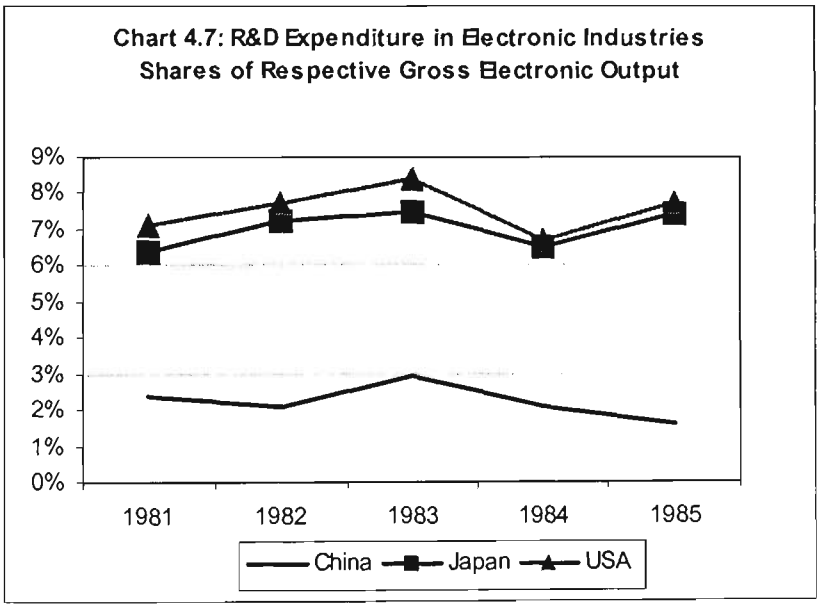


Source: Data is edited from *Electronic Industry Yearbook 1987*, published by Electronic Industry Yearbook Publishing House, Beijing.



Notes: * 1979, 1982-1985, China investment of capital construction *excluded technical updating.*
** &*** *Included 75 major electronic companies.*

Source: Data is edited from *Electronic Industry Yearbook 1987*, published by Electronic Industry Yearbook Publishing House, Beijing.



Source: Data is edited from *Electronic Industry Yearbook 1987*, published by Electronic Industry Yearbook Publishing House, Beijing.

Limitations on finance and on human resources led government policy to move towards product-specific targeting. In view of its limited supply of human and financial resources,

it seemed appropriate for China to be more selective and to try to obtain the maximum economic benefits on the basis of its long-term, dynamic and comparative advantages.

The detailed product-specific targeting was restricted to a very few sectors where technological gains or export promotion objectives could be clearly identified. Certain electronic products were selected as priority sectors, among them the consumer electronics, telecommunications and computer equipment, and microelectronic products. The Government also chose colour TV as one of the few targeted sectors, on the basis of its characteristics as a basic consumption good with the potential for exports.

To facilitate effective targeting, two actions played essential roles. They were promoting technology development and export.

4.3.2 Technology

Along with the reform programs, the Government had realised that China lagged behind the Western countries in many aspects of technology. A natural response of the Government was that one way to speed the catch-up process would be to import superior technology, and to encourage entrepreneurs to assimilate foreign technologies. In the early stages of reform, importing was a vital way to learn about and to get new technologies. The import of high-tech electronic goods was an integral part of the electronics industry development strategy.

The most complicated and politically challenging issue in China in the technological area at this time was the import of 'high technologies'. Many high technology products were called dual-use high technology, because of possible military as well as civilian applications. In the light of the international political context, self-dependence had been one of the fundamental principles underlying the technology policy of China.

The principle of self-dependence still shaped the technology, import and export policies at the early reform stage. Under this principle, import policy was mainly focused on import substitution. Heavy attention was paid to the selection of appropriate technologies,

the absorptive capability in relation to a given technology and the way technology was transferred: eg. purchases of complete plants, or of individual machines and equipment.

Box 4.1: Self-dependence in Technology Development

Self-dependence in the Chinese sense was manufacturing all needed equipment by Chinese companies, even if the quality and function of their products were slightly poorer. Chinese companies strive to carry out technical innovation and modification to improve their product quality and function with limited resources. This principle has dominated technological development ever since the pre-reform period. Chinese companies had been working hard to design, manufacture, import and copy any necessary equipment. In addition, because of the shortage of foreign currency, if the domestically developed technology was improved, they would manufacture the equipment instead of import. Furthermore, localisation of import goods and technologies was another important step.

Source: Mohanty, D. R., *Defence Industry Conversion in China,* Institute for Defence Studies and Analyses 1999, New Delhi.

The technology level of industries in China lagged far behind that of the developed countries during the Sixth FYP. In many sectors, machinery and equipment obtained in the 1950s and 1960s were still in use even in the early 1980s (Wang, 1987). Under these circumstances, the need to pursue an effective technology upgrading and to catch up with international technology development was a critical policy issue. The consumer electronics industry was selected as a pilot sector to activate the catch-up process. The open door policy in the 1980s gave Chinese companies the flexibility to make their own decisions on import related matters, but central government policy was less effective in this regard. A typical case was the extensive imports of CTV assembly lines, which will be discussed later in this chapter.

Several issues outlined below had been debated at the policy level during that period of time.

Views on Technology Transfer. There was general agreement about the importance of technology imports from developed countries, but there were however, many discussions among Chinese policymakers and academics about related issues. One group firmly believed that purchasing of complete plants, preferably together with extensive foreign managerial and production services as well as technical advice, was a faster and more efficient way to acquire and absorb new technology. They argued that importing individual items of foreign equipment with embodied new technology, or the use of imported items as prototypes for imitation, was slow and ineffective.

Others took the view that to import complete plants would be very expensive, especially in the light of the budget constraints in China. Moreover, the effectiveness of this type of import depended on many factors, such as the availability of quality local skilled labour, the adequacy of the training and advisory services that came with the plants, and local R&D capacity, which in many cases was still a labour-intensive endeavour (Xiang, 1986). China suffered an absolute shortage of scientists, engineers, and technicians, as well as limiting the effective supply by misallocation and misuse of trained people. The lack of any of these factors would affect the complete plant import programs. Thus individual equipment import would be more appropriate, in this view.

Views on Components and the Supply Chain. In the consumer electronics industry, much of the technology was embodied in the components; in fact, the product may have owed its existence to the particular combination of components used. Thus, in the process of manufacturing one particular product, the reliability of the supply chain of components was an important factor. Any important technologies in the supply chain of components that do not work properly affected the production of final products. Two extreme possibilities existed: to import all the necessary components and to assemble the products from them, or to produce all the components.

Producing all components in-house may provide greater control over product development. However, it would require enormous capital inputs into production, eg.

television picture tubes and certain types of semiconductors, and it may be difficult to keep up with the fast development of technologies. Component design becomes vital in such a case. An important factor in the success of Japanese consumer electronics producers has been their ability to integrate components. Simplifications achieved in this area had an enormous impact on productivity. This not only reduces the cost of the production with fewer components, but also simplifies the production process of that particular product, enabling the use of automated insertion machines.

Obviously, it is not always essential - or even possible - to provide all components for consumer electronics products in-house. The enormous capital costs involved in developing and producing the new generation of semiconductors forced even the Japanese producers to buy them in the open market. It is the more specialist semiconductors that became important for the new generation of televisions and other consumer electronics equipment, and here design is the key, outside foundries being available to produce these components.

Thus the policy that evolved during the period of 1980-1985 for the electronic industry does not seem to have provided the direction for growth of the domestic industry (Li, 1986). What it did was to generate a culture of assembly products based on imported components and materials. This made licensing, import policy and tariffs the key policy variables to which domestic units responded. Very high dependence on imports meant that domestic production was guided primarily by what technologies were available in the international market, and this was risky to a certain extent, as technologies change rapidly.

In addition, technology development within China had been slow. One of the main reasons for lagging technological development was the lack of coordination between research institutes and production enterprises[5]. Between 1979 and 1984, the number of major scientific and technical research discoveries reported grew from 2,790 to 10,000 and the number of inventions approved by the state increased from 42 to 264 (Xiang,

[5] This issue will be discussed detail in later, see Section 1 Chapter 6.

1986). Most of the discoveries and inventions were never implemented. This was mainly because research institutes and production enterprises operated independently, with little or no exchange of information. In addition, most enterprise managers were more concerned with meeting production quotas than with technological innovations.

China's technology situation also attracted a set of policy research works. The result was embodied in the Sixth FYP: 'During the Sixth FYP period, China's main task is (1) to improve the quality of products and develop new varieties, (2) raise technological research and develop new products, (3) import advanced technology which are suitable to China's conditions and step by step transform the backward technology' (State Council, 1984).

At the end of the Sixth FYP period, the CCP issued the 'Resolution on the Reform of the Science and Technology Management System.' The resolution sought to coordinate research and production more closely, and was consistent with the overall strategy of the Four Modernisations[6] (launched by former Primer Zhou Enlai in the Fourth People's Delegation Conference in 1974), which was to redirect science and technology toward economic progress. The document issued at the end of the Sixth FYP period was an important document, which dominated China's technology policy in the following years.

4.3.3 Promoting Export

The initial years of the reform program after 1979 were designated as the 'period of readjustment'. During that period major imbalances in the economy were to be corrected and a foundation was to be laid for a well-planned modernisation drive. During the 1980s, electronics become the largest export sector in East Asia, and each of the 'Four Dragons' developed significant competitive and technological capabilities in at least some areas of advanced electronics (Hobday, 1995). Under these circumstances, the Chinese government paid much attention to promoting the export of electronic products to earn much needed hard currencies. So, one of the major goals of this readjustment process was

[6] Four Modernisations include Agriculture, Industry, Science and Technology, and Defense.

to expand exports rapidly[7]. As mentioned earlier, China's international trade objective was to gain access to advanced foreign technology and equipment through imports, which were to be financed through hard currency earnings from exports. However, up until 1985, a very large share of China's exports had been low value added primary goods (NBS, 2000). Thus one obvious reason to promote electronic products exports was their relatively high value-added nature, at least in terms of the structure of Chinese exports.

Success in consumer electronics required an environment that encouraged: competition, especially at home but also in export markets; the achievement of economies of scale and scope; the mobility of goods, people and capital in order to achieve efficiency; and an increased flexibility and innovative capacity. China had a sufficiently large domestic market for economies of scale, and its low labour costs provided some advantages. However, as a whole these sectors did not function well (Wang, 1987).

Although China's export performance in the consumer electronic products area was not remarkable during the period of the sixth FYP, it actually laid a foundation for the later growth of consumer electronics export and also provided a window for other sectors of the industry to understand overseas markets. China's electronic product exports started from 1956, mainly involving exports to Hong Kong. Up to 1980, the actual value of electronic exports had been under US$10 million per annum. During that time China's companies had no right to import or export any goods to or from overseas directly, so that developing sound facilities for dealing with exports and imports became an urgent matter for policy. In April 1980, as part of the export promotion strategy, China established the China Electronics Product Import and Export Company, a specialist company handling the whole nation's exports and imports of electronic products. Along with increased production, the export of electronics increased rapidly from a very low base (CEIYB 1986). The value of exports of electronic products increased from US$18.5 million in 1981 to US$63.3 million in 1985. According to the No. 128 document of the State Council, the Office of Machinery and Electronic Product Import approved the

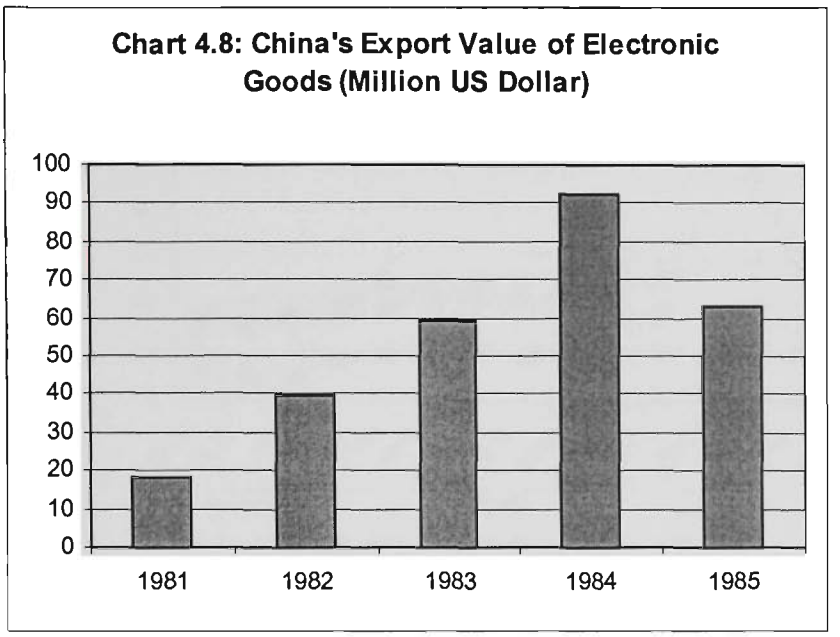
[7] For details see *The Sixth Five-Year Plan of the People's Republic of China for Economic and Social Development, 1981-1985.* 1st edn Foreign Languages Press, 1984, Beijing, China.

establishment of 16 electronics export base companies (chukoujidiqiye)[8], and 25 electronics companies were granted direct dealing rights for exports and imports, as the export production system was formed.

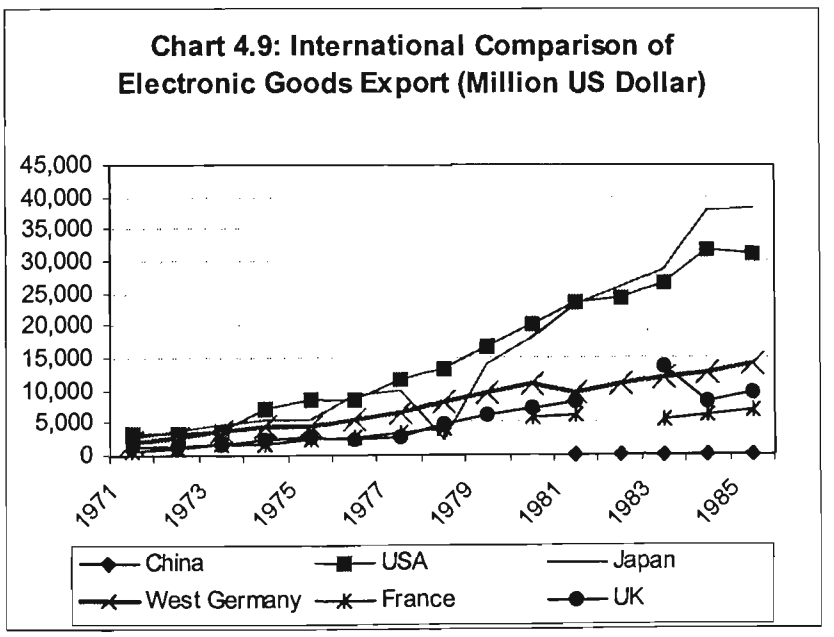
China targeted consumer electronic products as a potential foreign currency earner based on other country's experiences (Wang, 1987). To improve the competitiveness of Chinese products, exports was a good test case, so promoting exports also became a part of the strategy to improving competitive capability. On 5 August 1983, the State Council issued a directive 'Increasing electronic and machinery products exports', which stated the need for the electronics and machinery products industries to export (State Council, 1983). Unlike smaller nations that deliberately pursued policies of export-led growth, in the early years of reforms China tended to view exports primarily as a mean to pay for imports. Those imports were thought to be essential to national development and social stability, and included imports such as complete plants, machinery and equipment, various semi-manufactured goods needed by Chinese industries, and basic commodities such as food. Generally, in the past the government first estimated its essential import needs in any particular year and then drew up an export plan to earn enough to pay for all or most of these imports (Xiang, 1986). Exports were not seen as a means to spur growth until the late 1980s.

It is evident from Chart 4.8 that the growth performance of China's exports of electronic products from 1981 to 1985 was substantial. Nevertheless, compared to other countries, the level of exports remained very low. China started its export growth from a very low base of less than US$20 million in 1981, compared to figures for America of US$23.5

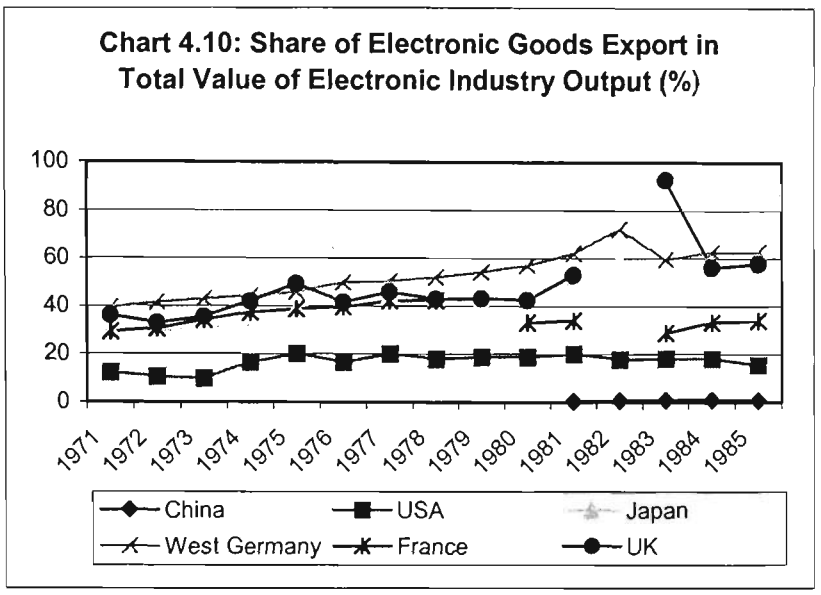
[8] Export base company: the majority of the products of these companies were for export purpose.



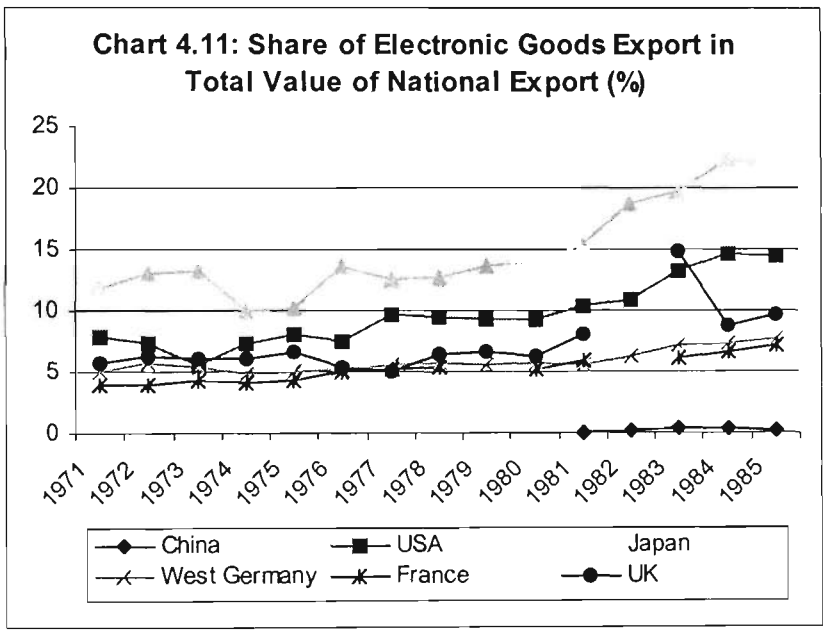
Notes: (1) Value of Chinese electronic exports is real export value of the China Electronic Import and Export Corporation, excluding exports as a part of other products that were exported by other companies.
Source: data from '*Electronic Industry Statistic Yearbook*', Electronic Industry Publishing House, 1987, Beijing.



Notes: (1) Value of Chinese electronic exports is real export value of the China Electronic Import and Export Corporation, excluding exports as a part of other products that were exported by other companies.
(2) Japanese data included 75 major electronic Companies.
Source: China data from '*Electronic Industry Year book*', Electronic Industry Publishing House, 1987, Beijing. American data from '*Electronic Market Data Book* 1987'; data from 1984 to 1986 includes other products and services, so total is not equal to 100%; and the new statistic method is being employed, the output of consumer excludes imports. Cited from *China Electronic Industry 2000 Year Plan*, research report, the MEI Internal Report. Other data from *China Electronic Industry 2000 Year Plan*, research report, the MEI Internal Report.



Source: Same as Chart 4.9.



Source: Same as Chart 4.9.

billion, Japan US$23.3 billion, West Germany US$9.7 billion, Britain US$8 billion and France US$6 billion respectively (see Chart 4.9). Thus even a strong export growth rate left China's exports at a low level by comparison with these countries by 1985.

To view exports in the context of the scale of national industries, it is worth examining the ratio of the value of electronics exports to the gross value of the electronics industry output (Chart 4.10). West Germany and Britain experienced both a high shares of exports in total electronics production and strong growth in that share from 1971 to the early 1980s, as did Japan. In 1981, in terms of the ratio of the value of electronics exports in the gross value of electronics industry output West Germany stood the top position, with 62%, followed by Britain, 53%, then Japan 49%, France 34% and America 20%. By this measure the Chinese electronics industry had a very low propensity to export through the first half of the 1980s, with the 1981 ratio at 0.3% (Chart 4.10).

It is also of interest to view electronics exports in the context of national export totals (Chart 4.11). For many of the countries shown, electronics exports already contributed a significant part of total exports by 1981 (eg. Japan 15%, America 10% and Britain 8%), and the shares increased significantly over the period to 1985. In China electronics exports were a very small part of total exports in 1981 (0.08%), and this remained true through to 1985.

The experiences of Western and East Asian countries illustrated to the Chinese Government that exports of electronic products had the potential to contribute greatly to the growth of the electronics industry. According to this understanding, the electronic products export strategy of China was shifted from the goal of earning foreign currency for imports of urgently needed equipment and materials to that of promoting the growth of the industry during the Sixth FYP.

However, the existing Chinese industry could not be expected to win international markets with their present products. The products might have met local market requirements, but most of them could not match the quality or the design requirements of leading overseas markets. To push China's electronics industry to a new export capability, further consideration to promoting electronic product exports was undertaken by the Central Government, in the light of what it had learnt about the industry and its challenges. On 19 October 1985, the State Council approved a 'Report on Increasing

Electronic and Machinery Products Exports' issued by SPC and other eight Government departments. The document stressed the export strategy of China's electronics industry, which had widespread government endorsement. This strategy facilitated rapid output growth, broadened the product structure, and led to major changes in the location of production.

Following the release of this strategy, companies worked hard to achieve exports and to earn foreign currency. This was in spite of the fact that such exports were often not directly profitable, because the specialised import and export companies purchased products at very low prices, sometimes even lower than the price at which the product sold in the local market. But with the foreign currency earned, and the related quota for using foreign currency, companies had the ability to import critical technology, key parts and equipment.

For several reasons, China had only limited success in employing an export strategy to achieve high efficiency. China lacked a broadly competitive environment, with such policies as price controls, and administrative controls over the allocation of materials still prevalent (Li, 1986). Competition policies were lesser priorities. The high degree of industrial fragmentation and the weak product structure were also weaknesses of the industry (Li, 1986; Wang 1987; Lui, 1987). Key parts and components were scarce and highly priced. There was a low utilisation of capacity, high stock levels, low plant efficiency levels, and in a number of cases inadequate product quality. Those factors were particularly critical in electronics because of the inherent character of the industry and the need to strive for international competitiveness from the beginning. These problems will be reflected in the discussion of the CTV case later. However, the difficulty and the struggle to enter international markets was a valuable learning exercise for the electronic industry.

4.4 A Typical Case: CTV

Following the product targeting policy, colour television (CTV) was soon targeted as a favoured product within China. The CTV case is also one to provide insight into how the Chinese Government struggled to make technological choices about importing either assembly lines or key parts, and how to push Chinese companies to absorb imported technologies, as discussed earlier in Section 4.3.2. As the export promoting policy and the decentralisation of decision making brought local governments and companies more freedom to purchasing goods from overseas, this led to excessive imports of CTV assembly lines.

4.4.1 The Institutional and Policy Context of the CTV Case

As outlined above, under the policy of opening up to the outside world, exports and imports were all assigned an important role in promoting economic development (SPC, 1985). Exports earned foreign currency, which was used to fund domestic development projects and to purchase advanced foreign technology and management expertise. Imports of capital and industrial goods were used to modernise the electronics industry.

Before the reform period, the combined value of imports and exports had seldom exceeded 10 percent of national income. In 1980 the figure was 15 percent, in 1984 it was 21 percent, and by 1986 it reached 35 percent (NBS, 1987). Under Deng Xiaoping's leadership foreign trade was regarded as an important source of hard currencies and of modern technologies. Therefore, the trade policy and practice in this period is worth to study further, as it provided the essential backdrop to the CTV experience.

In January 1979, facing the problem that planned programs would need more resources than what were available for the 1979 yearly National Economy Plan (NEP) made by the SPC, Deng Xiaoping gave a very important comment on the plan, which was believed to

be critical to influence both 1979 NEP and the following years' economic operating direction. He was reported as having said:

> 'We must have an adjustment to the total guideline of the 1979 NEP, that is, we choose projects with such characteristics: easy to build, short building period and profitable. The 1979 NEP has to be readjusted, such as reducing some big projects ... The key of import is focusing on the projects that could profit quickly and earn more money.' (Deng, 1979)

According to the principle of this statement and of other adjustment ideas from Chen Yun[9], the SPC and other ministries started to research and adjust the NEP of 1979. In April 1979, the Chinese Communist Party Central Committee decided to pursue a strategy of 'Adjustment, Reform, Consolidation and Improvement'. This principle underlined the characteristic of the policy option and the development strategy according to China's social and economic situation. Soon, the economy had slowed much more than was either anticipated or desired. This directly resulted in the following policy initiatives.

In June 1981, Premier Zhao Zhiyang made two points to directly address the stagnation of the economy. (1) It was needed to fully value the contribution of foreign debt to national development. Even the debt and interest are significant and the benefit might be not obvious at the moment, the idle workforce could be used and further it would give companies more opportunities to survive. Paying interest on the foreign debt now, in a sense, was buying time and a transfusion to a company. (2) It was acceptable that the national economic growth kept at a relative low rate for the period of economy adjustment, but it could not be lower than 4%. Zhao believed that 5% growth rate would

[9] Chen Yun: Mr. Chen Yun moved onto the supreme organ of political power (the Politburo Standing Committee) at the Third Plenum, Deng having already attained that level in August 1977. The crucial change at the Third Plenum was thus not simply Deng's emergence as top leader, but also that as part of Deng's assumption of this role; he had a common cause with Chen Yun. Chen Yun had been a top Communist party leader since the 1940s, and he specialized in economics. Chen made his reputation by taking over economic policymaking after the economy had been damaged by an unsustainable 'The Great Forward' and taming inflation in the early years of the PRC, and after the Great Leap Forward. In March 1979, Chen became the head of the Economic Leading Group.

be an appropriate target for the period of the Sixth FYP. It also should not be lower than 8% in the period of the Seventh FYP, in his view, as without reasonable growth rate, it was very difficult to keep the national economy stable (Zhao, 1981).

Later, in August and September 1981, Premier Zhao made the following further points. (1) The Sixth FYP is a time for striving for the fundamental improvement of the national economy. The central point of the Sixth FYP is to adjust the national economic structure. (2) Using foreign debt is actually buying time for development. (3) The investment fund in the Sixth FYP will be used in two areas: one is to improve economic efficiency, and the investment will go to the projects with a quick return and good economic benefit. The other is to prepare for future development, building infrastructure such as power, and transport (Zhao, 1981).

Those points influenced the direction of economic development in the period of the Sixth FYP, and determined the main features of the policy initiatives of this period. In fact, consumer electronic product was one of those areas with a short-term building period and a high return. It also had a high market demand. Following Zhao's indication and the principles of the Sixth FYP, the Chinese Government strategy for the development of the electronic sector was to take low and medium end consumer electronics as the major growth engine. This strategy was expected, through the growth of low and medium technology level electronic goods, to boost the whole electronics industry through experience in high-volume manufacturing and assembly, as well as in product design and development (Yu, 1986).

The consumer electronics segment, especially colour television sets, was expected to be China's major vehicle to achieve this goal. Deng and premier Zhao's comments in fact encouraged consumer electronics companies and local governments to develop CTV by importing assembly lines.

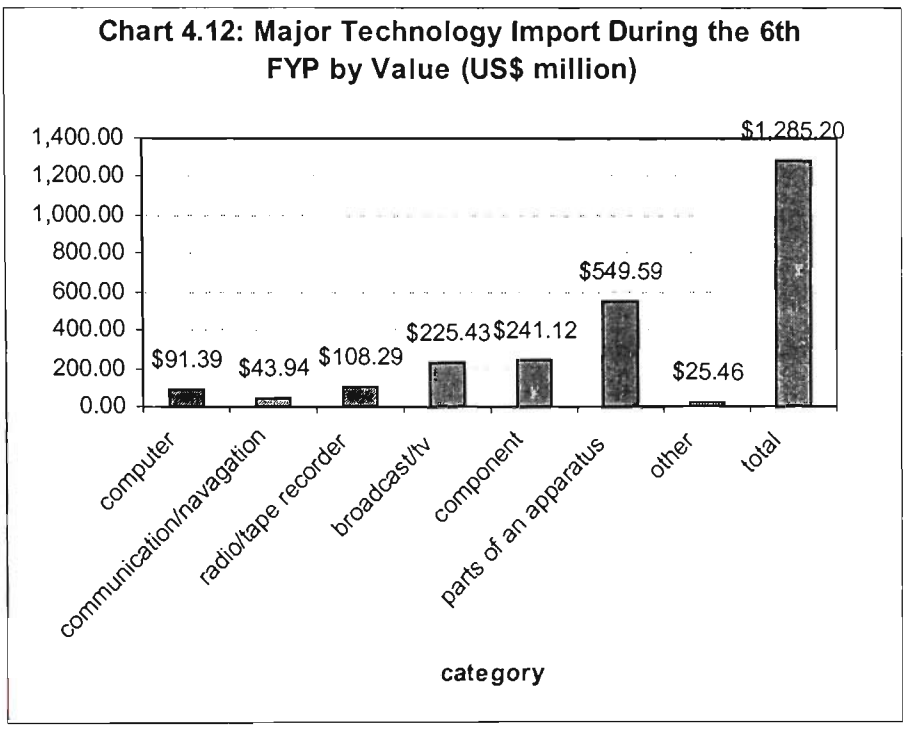
In the period of 1979-82, there were over 400 import projects at a cost of US$4.5 billion, and in the period 1983-1985 there were over 13,000 contracts worth over US$10 billion

signed with foreign companies in China. This large jump was also related to two measures introduced by the government. The first was a plan for the import of 3000 items of technology and equipment to re-equip existing enterprises. The second was the decision to allow greater autonomy in import matters to various cities and industrial sectors (Conroy, 1992).

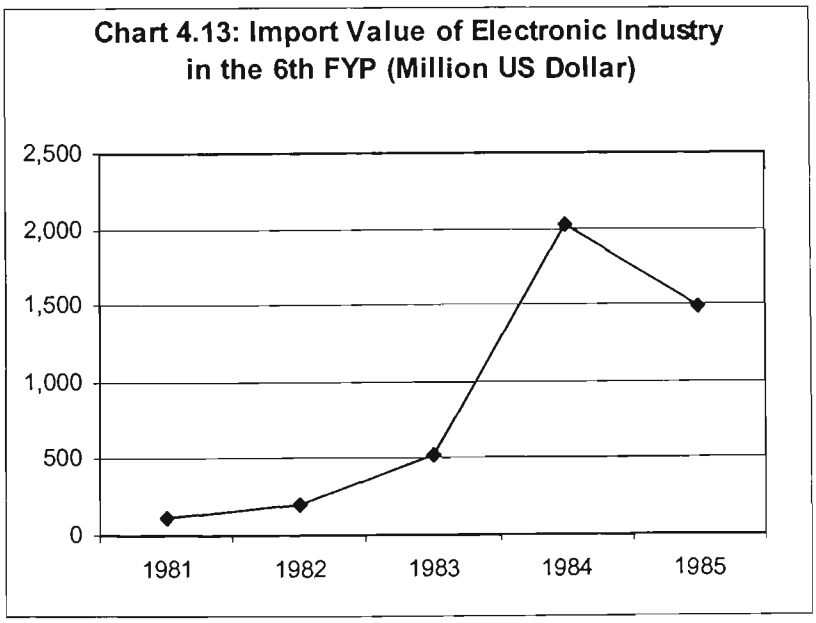
The actual value of electronic product imports during the Sixth FYP is shown in Chart 4.14: it increasesd steadily from US$117 million in 1981 to US$517 million in 1983. As the tight control over foreign currency had relaxed somewhat, the import of electronic products increased dramatically, reaching US$2,024 million in 1984. Following the contrary policy issued subsequently, the value of imports dropped to US$1491 million in 1985.

The total national technology imports for 1981-1985 were valued US$4.95 billion, of which US$3.38 billion were complete plants and US$1.54 billion were technology contracts (Conroy, 1992). The electronics industry, in the same period, had total imports of US$2.942 billion and 2,785 items. Of these, US$1.657 billion were whole-plant imports (2052 items), and US$1.285 billion were major equipment imports (823 items) (Wang, 1987).

Overall, 62% of the total agreed value of imports was components and parts of an apparatus. This high percentage of component and parts import underlined the assembly characteristic of the electronics industry of China (see chart 4.12 and 4.13.).



Source: Edited from 1987 CEIYB, 1987, Electronic Industry Publishing House, Beijing.



Source: Edited from 1987 CEIYB, 1987, Electronic Industry Publishing House, Beijing.

4.4.2 Numerous Import of CTV Assembly Lines

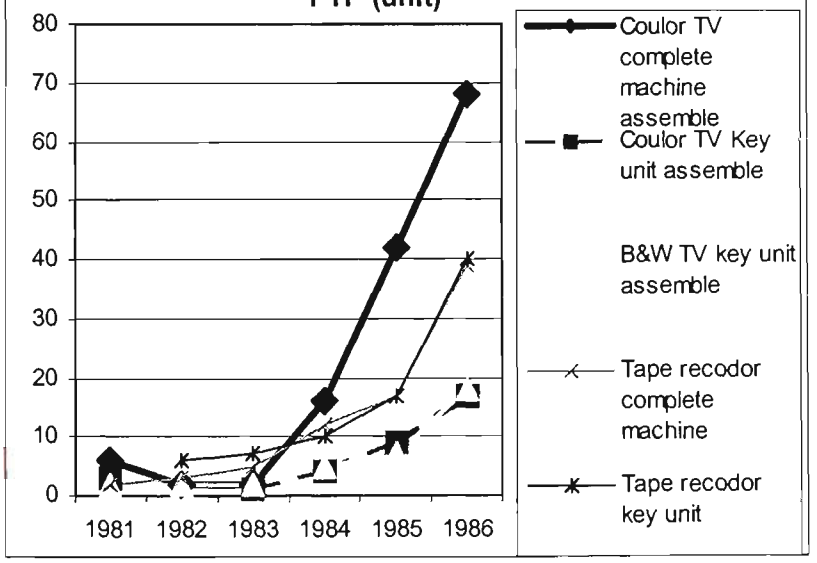
The history of China's importation of CTV assembly lines starts in 1973. In September 1973, China decided to import colour television picture tube whole set technology from America, a decision that was approved by the State Council and the Central Committee of Communist Party. The former Fourth Ministry of Machinery and the Ministry of Foreign Trade sent a group of people to America to inspect production lines and technology. At the same time, the domestic factory selection was being prepared. Because of the political environment in 1974, Chairman Mao's wife, Jiang Qing, made an event of the 'glass snail'[10] episode, which stopped the negotiations with the American company (Kangning), and the domestic factory selection was stopped also (OMCO, 1986).

By the end of 1976, China had a total of only CTV 8000 units (including imported units), which covered a very small percentage of total households. The demand for CTV was substantial, but the domestic production capacity of CTV fell far behind demand. In addition, the level of production technology of colour television picture tubes in China was much lower than required, so all the picture tubes needed for assembly of CTVs had to be obtained by import. Following an indication from the Central Committee of the Communist Party, the SPC called the former Fourth Ministry of Machinery, the Ministry of Foreign Trade and the Central Broadcast Bureau to investigate and decide on a proposal to import colour television picture tube whole set technology. In September 1977, the SPC agreed to re-start the negotiations for importing colour television picture tube whole set technology. The main content of the proposal included a whole set of technology for colour television picture tubes, that included the equipment and technology for the assembly line, the glass body case of the picture tube, the shady cover and fluorescence powder, and the IC. The factory was to be designed to a scale of

200,000 to 300,000 units per year (8 hour per shift) and be located at Xian, a hinterland city. The total foreign currency spend was planned as US$0.1 billion, with domestic supporting needed of RMB 0.1 billion. The building period was expected to be about three years.

The rapidly increasing market demand for CTV and the possibility of generating profits triggered the zeal of local governments and companies to import CTV assembly lines subsequently. There were a total of 113 CTV assembly lines with a production capability of 1.5 million units imported during the period of the Sixth FYP. In 1986 there were 68 CTV complete TV set assembling lines, 17 CTV key unit assembly lines, 18 B&W TV key unit assembly lines, 39 tape recorder complete assembly lines, and 40 key unit assembly lines were imported (see Chart 4.14). China did not have hardware support kits during 1979-1983 and production mainly relied on imported CKD and SKD kits. Because the import of components and parts manufacturing lines started from 1983, there were not sufficient supplies for CTV assembly to reach full capacity.

Chart 4.14: Major Electronic Imports in the 6th FYP (unit)



Source: Edited from 1987 CEIYB, 1987, Electronic Industry Publishing House, Beijing.

[10] The event of 'glass snail': an America company gave each member of the Chinese group a snail to show the quality of their glass products. However, Jiang Qing insisted that the Americans were teasing China's economic and social development as creeping slowly after the Americans like a snail (Paxing Zhuyi).

As mentioned before, the TV industry in China relied very much on the import of colour television picture tube to fulfil its annual production plan. This can be illustrated by the gap between the production of CTV and of colour television picture tubes during the period 1980-1985. Therefore, the ability of the local CTV industry to manufacture high end products was restricted by the level of tube production. In order to supply colour television picture tubes domestically, the No. 4400 colour television picture tubes factory[11] was built and was expected to supply 1 million cathode ray tubes. But this only met one fourth of CTV manufacturing needs during 1984 and 1985, and another $US1.5 billion was needed for imports from the international market (Wang, 1987).

Economies of scale are critical to achieving international competitiveness in the consumer electronics industry. As the capacity of the CTV assembly lines was much higher then the capacity of the available parts and components production facilities, there was an urgent need to import manufacturing lines for parts and components. Without sufficient foreign currency support, by the end of 1985 only a quarter of the production capacity of CTV was in operation, which was less than 4 million units (CEIYB, 1986). For CTV sets, firms need to invest in automatic component insertion machines for reasons of quality and reliability controls. Such machines have very high throughput and can only be effectively utilised in conjunction with high volume assembly operations. The insufficient operations resulted in low quality and high prices for CTVs (AEC, 1987; State Council, 1985).

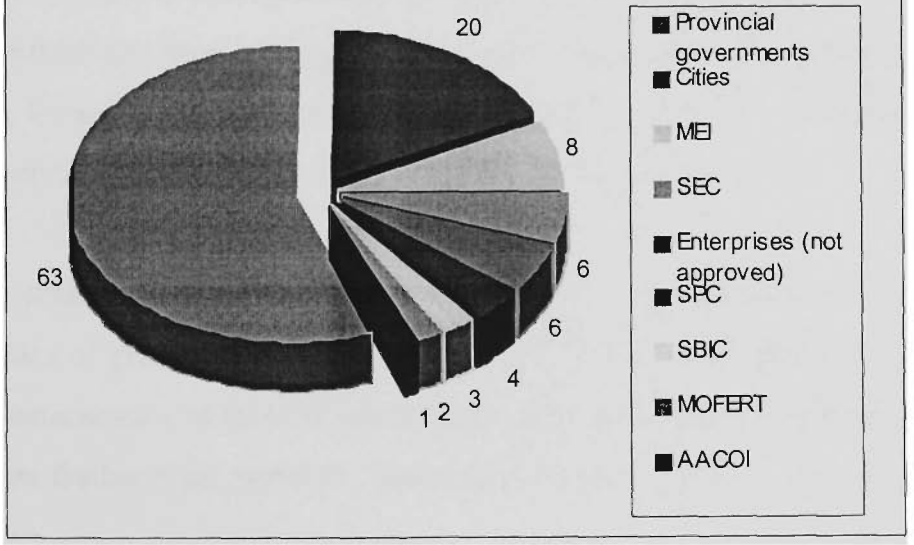
Japanese firms in the electronics industry took advantage of this situation in China and sold the same assembly lines to hundreds of small Chinese state-owned firms, through the big and well-informed general trading companies. Their remarkable business performance in China is outlined below. Nearly 100 Chinese state-owned firms imported 124 models of assembly lines between 1978 and 1986. Japanese firms sold 90 percent of

[11] No.4400 Factory: those factories that used to belong to the former military industry, for security reason were entitled by serial numbers.

them with limited technical assistance. Of these assembly lines, 13 came from JVC, 8 from Panasonic, 7 from Hitachi and 6 from Toshiba (Wang, 1987).

Thus the greater autonomy in import dealing rights provided to local governments had triggered vast growth in CTV assembly line imports. Since local governments can import goods directly within certain foreign currency limits, they tended to consider only on how to quickly spend limited foreign currency in hand and to meet market demand. Chart 4.15 shows the composition of the total of 113 (from 1979 to 1985) imported CTV assembly lines that were approved by different administrations. Of these 113 assembly lines, local governments (including provinces and Beijing, Shanghai and Tianjin the three municipalities directly under the Central Government) approved 83 lines, accounted for 73% of the total. The Central Government approved 18 lines (SPC 4 lines, SEC 6 lines, and MEI 8 lines).

Chart 4.15: Number of Imported Assembly Lines Approved by Various Agencies



Source: Edited from 1987 CEIYB, 1987, Electronic Industry Publishing House, Beijing.
Notes: SBIC: State Bureau of Industry and Commerce
AACOI: Aid Administration Commission for Overseas Investment.

The direct intervention of government leaders was believed to have contributed to the boom in the CTV industry (CEIYB, 1987). Individuals in powerful positions influenced

the whole authority system. Giving an instruction for a particular project directly to a project approving system was a common phenomenon. The local government or company used the superior's endorsement to pass all the necessary approving stages. Personal relationships between a particular leader, local governments and company was the key in many successful cases. A commonly used excuse for doing favourable things was 'to support a poor region through a potentially profitable project'.

Three policies had significant influence on the CTV industry in this period. Firstly, the introduction of an import and export licensing system, for the purpose of reducing foreign currency expenditures (Xiang, 1986), substantially reduced the level of imports of consumer electronics products. This led to trade deficits in 1984 and 1985. Secondly, the promotion of an import substitution strategy, which focused on enhancing domestic manufacturing capacity by spending the limited foreign currency resources effectively. Third, the impositions of strict restrictions on the import of TV assembling lines and CTV picture tube-manufacturing lines. This was an implication of the State Council decision (State Council, 1985). The aim of this decision was to switch the technology transfer policy from favouring complete plan purchases to targeting the enrichment of the domestic technology level by importing essential equipment. To implement the intention of the State Council, the MEI directed 22 assembling lines to stop operation, and required 29 lines to operate under strictly controlled conditions (Wang, 1987).

The policy practice in the technology import area is worth considering as a mirror to the characteristics of government learning in the early stage of the economic transition. One of the characteristics was that the immediate response to a previous policy failure was on emphasis on further tight controls. There was no clear sight on the leading role of the policies.

One of the lessons that China learned from the experience of the CTV imports was that, after a complete set of equipment had been imported, China could then identify the key parts of the set that have to be imported and the parts that can be produced locally. This would help to save limited foreign currency, and to avoid importing the same products

from many countries. Apart from this, it was learnt that in order to make maximise use of imported technologies, there are two factors that play very important roles. The first is 'absorptive' capacity, which is the capacity to absorb and assimilate imported technology. The second factor is to select appropriate technologies. A right selection can only be made with sufficient understanding of both the technologies themselves and the environment in which they are to be utilised. China's assimilation of imported technology was not very successful, because of shortages of raw materials, lack of a reliable power supply, low work force skill, and a shortage of service and applications personnel. However, as only a quarter of the production capacity of the CTV was in operation by the end of 1985, the other three quarters added a significant cost, which alarmed policy makers. Nevertheless, the strictly limited quantity of CTV production reduced further the requirement for foreign currency, and closing nearly a fifth of the assembling lines avoided crises away from insufficient supply of raw material and components.

China's electronic industry, like most other industries, was far from implementing advanced technology. After spending over $2 billion on imports of technology and equipment to modernise its electronics industry, China's electronic industry was still about 10 years behind the international frontier in most areas in 1985 (Li, 1986).

4.4.3 A Profile of CTV: Road of Changhong

The rapid growth during 1980 to 1985 had been mainly fuelled by a boom in consumer electronics (Yu, 1986). The transition from plan to market in the Chinese electronics industry was impressive. The output of electronics grew from 10 billion yuan in 1981 to 28.6 billion yuan in 1985. The Chinese electronics industry benefited from the boom in household appliances in the 1980s, especially in television sets and audio equipment (Xiang, 1986; Yu, 1986). This boom in consumer electronics drove the industry's growth, not only by increasing production lines, but also by boosting the purchase of television related products, such as picture tubes and semiconductors.

Radio and television expanded rapidly in the 1980s as important means of mass communication and popular entertainment. By 1985, the broadcasting system of China

covered 75% population with total of 215 million radios, through 167 radio stations and vast wired loudspeakers system. Television was growing at an even faster rate, its production increasing from approximately 0.5 million sets in 1978 to over 10 million by 1984. An estimated 85 percent of the urban population had access to television (CEIYB, 1986). A total 4.3 million units television sets were produced from 1980 to 1985. In the television market, there was a strong swing from black and white to colour sets in the early 1980s. In terms of the number of units sold, the average annual growth rates in the period 1980-1985 varied from 12.4% for television to 18.4% for audio systems (CEIYB, 1986).

All these exercises benefited the development of the electronic industry, and the reform policies, such as the conversion of military orientated companies, the open door policy and the greater autonomy in relation to imports provided a favourable environment for the exercises to take place. China's electronic industry was growing through these experiences. Changhong, a former military-orientated company, had experienced the whole period of transition from the start. The case of Changhong is a mirror of such a process that is worth mentioning here.

The conversion of the former military companies had succeeded with remarkable results. Changhong is a typical case. Those companies faced the transition in two senses: the transition from plan to market and the transition from military-oriented to civilian-oriented company. It was a process in which to learn how to survive the transition.

Changhong was a state-owned company, a former military-oriented company. It was located in the centre of Shichuan province, a shanxian qiye[12]. It was one of 156 major national projects built in the First FYP. Its only product was radar equipment before 1972. Changhong started the transition much earlier than other companies. In 1972, it began to manufacture televisions as their main product, by taking the advantage of the fact that the company owned relatively advanced technology and the potential market for

televisions. From that time, everything including purchasing material, product production and marketing had been the company's responsibility. In 1976, Changhong built a manual television manufacturing line and trial-produced a small number of television sets. It was a low standard manufacturing line but it gave the company enough confidence to further pursue this direction.

In 1979, Chinese electronics companies began the conversion from the defence industry to the civilian industry; television became very attractive to those companies, and many of them chose television as a product, which might help the company to survive. So the competition became fierce in the Chinese television market. Changhong located in the Shichuan province was disadvantaged in comparison with other companies at the coast. However, with its early experience on trial-production of televisions, it also had a technology advantage from making radar equipment that was similar to television. So Changhong was in a strong position to compete with other companies from the beginning.

Benefited from China's open door policy, Changhong acted early. In 1980, it imported China's first CTV assembly line from Japan and it was the first time technology cooperation with Panasonic. Following that, Changhong designed, manufactured and installed a black and white assembly line. From 1982 to 1984, the output of Changhong televisions was more than 100,000 units, reaching 230,000 units in 1985 (Lu, Zheng and Tian, 1991).

Its early involvement in the transition gave Changhong a strong position to compete in the television market of China. In 1984, China imported about 100 CTV assembly lines, which made the competition immense. Considering Changhong's market position and self-capability, it took a big risk to import a new CTV assembly line with a production capacity of 1000 units for single shift per day. The decision was made to achieve economies of scale, because the CTV industry requires scale output to reach high profit.

[12] Shanxian qiye: these companies were built in central of China for defense purpose. They were normally located deep in the mountains far from cities and public transport, and were individual isolated

Although Changhong had experienced a difficult financial environment as other companies in the industry, it successfully built the last imported CTV assembly line in China in 1986. It had the highest single shift output per day in China (Lu, Zheng and Tian, 1991).

The performance of Changhong was remarkable, in 1985, it ranked number ten in Chinese electronic companies according to sales income, number eight in 1987, number three in 1989, and number two in 1990 respectively. In 1990, for two years, the CTV output of Changhong was on top of the list in China; for three years, the profit and tax of Changhong was on top of the list in China's electronic companies. It is a successful case. It had developed the ability in designing and manufacturing radar, television, apparatus, motor electronic product and medical electronic equipment. Because of its abundant technical ability in developing defence products in three decades before reform, its technology capacity was more advanced than a lot of other companies (Lu, Zheng and Tian, 1991).

The government policy in this period was to give companies increasing opportunities to participate in the process of learning the rules of the market, to achieve economies of scale and to develop self-capacity. The practice was significant, because from this practice, companies learnt to be an independent company with decision-making rights and to train entrepreneurs in decision-making abilities. Before the transition, people in China had been trained to do anything and make any decision following an instruction from higher authorities. Instead of taking a lead from the market, the learned behaviour in the highly centrally controlled environment was to wait for instructions from higher authorities, and it was called: 'looking for help from the Mayor not the market'. The process that Changhong experienced was a practice of looking for a solution from the market rather than from the government.

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communities.

Conclusion

As China was seeking to make fundamental changes in its overall direction, particularly in terms of economic policy, the two important policy innovations in the electronic industry studied here were important. Undertaking the innovations of selecting consumer electronics as a key product to expand the whole industry and the reorientation of the electronic industry from military to civilian purpose, China's electronics industry faced institutional changes and innovative policies. It experienced institutional change in terms of the reshaping of the authority structure and decision making, and innovative policies were implemented in terms of product targeting, technology policy and promoting exports. These initiatives supplied experience and growth not only to the consumer electronics industry but also to the whole electronic industry. It was a good starting point for continued strategic innovation of the industry.

The CTV case showed that governments and companies both suffered and benefited from these strategic innovations. With ongoing learning, the central government learnt to make choices about how best to import urgently needed technologies to transfer the technologies to local companies. The road of promoting technology policy is a difficult task, and both ups and downs were experienced in the period, and these gave a lesson to policy makers for further policy making. The process of promoting exports was also a valuable exercise, providing important lessons about how to further international competitiveness in the electronics industry, which influenced later developments.

The innovations also brought challenges to traditional planning instruments, and policy makers had to consider not only political requirements but also emerging consumption needs. This was a sign that tight planning could no longer ignore emerging individual interest in the light of a particular conception of national economic development. The CTV case gave an example of the planning system basically working to regularise existing facts. The role of the SPC in the CTV case underlined this feature.

In a certain sense China's electronic industry learnt from the lessons of Japan's development experience (Taylor, 1996). The Japanese priority setting strategy can be seen from product targeting. Also, promoting exports of electronic products is another example of making policy by learning from other country's experience. The most important lesson that the Chinese government took is that any individual country experience has to be put in the context of China's economy and society, and that it needs a great deal of policy practice as well as balanced policies to achieve this result.

The two choices of selecting the consumer electronics industry as a key and of shifting the orientation of electronic products to civilian purposes were critical, and fundamentally changed the structure of the industry and built capacity to provide for the civilian market. Firstly, these innovations built a foundation of consumer electronics, so that by 1985 the total output of consumer electronics stood at about 48% of total electronic products output. Secondly, they laid the foundation for further competition. Even though the total of 124 CTV imported assembly lines was a sign of economic disorder, they later became the base for both domestic and international competition. It is a remarkable fact that the output of CTV accounted for 45% of the total electronics output during 1984-1985. Thirdly, the innovations built the confidence and experience of the whole electronic industry: (1) to deal with foreign companies and to manage large scale manufacturing; (2) to raise awareness of the market and of the need for efficiency; and (3) to stimulate the electronic industry switching to production of civilian products.

In recognising existing realities and committing to an ambitious program of technology acquisition, the electronic industry had taken a step of enormous importance, but it was only a first step. Both the Chinese government and companies still had to learn how to acquire and adsorb new technology most effectively, and this required a great deal of further trial and error.

5. Innovation in Institutions and Policy in the Microelectronics Industry, 1986-1990

Introduction

The rapid expansion of the consumer electronics industry during the Sixth FYP period brought about increased demand for products incorporating integrated circuits as well as potential opportunities for the development of the domestic microelectronics industry. The general status of China's microelectronics production in the Sixth FYP period was that it was mainly at the lower technology level and operating on a small scale. However, in spite of the rapid growth of consumer electronics, the initial stage of development of the microelectronics industry in China was not achieved directly as a result of increased expenditure on consumer electronics products.

Compared with the consumer electronics industry, the microelectronics industry requires much higher capital and technology input, but offers much lower expected profit in the short term. It needs expensive equipment and rapid upgrading of that equipment, at least every five years. The progress of the industry in China has also been severely constrained by its limited financial capacity.

Technologically, the starting point of China's microelectronic industry was very low. Given the restrictions on exports of high technology by Western countries imposed by the Co-ordination Committee for Export Control (COCOM) in Paris, China found it very difficult to gain access to advanced technologies, and this greatly limited China's technological capability. Therefore, it was seen as critical for the Chinese government to undertake a plan to develop the key technology of microelectronics, and to set out innovative policies to create a viable industry.

As mentioned in the last chapter, a concerted effort was required to encourage individual companies to acquire and to use advanced technologies effectively. The government

initiatives in the Seventh FYP period for the development of the microelectronics industry were aimed at promoting such an effort. Although the industry encountered many difficulties in acquiring high technologies and applying them in the Chinese context, the government played a significant role in the process of setting out an appropriate management framework for technology catch-up.

In this period, the national economy was facing important questions about how far and how fast the economic reforms could go. The situation with the electronics industry was that, although on average the growth rate of the industry over the period 1986-90 was, at an annual rate of 18%, faster than the overall industrial growth rate, growth on a year-to-year basis showed huge fluctuations. In 1987 and 1988, gross output of the electronics industry increased by 42.8% and 40.2% respectively, while in the years of 1989 and 1990, the annual rate of increase dropped to 5.8% and 6.0% respectively. This illustrated an unstable pattern of development of the industry and the fluctuations in the overall economic situation in that period. To a significant degree, conflicting ideas and views among policy makers over reform issues also affected the economic performance of China at this time.

There were two major factors that contributed to the inconsistency of government policies and affected economic performance during that period, but that also stimulated innovation in economic institutions and policy and contributed to ongoing government learning. One factor was the theoretical debate about 'how to employ market instruments to serve the planned economy' (jihua jingji yu sichang tiaojie xiang jiehe). The arguments were about how to balance the interests of central and local governments through economic instruments, and how to relate planning processes to the market. It was argued that planning was more favorable to long-term development and to a national focus, while market instruments were more favorable to short-term development and to local development. Most agreed that planning instruments could play their role effectively only if market forces were also recognised, but it was still unclear how to use market forces within a planning system (Liu, 1991).

The other factor was the strong commitment of the government to undertake economic reforms. It encouraged a variety of experiments in terms of policymaking, responding to the interests of the public, the politicians and different interest groups (i.e. different government agencies). Therefore, the action of government was uncertain and very much in the pilot project mode in this period. It was also apparent that all the decisions made during that period were the results of balancing and compromising between different groups.

The microelectronics industry experienced a unique path of institutional change in this period, and government learning played a positive role in the process. This chapter reviews the transitional path of the institutions that affect the behavior and interplay of the contending actors from the state and the industry in the development of the microelectronics industry in China.

This chapter tries to answer the following questions:

- Why did the government undertake institutional innovation in the period of the Seventh FYP (1986-90)?
- What were the determining factors that enabled China to achieve its institutional change?
- What domestic and international circumstances affected the government's choices and actions in terms of the microelectronic industry?
- What were the effects of the government's promotion policies upon the behavior of microelectronics firms and other related actors?

In this specific period, the interactions between policy-making elites, other relevant players in central government and in society will be analysed within the context of the broader planning and policy-making system. This will enable an assessment to be made of how government learning took place to facilitate institutional and policy innovation.

5.1 The Strategic Importance of the Microelectronics Industry

In this section, a brief review of the microelectronics industry and of its situation in China will be given, to show the background of the industry and to facilitate the discussions in Sections 5.2 and 5.3. Four main issues are to be addressed: (1) Microelectronics is not only the driving force of technology development in international experience, but is also a strategic choice for Chinese long-term technology and industry development. (2) Intensive capital investment is vital to develop this industry. (3) Industrial R&D centres and (4) Research institutions and university research centers are fundamental factors for the strategic development of this industry.

5.1.1 Microelectronics as a Technology Driving Force

Microelectronics, the design and manufacture of integrated circuits (ICs), is an important enabling technology for all other segments of the electronics industry. Microelectronics is one of the basic technology drivers of the information age. The modern electronics industry now incorporates increasingly complex circuits in ICs, which are the core constituent of computers, communications equipment and consumer electronics. The development of ICs therefore holds a central position within the entire electronics industry. The incorporation of ICs in electronics equipment has thus become the technology driving force of the electronics industry.

These emerging trends were realised internationally and in China in the middle of the 1980s, at the beginning of the period being studied in this chapter, although expectations inevitably evolved over time. In projections published in 1993, for example, the world market for semiconductors was expected to grow by about 10% per year during the 1990s, from $61 billion in 1991 to $113 billion in 1997. The fastest growth was expected in the Asia/Pacific, as shown in Table 5.1.

Table 5.1: Forecast of the World Semiconductor Market, by Region ($billion)

Countries	1991	1993	1997
North America	17	28.5	40.2
Japan	20.3	18.8	27.0
Western Europe	10.4	14.4	20.3
Asia/Pacific and ROW	7.3	16.5	25.9
World Total	**61.0**	**78.2**	**113.4**

Source: MEI, 1993, cited from the World Semiconductor Trade Statistics Program.
Note: ROW: rest of the world.

The manufacture of computers and telecommunications equipment requires large volumes of ICs. Consumer electronics products have in the 1990s relied more and more on ICs, and this trend will continue as consumer electronics products switch more and more to digital electronics. ICs, particularly microcontrollers, are a vital component of many consumer electronic goods. They are the 'brains' of modern industrial machinery and equipment. As a result of an awareness of these trends, it was recognised in China in the mid 1980s that a country can have a modern electronics industry only if it has a well-established national capability to manufacture ICs (MEI, 1987).

Therefore, the top leaders of the Chinese Government concluded that, to build an internationally competitive electronics industry in China, an essential element was to establish the capability to design and manufacture ICs (Yu, 1987). Having realised the importance of ICs in the process of developing the technology capability of China, the Chinese government started to make policies for the development of this area as a matter of urgency in the Seventh FYP. Two transitions started in the Electronic Industry Seventh FYP were of central importance here. They were:

(1) The transition of the electronic industry from its initially military focus, and its subsequent military and consumer products focus, to serve the needs of national economy, the Four Modernisations program and society in general. As discussed in Chapter Four, the electronic industry had been excluded from civilian production, but the reform in the Sixth FYP period involved reorienting the industry to civilian

purposes. But it produced electronic products only, and seldom attempted to meet the requirements of other industries. The purpose of transferring the orientation to serve the national economy, the Four Modernisations and general society was not only to give the industry a better chance of surviving but also to put the industry in a position to boost the national economy.

(2) The identification of microelectronic technology, computers and telecommunications as preferential sectors, and setting the objective of gradually making the microelectronic industry a dominant sector within the whole electronic industry (Yu, 1987).

However, these were not easy goals to achieve within a relatively short period. According to an official estimate, the gap between China and advanced western countries in leading edge technology for designing and manufacturing microelectronic products was fifteen years at the end of 1990 (CMEIYB, 1991). A simple example to reflect this situation was that, in 1993, the total of 24 China's ICs manufacturers took only about a 20% share of the domestic IC market. This is to say that locally manufactured ICs could not meet the needs of local electronic product producers in quantity and, to a large extent, in quality.

5.1.2 The Investment Requirement

Along with the limited capability to manufacture ICs, constraints on financial resources were a critical issue in developing a modern microelectronics industry in China (CMEIYB, 1991). Finding ways of meeting the investment requirement was a key element of the overall government strategy for the development of this industry.

In 1984, the total investment spending on ICs of the top ten companies in the United States was US$2.874 billion, and that of ten Japanese companies was US$3.1 billion (SSTC, 1989). The most successful semiconductor companies in the United States and Japan would normally invest between 15 percent to 25 percent of sales revenue each year in R&D and new manufacturing facilities (MEI 1993).

There was no single company in China that was in a financial position to undertake comparable investment, nor was the Government able to provide investment on this scale. This was partly because the central government had put more funding into power, transport and agriculture as part of the process for readjusting national economy. The government's expenditure on investment and R&D in microelectronics totaled RMB200 million between 1986 and 1990. Until the end of the Seventh FYP in 1990, total investment in R&D and production lines was RMB1.8 billion (US$320 million). The total R&D expenditure on ICs in the Sixth FYP was RMB36 million, which was 2.9% of sales revenue of 1985 (SSTC, 1989). The total planned investment for China's microelectronic industry in the Seventh FYP period was 1.72 billion RMB (approximately US$0.33 billion) for 35 projects (construction investment 1.09 billion RMB, technical upgrading 0.6 billion RMB) (MEI, 1992).

Even worse, the actual investment accounted for only 55.2% of the plan, due to the fact that the feasibility studies for quite a number of the proposed projects were not properly prepared for them to be considered in the national yearly plan. For example, a large scale IC project proposed by China Huajing Electronics Corporation, which was planned in the Seventh FYP, failed to be listed in the national yearly plan for several years. As discussed in Chapter Four, the purpose of the yearly plan was to embody the objectives of the current FYP through investment, material and production arrangements. If a company's project failed to be listed in the yearly plan, there was no possibility for the company to reach the objective planned in the FYP. There were varying reasons that might result in such a failure to meet the plan. China Huajing Electronics Corporation found it particularly hard to find a foreign partner who would supply suitable technology.

Generally speaking, the IC industry is a high investment intensive industry. With each development stage, a certain threshold level of investment intensity is required. Only if the threshold level is reached can the industry move to its next stage of development. According to the Ministry of Electronic Industries (MEI, 1993), for a company to have economies of scale in the early 1990s to be able to produce a 6 inch 1-1.5 micron technology product, the total investment requirement was about US$0.2 billion. In China,

as mentioned above, total investment in the 7th FYP was 0.95 billion RMB (US$0.18 Billion), for 35 projects.

The total central allocation of resources in the Seventh FYP period for the industry appeared to be not sufficient to purchase modern equipment. The cost of building a wafer fabrication facility used to be around US$50 to US$100 million in the mid 1970s, but it increased to about US$200 million in 1985 and to US$400 million in 1990 (MEI, 1993). The surge in price was driven by the increased complexity of both products and production processes. Only a few of the microelectronics enterprises in China were able to fund the high level of investment required. As a result, only a few companies, such as Huajing and Shanghai Beiling, had fabrication plants close to world-class standards. It was unfortunate but very common that, because of the funding constraint, some companies just imported a piece of equipment instead of a complete production line, and lacking further funding, the imported equipment would almost certainly be lying idle.

It became apparent to the Government that, in dealing with the funding shortage for the microelectronics industry, a better option for China would be to set up joint ventures. Apart from bridging the financial gap, joint ventures could also benefit the industry in the following ways: (1) assist in obtaining the most suitable modern equipment for the new IC fabrication plants; (2) provide training for Chinese staff to operate and service the IC fabrication plant; and (3) gain access to the international market for the semiconductors produced domestically. This awareness was evident in government policy in relation to promoting foreign investment in this area subsequent to the 7th FYP, and was an important result of China's experience during this FYP.

Focused on this particular area, the SPC held a series of seminars late in 1993, to review the experience of the microelectronic industry in the 7th FYP period in China. The SPC normally ran seminars to gather information relevant to particular policy areas, before issuing a new policy. These seminars were aimed at reviewing the successes and failures of past policies and at understanding what the local governments, enterprises and other

related organisations expected of a particular ongoing policy. They were an important part of the policy making process, and a good example of government learning at work.

A very important consideration drawn from the experience of the microelectronics industry in the 7th FYP was that the successful joint ventures in this area were those where foreign investors had a substantial equity stake in the outcome of their investment (IDIL, 1993b). Under such an arrangement, the speed that local engineers and staff mastered a new technology was be faster, because the foreign investors showed a greater willingness to disclose and transfer the 'know-how' of the manufacturing process to the local management teams. Therefore, to attract foreign capital flow into China in the leading edge technology IC manufacturing plants, a shortcut was to have a foreign partner committed to sustaining a project, as a result of having a substantial equity interest. Striking the balance between high technologies brought in through foreign investors and the sacrifice of some benefits by giving up equity shares, was an issue that the Chinese government had to face when making policy decisions. This issue seemed extremely sensitive at this early stage of China's transition from the strictly controlled economic model. Acknowledging the benefits of foreign investor's interest in joint ventures led to a policy where foreign investors could own up to 49% of shares in important industries in China (IDIL, 1993b). This was a significant change in foreign investment policy, and it attracted the attention of big international companies. It also gave the microelectronics industry a chance to gain access to critical technologies from foreign partners. A more detailed discussion about this point can be found in Section 7.4 of Chapter 7.

5.1.3 The Technological Capability of China's Microelectronics Industry

China had successfully developed 5-micron production technology and 3-micron R&D technology at the beginning of the seventh FYP. However, the overall technology level of the industry was quite low internationally (see Table 5.2), and the domestic price of ICs was higher than the international price (see Table 5.3). From Table 5.3, it is clear that the price gap, between Chinese prices and international prices, for ICs for use in consumer products was lower than for other products. The Government realised that the boom in

consumer electronic products in the Sixth FYP had created a market for consumer ICs. Those two tables highlight the general capability of the microelectronic industry of China and its international competitiveness level at the end of the Sixth FYP.

Table 5.2: China Semiconductor Technology Level, 1985

Item	Best Technological Capability in China	Equivalent to America and Japan (year)
Silicon chip	2-3 inches	1972
Equipment	General	1975
Process dimension	4~6	1976
General equipment	Clean workshop	1973
Dirt control	Air shower	1977
Exposure technology	Close	1974
R&D	Computer plotter	1976
CAD		1974
Plate making technology	Pattern generator 10:1 shrink	1974
Encapsulation	Model and porcelain	1975
Product design	8080, 6800, 2102, Z80, 16KDRAM	1976

Source: Research Report of China Microelectronic Technology, State Science and Technology Commission, July 1987.

Table 5.3: ICs Prices: China and International

Types of ICs	Ratio (China/International)
Small scale ICS	1.5- 3.0
Medium scale ICs	2.5- 3.5
TV ICs	1.0- 2.0
HiFi ICs	1.5- 2.0

Sources: China S&T White Paper, p204, 1989 published by Science and Technology Wenxian Publishing House, Beijing.

In terms of the local development of manufacturing processes and of the skills required for the development of industries in China over the past fifty years, the main source had

been the major research institutes and the universities. The same was true for the development of the emerging microelectronics industry.

There were a number of Chinese universities offering courses in microelectronics in the 1980s. For example, a leading university, Tsinghua University in Beijing, had an Institute of Microelectronics with a semiconductor fabrication facility. This institute was undertaking research and development projects to produce prototypes of new types of semiconductors such as MPUs and RISC microprocessors. It also had a library of standard cells for the manufacture of ASICs. This was the best microelectronic research institute among the universities and it played a leading role in developing China's microelectronics technology.

All together, there were about 10 research institutes and 30 companies engaged on IC research in China. The major six research institutes in China conducted microelectronics related research, of which three were supported by the MEI and the other three were supported by the Chinese Academy of Sciences. Two of the six research institutes were specialised in materials used for IC production. The tasks that each institute carried out were decided by the SPC according to a series of surveys based on experts' views and on a balance between the tasks of each institute. Research topics were dictated by the current FYP and each institute was required to bid for funding within this framework. Box 5.1 and 5.2 provide two examples of such research institutes.

Box 5.1: Microelectronics R&D Centre

Microelectronics R&D Centre (MECCAS): The largest and best-equipped R&D centre among six major research institutes conducting microelectronics related research activities was the Microelectronics Research and Development Centre in Beijing (MECCAS). MECCAS had 18,600 square metres of buildings and 5,000 square metres of clean rooms.

MECCAS carried out basic research on sub-micron technology and the packaging and testing of ICs. MECCAS had successfully investigated four kinds of technology (CMOS, Bipolar, BiCMOS and VDMOS) with 2.0 micro geometry. MECCAS was also involved in research in the basic technology of the next generation of semiconductors. The aim of the centre was to become an independent enterprise offering advisory services and the manufacture of semiconductors on a commercial basis.

Source: IDIL, 1993b.

Box 5.2: The Beijing Integrated Circuit Design Center

The Beijing Integrated Circuit Design Centre (BIDC): BIDC was an independent technology research centre supported by MEI. Its main areas of activity were IC designing, IC CAD software systems development, general software development, electronic systems and engineering.

BIDC had jointly developed the Panda System (a VLSI Circuit Design System) in conjunction with the 17 principal CAD R&D organisations in China. The system is capable of supporting the design of semiconductor chips with a complexity of up to 100,000 transistors.

Source: IDIL 1993b.

The manpower engaged in semiconductor manufacture and R&D activities was reported to be 40,000 persons in 1986, and 178,000 persons in 1993. Of this total, 141,200 were engaged in the production of discrete semiconductor devices and 12,600 were with research institutes. There were 24,200 persons in the manufacturing of ICs, of which about 3,000 were management personnel and about 5,000 were technical staff (CMEIYB, 1991).

Generally speaking, the quality of manpower required in the microelectronics industries is very stringent and demanding. Highly qualified engineers, with Masters degrees and above, were in high demand for integrated circuits designing. The manufacturing process requires very competent individuals who can: (1) manage very expensive precision equipment; (2) carry out the stringent procedures required for the operation of such equipment; and (3) manage the hazardous materials that are used in the manufacturing process. China had a very short supply of such individuals. The common practice in China for training such people has been through intensive on site training by the workers from more advanced companies, but this is a slow process.

The situation of the technical skills of researchers in universities and research institutes in China was more complicated. Their knowledge of basic science was generally sound but they had limited experience in applying their research results in an industrial situation. The new joint venture companies tried to overcome this weakness by extensive in-house training programs within their enterprises in China, and in some cases by training abroad.

Based on the analysis of the status of China's microelectronic industry in its financial resources, production and technology capacities, and human resources, three major tasks were laid out by MEI for the Seventh FYP. In order to catch up with world class technologies, developing China's domestic technological capacity was considered a critical step, and the first task. An important initiative here was setting up two microelectronics hubs in China with state of the art equipment and senior research staff. One of the hubs was chosen to be located in southern China, the other in northern China. Another initiative was to position the microelectronic industry as a preferential industry, implying relatively high central funding and supporting policies. The common word used in relation to the electronic industry, and to other industries, was 'position'. This means that when the electronic industry was put into the top position in terms of preference consideration in China's economic plan and policy making, the industry would get more resources, such as funding, specialised policy attention and so on.

The second task was to target IC development as one of the four major projects of MEI[1]. This ensured that the microelectronics industry was a main development target of MEI. The third task was to select a few important IC products and technologies as enabling technologies to drive the electronics industry. This meant that the strategic role of microelectronics in the electronics industry was recognised and stated officially. Again, these two tasks were consistent with positioning the microelectronics industry as a preferred industry (CMEIYB, 1991).

5.2 Institutional Change and Ongoing Government Learning

Because of the dramatic changes in the economic environment in the period of the Seventh FYP, the policy making organs, such as SPC and MEI, faced a puzzling time, while economic development was dominated by Deng's idea of 'groping for stones to cross the river'. In this context of trial and error in pursuit of effective change, and given the strong government commitment to the reforms, the central government agencies needed to re-adjust their functions and to reshape their systems, so as to meet the more radical reform requirements of the State Council and the public.

5.2.1 Investment System Reform

A comprehensive reform of the investment planning and administration system was started after 1984. Firstly, the respective responsibilities of the state, the ministries and local governments in investment activities were defined according to the source of funding. For example, if an investment activity were mainly funded by the central government, the central government would undertake proposal evaluations and the approval process for the project. If local governments funded the activity, then local governments would play these key roles accordingly. Secondly, funding for investment in capital construction and technical upgrading came to be provided in the form of loans rather than direct central allocations, and the overall scope of the two types of investment was bound by the national credit plan.

[1] The four projects were a Large Scale IC Project, Computers Telecommunication equipment and Software.

From 1984 to the end of 1985, fixed asset investment grew dramatically. This generated a huge requirement for production materials, and led to a major boom in the prices of materials. More generally, China's economy suffered accelerated inflation, to which the investment boom was a significant contributing factor.

From Table 5.4, we can see that the total investment in fixed assets in China in 1984 and 1985 was RMB105.2 billion and RMB152.3 billion respectively, compared with RMB88.5 billion in 1983. The national retail price indices increased at an average of 10.1% per year in this two-year period.

However, because of the dual track[2] of material prices, this retail price did not include the much higher market prices. But these higher prices could be seen from the extent of the boom in bank loans, which were mainly used in buying materials. Bank loans increased much more rapidly than planned, with the annual rate of increase in bank loans being 26.6% between 1984 and 1985, 29.4% in 1986, 28.5% in 1987 (NBS, 1991, p95).

Table 5.4: Investment in Capital Construction and Technical Updates and Transformation (RMB billion)

Investment	1983	1984	1985
In Capital Construction	59.4	74.3	107.5
In Technical Updates and Transformation	29.1	30.9	44.9

Source: Page 140, *China Statistical Yearbook 1995,* China Statistical Publishing House, Beijing.

To curb this credit expansion, unprecedented in the history of the People's Republic of China, on 12 January 1986, the National Planning Conference[3] discussed and revised the

[2] Dual track prices of material in China was started in the 1980s. Because the requirement of material was much higher than the planned quota, dual track pricing was launched. It consisted of a fixed planned price for the material with a quota, and a market price for the material traded in open market the price could float.

[3] National Planning Conference: it is a top national economic conference, it ran yearly by the SPC to discuss current year economic issues and the next year planning. It used to decide the planning quota of

Seventh FYP in ways that had a profound impact on China's investment system reform in the remaining years of this plan.

At the conference, the critical problems that had developed during the year were reviewed, especially the factors that had contributed to an overheated economy: (1) investment allocations which depended on departmental or local subsidies that did not correspond well with the national interest; and (2) autonomous rights, responsibilities and benefits were divorced from each other, and the body carrying out the investment did not have to bear the risks involved. That meant they were not responsible for the result of the investment activities and did not suffer if the return was not as expected. The lack of such accountability was seen to have encouraged investment by local governments. Because the interests of local governments were focused on the number of projects and the total volume of investment, which had been the key factors used to judge the performance of local leaders, they encouraged investment without being responsible for the results of the investment activities. Thirdly, the managers of investment activities, without self-disciplinary mechanisms and outside pressures, were focused on getting any possible investments and projects, and the returns on investment were not the decisive factor. In addition, too much attention was given to short-term returns, especially in the manufacturing industry.

Based on the above understanding, the idea of reasserting central control was formed. At the conference, there were different ideas within the ruling circle concerning the extent of economic reforms. The core issues related to whether there was a need to control the scale of investment and to readjust the structure of investment. The powerful Chen Yun camp took a more moderate stand towards economic reforms than some others (Wang and Fewsmith, 1995). They believed that the problems of the Chinese economic reforms could be addressed most effectively through heavily controlling the scale and structure of

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essential materials and products of local governments, so usually top leaders of local governments participated in the conference. It also was an important time for the SPC, to launch and discuss new policies and planning issues, and for local governments to report and address local economic issues and problems. Usually, the national yearly plan would be finalised in the conference, and local governments and ministries would have their planning conference to finalise their planning based on the quota and decision of the national planning conference.

investment. Chen's view played a dominant role and had gained more acceptance than other views among the top authorities (Wang and Fewsmith, 1995). This view became a consensus in the conference, as is evident from two facts. Firstly, Premier Zhao Zhiyang addressed these issues as the key to stable economic development at the beginning of the conference. Secondly, Chen Yun, the executive member of the Central Consultant Commission, the real controller of the SPC, and Vice Premier Yao Yilin addressed these two important issues, controlling the investment scale and readjusting investment structure, in later conference speeches (Wang and Fewsmith, 1995).

The conference lasted more than twenty days, and it became a stronghold for Chen Yun's central control ideas. The revised Seventh FYP subsequently announced incorporated Chen's balanced growth philosophy. Although all agreed on the principle of 'readjustment,' the debate on how to actually allocate resources remained tense. The microelectronics industry was squeezed by the process of macroeconomic readjustment, and it struggled hard to attract more resources from the central government.

Following the adoption of the balanced growth philosophy, a further investment system reform took place later to improve the efficiency of investment. In 1988, the Capital Investment Fund and state specialised investment companies were formed to overcome over-centralised investment activities, unstable financial sources, over-investment and low efficiency (Huang, 1988). The principle of this reform was that the limited investment funds available should be used in key national projects and in high return projects. To reach its goal, there was a need to ensure that critical national projects received stable investment input and supported other competitive projects offering high returns. The funds for such support came from the construction budget of the national finances. The advantage of this fund was that it provided a secure financial source once the investment scale of a given project had been decided. The funds would be appropriated to the project administrator on a yearly basis until the full investment was reached. Securing enough investment funds for key projects was critical for projects in agriculture, infrastructure and other areas.

Selecting projects with high returns was also valuable for re-building the fund and keeping the fund growing. The state specialised investment companies, acting on behalf of the state, undertook investment activities according to the SPC's plans, and their interest was mostly focused on high yield projects.

The microelectronics industry was neither on the priority list of the central government as, for example, were the agriculture and infrastructure sectors, nor among those high yield projects. Thus the microelectronics industries did not get enough attention from either central or local governments to attract a large amount of funding. This was mainly due to the fact that the immediate target at the time, for the governments at all levels, was to break the bottlenecks to economic development, which were in the areas of energy, transport and raw materials production. In China, the electronics industry, as a whole, had been categorised into the machinery industry, which usually gained less support from direct government finance. Because of the long historical influence of the Soviet system, the electronics industry was a strategic industry and hence was a highly classified industry. Therefore, the industry was developed in limited areas, especially when the national budget was tight. Within the electronics industry, the microelectronics industry was less attractive than consumer electronics and other equipment products in terms of immediate returns, so it was not of interest to the specialised investment companies either.

The most important change from 1986 to 1990 was the gradual reduction in the role of central planning. This is most evident in the decline in the share of total industrial investments that came under the plan. Both the shares of investments controlled by the SPC and the share of investments in state-owned enterprises financed through the central budget declined dramatically since 1978. The role of mandatory planning through production quotas and the use of the material supply system for the allocation of inputs to meet these quotas was drastically weakened. The number of key materials allocated through the central material supply system and under the control of the SPC and industry related ministries was reduced from around 211 in 1978 to 23 in 1988 (Liu, 1991). As noted above, as part of the economic reform process, local governments and firms had

gained a fairly large degree of autonomy in regard to areas of investment. When there were no incentives in place to encourage them to invest in projects with relatively low returns, such as in microelectronics, understandably they would invest in projects with high returns or immediate benefits to local development. Microelectronics was not on their agenda.

While investment was undergoing a decentralised movement, ownership reform in industrial firms also started. As this reform proceeded, the changing nature of industry ownership reshaped the behaviour of enterprises, as well as their sources of funding. It has transformed an industrial system dominated by state ownership, which had central or mandatory planning as the principal means of resource allocation, to one where the state owned less than half of industrial companies and hence where mandatory planning played a secondary role. In 1978, the total output of the state owned firms accounted for 77.6 per cent of gross industrial product, while collectives accounted for the remaining 22.4 per cent. Fourteen years later, in 1992, the share of state enterprises had fallen to 24.1 per cent and the share of collective enterprises and new forms of ownership accounted for the remainder.

The decline in central government control led to a decentralised investment structure, which no longer directly corresponded to perceived national priorities. Huge amounts of investment funds flooded into local government budgets, while the amount that was available to the central government was insufficient for the large number of national projects.

The microelectronics industry needed the intensive investment, which used to come from the central government, but the investment system reform and the ownership changes meant that government could no longer be the main funding source to the industry. The investment system reform and the ownership changes pushed the microelectronics industry to look for new ways to access financial sources. The Specialised Funds proved to be a successful way to facilitate the industry's growth, as would be discussed in a later section.

5.2.2 Government Restructuring

As the process of market reform and decentralisation proceeded, the requirement for institutional change in government agencies became more urgent. It became apparent that the structure of various ministries built upon the strict central planning system could not work properly in a decentralised environment. As discussed earlier, before the reforms the functions of government ministries had been to deal with individual projects, with the allocation of materials and with direct supervision of affiliated companies (such as the appointment of senior staff, the transportation of products and materials, and so on). Because of direct control by the ministries of the whole process of production, local government had no influence at all on these firms although they were located in various provinces. At the same time, since the government ministries worked on every detail of a company's operation, the companies did not enjoy any flexible management of their production. Therefore, restructuring ministries seemed a necessary step, and giving more autonomy to local governments and to companies was seen as the critical element in the government restructuring (Liu, 1998).

In responding to the need to change government functions, an institutional restructuring was proposed on 9 April 1988 at the first session of the Seventh Conference of the National People's Congress, and a decision on the restructuring was made at that time. The merger of the Ministry of Electronic Industry and the Ministry of Machinery Industry was a typical case, and one, which was initially targeted as a pilot project of institutional reform. This process of restructuring had a strong effect on the development of the electronics industry in the period of the seventh FYP.

In the restructure, the Ministry of Machinery and Electronics Industry (MMEI) replaced the Ministry of Electronics Industry and the Ministry of Machinery Industry. The new Ministry started operating on 13 July 1988. It was aimed at combining machinery and electronic industries as one industrial ministry. A total of 26 departments were formed, and they were mainly based on the organisational system of the former Ministry of Machinery Industry. Thus there were 23 departments, which were machinery orientated,

and three departments were given titles related to the electronics industry. These were communication and broadcasting, computer and part and implementation departments.

The challenges to the electronics industry were mainly in two parts, one of which was the conversion from military orientation to civil orientation. This involved not only new organisational settings but also new operational ways. The other one was the pressure from other industry ministries, who made strong calls to combine electronic technologies into traditional product production. The idea was that the electronic technologies could play a driving role only if they were closely connected to traditional industries.

Apart from the restructuring of the ministries, another focus of this reform was to shift the function of ministries from overseeing all subordinated enterprises, no matter whether they produce socks or radios, to the function of supervising all enterprises whose main products belong to their industry, no matter which ministry the enterprises were affiliated with. Thus the management function changed from departmental management (bumen guanli) to industrial management (hangye guanli). For example, computers were produced mainly by companies affiliated with MEI and the China Academy of Science (CAS), but under the departmental management framework the policies and regulations issued by MEI would only cover the companies affiliated with MEI. The CAS might have its different set of rules to cover the computer companies under its authority. The industrial management meant that the policies and regulations issued by MEI would apply to companies affiliated with both MEI and CAS.

At this time, the machinery industry was considered a key sector in the national economy as it supplied equipment to firms affiliated with all other Ministries. Nevertheless, this huge industry was very technologically backward and inefficient, and needed to be improved by applying advanced electronics technologies. The idea of merging the two Ministries into one was originally put forward by senior leaders, mainly by Mr. Zou Jiahua[4], who used to work in a research institute for digital machine control. From his

[4]He was a member of the Committee of State Affairs and Minister of the Ministry of Machinery Industry, in charge of industry, transport, and communication in the State Council.

earlier experience, Mr Zou had a strong belief that electronic products were very important to improve the efficiency and capability of the machinery industry. As the minister of the Ministry of Machinery Industry (MMI) at the time, he made a big effort to promote the utilisation of electronic products in machinery manufacturing. Because of the split administration system between ministries, he had no power to force any companies affiliated with MEI to use effectively the resources of those companies, such as technology and human resources, to implement his ideas. Another important point, that played a vital role in this institutional change, is that politically Mr Zou was more powerful than the then Minister of MEI, in that he held a position in the State Council. This had meant that the influence of the machinery industry and MMI was greater than that of the electronics industry. Therefore, the dominant idea for the restructuring was that the electronic industry should serve the machinery industry's development.

Consequently, the main work of the new Ministry was confined to the traditional machinery industry. The initial consideration of reconstruction of the traditional machinery industry by advanced electronics technologies and products did not proceed well, because the electronics industry was not able to play the expected role. The Ministry structure determined which people played the leading role and which played supporting roles in the ministry. It was clear that the advanced electronics industry had its specific development paths, which were quite different from those of the traditional machinery industry. Further, the development of the electronics industry was not only essential to the machinery industry but also to all other industries, and was particularly important to the increasing international technological competitiveness of the whole nation. The proposed role for the electronics industry constrained the industry to facilitate the development of the machinery industry. In addition, it resulted in conflict between the staff from the former MEI and MMI in the new ministry. The former staff of MEI felt that they played a supporting role in the routine work of the ministry, and were not satisfied with this role.

The restructuring of the administrative system did not bring efficiency to the operation of that system either. Such a dramatic change in the institution greatly affected the

continuity of policies and of effective management operation. The enterprises that were supervised by the former MEI or MMI paid much more attention to managing the relationship with the new authority (Liu, 1998). At the same time, the initial search for a new way to manage the industries failed because of the difficulties encountered in balancing the interests of the two previously independent Ministries. One of the most important reasons was that new policies and reform strategies of the two previously different bodies were not the same and were not synchronised, so that the system could not operate properly. The system was split into two parts, with each party addressing their own issues and following their own traditions in the management of daily operations.

To better address the development needs of the electronics industry and the institutional hurdles the industry was facing under the new ministerial arrangement, the China Electronic Industry Corporation (CEIC) was finally established in June 1991 (Liu 1998; EIYB1992).

The CEIC was formed from three parties, namely:

- the former China Information Industry Corporation;
- all the MMEI affiliated electronic enterprises and associations; and
- the electronic enterprises and organisations which were re-centralised according to the State Council's 'Approval on MMEI's Decision on Regain the Supervision to Part of the Previous MEI's Enterprises'.

The following were three important features of the CEIC:

(1) The CEIC held a ministerial position as high as MMEI, and was independent from MMEI in the planning system. For other companies, their planning (on investment, production, human resources, and so on) was brought into either a ministry's plan, if they were supervised by the ministry, or a local government's plan, if they were supervised by the local government. In the case of CEIC, and with the authorisation of the State Council, the plan was handed directly to the SPC. This placed CEIC's

plan as one of the plans sent by all ministries and local governments into the SPC for the inclusion in national plans, and MMEI had no right to influence CEIC's plan.

(2) The chairman and president of CEIC were directly appointed by the State Council. This meant MMEI could not appoint the leaders of the CEIC, as MMEI did to other enterprises.

(3) The staff of CEIC were mainly recruited from the former Ministry of Electronics Industry, so the daily routine was mostly run in the same way as former MEI. In fact, it was a new MEI in terms of its functioning.

The duplication of the responsibilities between CEIC[5] and MMEI made the relationship between MMEI and CEIC quite complicated, and MMEI had no way to actually manage the CEIC.

After two years of conflict between the MMEI and CEIC, a strong call to rebuild the Ministry of Electronic Industry was finally put into effect. In June 1993, according to the restructuring plan of the State Council approved by the first session of the Eighth Conference of National People's Congress, the new MEI was launched.

Summing up the institutional changes in this period, it is apparent that such repeated changes did not generate a favourable administrative system for the microelectronics industry. One lesson that can be drawn from the history of such changes is that organisational change within government does not necessarily mean functional change, and that political influence often shapes the directions and principles of institutional change in China. In terms of government learning, that this occurred is evident from the continual response to perceived inadequacies in the administrative system for this industry. But it was not sustained, shared and effective learning, as evidenced in the

[5] For the responsibility of CEIC see 'Buildup of China Electronic Industry Corporation and Performance in 1991', 1992 Electronic Industry Yearbook.

continual change in administrative structures and the lack of any steady progress towards a more effective model.

5.3 Innovative Policies

5.3.1 Specialised Fund and Tax Package

As mentioned in an earlier section, one of the objectives of the institutional restructuring was to replace the direct administrative control in the handling of economic matters with indirect measures, such as policies in relation to prices, taxation, interest rates, and the exchange rate. These are the 'prices' that provide the signals and incentives for enterprises to change their behaviour. Several strategic choices had to be made. Many of them emerged from the structural changes in the economy, which called for other institutional and policy-making responses.

The central government had attempted to restore some of the balance between industries by centralising investment controls over a smaller number of sectors, such as power, transport and raw materials. This had helped to stabilise the proportion of resources going into priority sectors such as infrastructure. Unfortunately, the microelectronics industry was not considered as a top priority at the national level, even though its critical role in the modern economy was recognised.

Due to the surge in prices and the urgent need to control inflation in the middle 1980s, and the decline in central government control over investment, additional measures were needed to guide the flow of resources into priority sectors. As outlined above, the central government reimposed control on investment, largely through the allocation (or restriction) of loans to priority (or non-priority) sectors. These controls had been introduced under the guidance of 'industrial policy'.

Industrial policies were aimed at increasing industrial efficiency and restructuring the industrial sector along the lines of comparative advantage, both domestically and

internationally. In addition, they were also used to correct structural imbalances in the composition of investments. The SPC was in charge of implementing and coordinating industrial policies during that time. It drew up a list of priority sectors as well as a list of industries to be restricted, discouraged or banned. The list served as a guide to identify areas where investments should be cut in the short run, for cooling off the overheated economy and rectifying the structural imbalances between sectors.

To achieve the necessary shift of resources into priority sectors, the government had relied heavily on its 'state key projects' program, as also noted above. This program consisted of large projects in priority sectors, normally defined as 'important to national wellbeing', such as large infrastructure projects, important industry projects and so on. They were not necessarily huge in terms of investment volume, but were seen as critical to the nation. Those selected were assigned 'key project' status by the State Council.

In order to attract attention to the consideration of the microelectronics industry as a state key project, there were serious calls for immediate attention to the microelectronics industry at the time. After a heated debate among the various authorities involved with the industry, it was accepted that the microelectronics industry held a strategic position in relation to the national economy and defence. Following a series of surveys and discussions, an agreement was finally reached between SPC, MEI and the Ministry of Finance (MF) in 1987. The heart of the agreement was: (1) to set up a Specialised Fund[6] from MF to finance a few key sectors of the electronics industry, including microelectronics; and (2) to issue a priority policy to support the key sectors in the electronics industry.

As a young and very dynamic industry, the microelectronics industry needed a government policy framework that was more supportive than what had been enjoyed by other industries. It also needed an environment where the cost and the price of semiconductors in China would not substantially exceed the international level.

China had intentionally avoided using import controls and high levels of tariff protection for the semiconductor industry. Such protection would help the industry to make higher profits domestically in the short run but would discourage the enterprises from making the industry more efficient and internationally competitive.

As China expected to export a high volume of final electronic products that included semiconductors, it was vital that semiconductor prices were kept internationally competitive. As semiconductors accounted for on average 15 per cent of the cost of manufacturing a computer (IDIL, 1993b), if the microelectronic industry was given protection the computer industry could lose its international competitiveness.

Due to the high degree of uncertainty, investments in capital-intensive projects with long payback periods appeared much less attractive than investments that could be recouped in a few years, as was the case with many investments in light industry. It was widely acknowledged within the Chinese electronics industry that the microelectronics industry was a low profit industry in the short to medium term. On one hand, Chinese microelectronics enterprises were disadvantaged in terms of their financial situation for supporting huge investment in R&D. The government funds for establishing plants and training human skills in China mainly went into the design of chips. On the other hand, users of ICs preferred to import them than to purchase domestically produced goods.

Therefore, the Chinese microelectronic industry was in the situation of producing low quality, standardised products. For China to participate in the microprocessor and DRAM segments of the world semiconductor market would require high volumes of output, massive investments in plant and machinery and a very high level of R&D in order to compete with the large existing players.

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[6] A Specialised Fund is set for a particular purpose to support a sector in China. Normally the fund is from the Central Government accompanying favour policies, such as zero to low interest rates to fund users, zero to low tariffs to import key equipment, etc.

Since the upgrading of processing technology depended much on using new equipment and materials, which needed substantial import, an import incentive scheme needed to be in place to accelerate the development of the industry. On 18 March 1987, a document entitled 'Free Custom Duty of Major Imported IC and Other Projects' was issued by the China Customs General Administration and the Ministry of Finance. In Oct 1986, the Number 122 Standing Committee (Changwu huiyi) meeting of the State Council initiated a proposal regarding the development objectives and strategies for China's electronics industry.

The principle of the proposal was to exempt from customs duty imported equipment for major IC projects, such as computers, software and programming control-switching equipment, during the Seventh FYP. After consulting with the SPC, the State Economic Commission (SEC), State Science and Technology Commission (SSTC) and the Ministry of Electronic Industry, the decision had finally been made and the valid period was from 1987 to the end of 1990 (MOF, 1987b). The customs duty decision exempted imports including equipment, apparatus and instruments, and special materials. The conditions for enjoying the benefits of the policy were that: (1) the project that needed to import had to be approved by SPC together with SEC and SSTC; (2) the equipment to be imported had to be selected by public bidding under the close supervision of a censor official of SEC; and (3) the approved plan, and import list, were to be handed to the Customs General Administration (CGA) (haiguan zongshu) (GOC and MOF, 1987).

Furthermore, as a complement to the import incentive scheme, on 19 August 1987, in line with an understanding reached within the four central administrations (SPC, SEC, SSTC and MOF), a further tax incentive scheme for promoting the industry was launched by the Ministry of Finance. The scheme was 'Reducing or exempting product tax and R&D funds for IC products, computers, software and programming control switching equipment'. In the period of 1987 to 1990, the tax benefits that the four products[7] enjoyed were: (1) starting from 1 July 1987, value-added tax and sales tax for the four products were exempted; and (2) starting from 1 June 1987, income tax on the producers of these

[7] See note 2.

products was reduced by 50%. While enjoying the tax benefits, companies were required to retain up to 10% of sales income as their R&D fund (the ratio of R&D to total sales was less than 1% in 1987), based on the principle that after the 10% mandatory retention the companies would still have profits (GOC, 1987).

Up until the end of 1990, the benefit of this priority policy, such as tariff, value-added and sales tax exemptions, added up to 800 million RMB. In addition, the electronics industry development special fund was formed, and tax privileges were provided, to encourage enterprises and R&D institutes to carry out national projects. The fund of 471 million RMB was distributed to improve R&D capacity of 22 manufacturing lines of the four products (MEI, 1995).

As powerful tools of industry policy, specialised funds and tax packages for the development of the microelectronic industry no doubt played a significant role in the development of the Chinese IC industry (MEI, 1995). The output of ICs increased from 50 million units in 1985 to 200-250 million units in 1990, although the level of investment was still short of the needs of the industry. Chinese IC enterprises were not in a position to self-fund R&D - only 9.2% of R&D input was funded by the enterprises themselves, with the remaining 90% being solely reliant on government funding (SSTC, 1987). The government's expenditure on investment and R&D in the microelectronics industry totalled RMB 200 million between 1986 and 1990. But, as also noted earlier, this was not even comparable to a single firm's R&D investment in Japan. For example, the tenth Japanese semiconductor company in 1987, Sony, undertook R&D investment totaling US$299 million between 1979 and 1984 (IDIL, 1993b).

5.3.2 Import Technology Policy

Another policy issue that was important in relation to the microelectronics industry is the policy on imports of technology. Industrial competitiveness in developing countries depends substantially on how well individual companies manage the process of technological and managerial development. Technology is not perfectly transferable like

a physical product; it has many elements that need the buyer to invest in developing new skills and technical and organisational information. Technological development thus does not necessarily mean creating entirely new technologies but at least at the start, it means efficiently using imported technologies.

The process of gaining technological competence is not instantaneous, costless or automatic, and it had been particularly difficult for the Chinese microelectronic industry. It is risky and unpredictable, and often the way of gaining technological competence has to be learnt; the development of competitive capabilities may be costly and prolonged, depending on the complexity and scale of the technology. It involves interactions with other companies and institutions; apart from physical inputs, it needs various new skills from the education system and training institutes, and technical information and services.

It was important to the industrial competitiveness of China that, while the industry invested in 'embodied' technology (plant, equipment, licences, blueprints, and other external inputs), this was accompanied by investment in skills, information, organisational improvements and linkages with other companies and institutions.

The microelectronics industry features rapid new product development and fierce competition for any commodity IC produced in large volume. As the main cost lies in the design of the IC, prices tend to fall once a company has recovered its high start up cost. Local electronics enterprises, whether they are computer, consumer electronics or telecom equipment manufacturers, would switch over to using imported ICs if the ICs produced locally are not of the same or better quality and of similar price/quality performance as those available internationally. In such an environment, inaction by the Chinese industry would be dangerous.

A faster and more effective way to gain technological improvement is to import technology from developed countries. Foreign technology is the primary input into industrial technology development in developing countries. Facilitating access to foreign technology is a critical part of any technology policies. However, the international

technology market is not like a physical product market, where sellers, prices and terms are relatively well known to buyers, so that the transaction can be completed in a clear way. The technology market is different. Technology is not perfectly transferable like physical products. It involves a very high cost in searching for buyers, especially while sellers are new, small and are not well known to the international marketplace.

China was disadvantaged in the international technological market, because of western countries' ban on the Chinese access to advanced technology. The international market was often fragmented and oligopolistic, with information asymmetrically distributed between buyers and sellers. Once purchased, the effective use of the technology required complementary physical and human inputs that could also be difficult to locate and price.

In China, the unbalanced human inputs to the microelectronic enterprises made the use of technology even harder. At the end of 1990, 70% of R&D staff worked in universities and research institutes mainly focused on basic research, and only 30% of R&D staff worked in enterprises for applied research (CEIYB, 1992). Thus, China's microelectronics industry had been undertaking a hard and complicated path even in terms of the import of IC technologies (CPLOMEI, 1992).

From 1979, when the No. 878 Factory[8] imported the first IC manufacturing line in China, up until 1988, China imported a total of 45 IC manufacturing lines, at a total cost of US$0.262 billion. These imports can be divided into four types: (1) Whole set import (e.g. No. 742 Factory). This was seen as a successful model. The No. 742 Factory employed this model and its production scale was reasonable, the annual output being 38.6% of national IC output in 1985. (2) The equipment for the manufacturing line being imported from different countries and manufacturers (e.g. the No. 878 Factory). (3) The imports of second-hand lines. Nine out of 20 second-hand lines imported during the Sixth FYP were from the USA and most of these have not been used at all. (4) Import of individual items of equipment (CPLOMEI, 1992).

[8] China electronic industry companies were usually named by number for security purposes, as their military history.

In the process of technology importing, China lacked the most important determinant of price and the terms of sale: bargaining power. A few reasons contributed to such a situation, apart from China's poor international relationships. One was that the uncoordinated import plans of the central and local governments had created a situation where similar equipment could be imported through several different channels. Another related to the foreign currency control system. The yearly allocation of the foreign currency quota would normally be finalised quite late every year, sometimes in the later half of the year. Thus, as the companies could only negotiate with foreign suppliers after they got the quota, they had to finalise the deal in a limited time frame, for the quota was for the current year only. Because of the inflexible planned time to use foreign currency, normally the project manager did not have enough time to get sufficient information about potential suppliers. This often ended up with the companies rushing their spending, and often resulted in purchases at excessively high prices. The price of imported equipment could then be much higher than the average international market price.

There were also other problems that emerged in the course of technology importing. These are outlined as follows:

(1) In terms of the composition of technology imports, enterprises often put too much focus on the equipment itself instead of on the technologies, whether manufacturing technologies or design technologies. From a technology point of view, a high percentage of hardware imports and a low level of software imports were not a secure path for the development of this industry.

(2) Intensive investment was a major feature of IC industry. The import of IC equipment in the period of the Sixth and Seventh FYP was mainly license trade with equipment and technology that required a high level investment. Lack of investment capital was a critical factor in China; therefore, the industry imported a certain capability as planned but it never actually caught up with the design capability.

(3) In order to get projects approved readily by the authorities, companies would normally overstate the design characteristics of the manufacturing lines, which they planned to import, and understated the amount of the budget needed for the whole project. After the importing plan was approved, they had to reduce the whole cost by either reducing the number of items of equipment or by selecting less satisfactory equipment. These projects were known in China as 'fishing' projects. The real outcome of such project was that the actual output capability of imported manufacturing lines was much lower than the design capability reported to the higher authority when companies proposed the project.

(4) Given the rush to spend money, the companies often did not have enough time to locate all the equipment they needed. In case there was no way to manage foreign currency in following year, they would often buy a replacement item if the desired piece of equipment was not available. This often resulted in the functions and standards of imported equipment, which were incompatible with each other and left many bottlenecks.

(5) Many imported manufacturing lines could not run at full capacity for certain years because of lack of demand, and the domestic market did not support the Chinese IC manufacturers. ICs manufacturers were often in a position that the more products they produced the greater the loss they would make, as their products were not competitive with mass imported ICs in terms of functionality and price. The end users of ICs preferred to use imported ICs because of their competitive price and good quality.

In order to overcome the above shortcomings, a policy decision was made by the SPC in relation to ICs and other electronic products, aiming at creating a stronger domestic market for ICs and other electronic products. The vehicle that was formed to carry out the task was titled 'A Specified Plan'. The core piece of the specified plan was that, while local governments and industrial ministries were preparing their industry development plans, they had to explicitly lay out a percentage of domestically produced electronic products that would be used and their technological level (Sheng, 1991). The purpose of this was to force industries to incorporate domestic electronic products in their

production. As a rule, in 1990, companies had to state, in their capital investment project proposals and feasibility reports, to what extent the efficiency of the projects could be improved by applying electronic products. If project applicants failed to do so, the proposals or feasibility reports would not be approved by the higher authorities, e.g. SPC. The specified plan gave ICs manufacturers more room to compete in and explore the domestic market. It was one of the actions of government intervention to protect local electronic products.

On the other hand, the only choice for ICs manufacturers was to increase their competitive position. China had to focus on building a basic capability in the microelectronics industry, becoming competitive in cost and offering services that differentiated them from those of other competitors. It was quite common for companies to import manufacturing lines but to discard the control equipment, as there were no qualified technicians able to handle it (IDIL, 1993b). So, the necessary inputs of human resources and on site training were also important factors for the survival and success of China's microelectronics industry.

5.4 Achievements and Problems

China's microelectronics industry had achieved a sound base in technical knowledge, which resided in the enterprises, universities and research institutes specialising in microelectronics, during the Seventh FYP. This was essential to drive the industry forward to higher levels of achievement in the later years. The small nucleus of skills in semiconductor design also made impressive progress. The requirement of domestic demand was a positive incentive to encourage the further development of the industry. Because only 20 per cent of ICs demand was met by local producers in 1990, there existed the potential for greatly expanded domestic demand for semiconductors in the 1990s.

5.4.1 Achievements

As an integrating technology and a knowledge industry, the development of the electronics industry depends very much on its R&D ability and on intelligent human resources. Generally speaking, the capacity of China's electronics industry has grown dramatically, but the technological progress was far from sufficient for the expansion of the industry. The critical technologies, especially microelectronics technologies, were still dominated by western countries.

During the Sixth and Seventh FYP periods, the basic infrastructure for China's IC production was created. A total of 24 production lines with a clean room area of 245,000 square meters had been established (CEIYB, 1992). Investment and R&D totaled RMB 200 million in the Seventh FYP. In this period, 223 new types of IC were designed in China. The level of technology achieved was 2.0 to 3.0 micron for mass production purpose and 1.0 micron for R&D purpose.

Promoting the restructuring of the microelectronics industry, as well as the computer and telecommunications industries, was one of the major goals of the Seventh FYP. Large Scale IC, as one of three critical science and technology R&D programs[9] (Keji gongguan xiangmu), was promoted in the National Science and Technology Development Plan by the SPC for the Seventh FYP period. It was coordinated by the Ministry of Machinery and Electronics, in conjunction with the State Education Commission and the Academy of Sciences. In total, there were 17 R&D major projects, under which 299 sub-projects were identified. Total funds of 446 million RBM were allocated across 1225 institutes and enterprises, involving 10,000 personnel, in the three programs.

The development of technology for the manufacture of large-scale integration (LSI) ICs was one of the three key natural scientific and technological projects in the Seventh FYP. One of the major achievements was the design of two 1 Mbit Chinese character ROMs (Read-Only Memory) and their production in 1.5 micro geometry. The Research Institute of Tsinghua University developed the chips. Each chip contained more than 1 million

[9]The three critical science and technology R&D programs were LSIC, computer and software

transistors and measured 5.4 mm by 6.5 mm. The two ROM chips could store 7830 Chinese Characters and symbols as per the National Standard (IDIL, 1993b).

Another highlight of the 1986-1990 period was the development of gate array ASICs with 100,000 gates. Most of the ICs produced in China in the period 1986 to 1990 had a pin count of 36 to 48 pins, mainly using the DIP process; a pin count of 64 to 128 pins was achieved using the LCC process (IDIL, 1993b).

In the period of the Seventh FYP, there were three major investments in major fabrication plants:

- a 2-3 micrometer MOS production line started in November 1990 at China Huajing Electronics Corporation;
- a 3 micrometer MOS production line started on July 1989 at Shanghai Belling Microelectronics Co. Ltd; and
- a bipolar circuit project started on November 1989 at Shanghai Phillip Semiconductor Corporation (MEI, 1995).

5.4.2 Problems

The problems apparent in the 1986 to 1990 period were mainly in four areas. Firstly, there was an absence of a developed link between the demands of the market in China and the response of enterprises producing semiconductors. Some of the enterprises in China were not equipped with a marketing and sales development function to overcome such weaknesses.

Secondly, the experience in building modern plants with advanced equipment was also very limited, although some of the new plants had clean room down to 100 particles per cube centimetre. Because a single dust particle may damage an integrated circuit they are manufactured in a clean room, which requires a room almost entirely free of dust particles down to a very fine size. China had to learn how to manufacture in clean rooms of 10 particle per cube centimetre or less. These were required for the very fine sub-

micron process specifications that were already used by some of the more advanced plants in western countries.

Thirdly, the general technological level of equipment was quite low, as there was no freedom to import relatively modern equipment from abroad until 1988. Some of the equipment needed by the industry had to be made locally, using plants with a low technological capability dating from the 1970s and 1980s. As a result, most of this kind of equipment was technically far behind international standards during that period.

Fourthly, enterprises in the industry were not in the position to control their investment plans for expansion. Even if markets were identified for new semiconductors, there was no guarantee that the finance would be available for the production of the new products. Sometimes, important opportunities were missed because of this obstacle. For example, some microelectronics projects planned in the seventh FYP experienced a long cycle of discussions and approvals. The proposals were handed in to the relevant government agencies early in the seventh FYP period, but up until 1995 the proposals were still in the process of approval (Yu, 1995). To the microelectronic companies more channels to facilitate their new investment, therefore, became vital for market success. Borrowing from banks, and perhaps from international finance institutions was seen as a possible option.

Conclusion

The uncertain political and economic environment, the impetuous responses of public and the dramatic changes in the rate of economic growth, provided the context of institutional change and policy innovation in the period of Seventh FYP.

Investment system reform and government restructuring were two important institutional changes, which directly shaped the direction of development, the funding sources and the emerging path of China's microelectronic industry. The institutional change induced

ongoing government learning, which was embodied in making policy choices and in implementing those policies.

The institutional change in this period did not give the microelectronic industry more reliable administration or more effective support from government. The lesson here is that the organisational change of government agencies does not necessarily mean effective functional change. It is difficult to determine directions and principles of institutional change that would enable China to achieve that institutional change which best met the needs of economic development. These difficulties were apparent in many issues arising during the period, such as shaping the financial sources available to the industry to meet the heavy investment requirements, reforming the investment fund and restructuring government organisations to respond to the specific requirement of the industry, as in the case of the merger of MEI and MMI.

The innovative policies involved enormous ongoing government learning. The critical challenge to innovative policy in the transitional economy of China was to understand the feasibility and the limitations of using indirect policy instruments, rather than direct controls, to achieve economic objectives. In general, the Specialised Fund and technology import policy implemented during the Seventh FYP promoted the microelectronics industry and facilitated technological catch-up. They were also successful in the sense of establishing a starting point for the government to exercise indirect management activities.

Nevertheless, the effectiveness of the indirect policies was limited because of poorly developed factor and product markets, the highly oligopolistic nature of the relevant markets, and the continued importance of the planning system and direct controls. In particular, the role of the market needed to be strengthened and a more efficient, market conforming planning system needed to be in place, for the indirect measures to be fully effective.

Although the foundations of the microelectronics industry in China remained weak by international standards, one important achievement was that the microelectronics industry became recognised as a strategic and determining factor for the nation in China at the time of the Seventh FYP. The development of the microelectronic industry had provided hands-on experience for the whole electronic industry in terms of policymaking, import issues handling and localisation of foreign technologies.

China's microelectronics industry was forced to explore an extraordinary development route, due to international political circumstances. The cost of this exploration was high, but the rich experience was a fortune to itself as well as to the whole industry. The key is that China learnt, from the case of the microelectronics industry, bargaining experience in the high technology area, and also it built bargaining power for the computer and telecommunications industries. The higher the level of microelectronics technology China's industry possessed, the higher the level of new microelectronic technology involved in computer and telecom products it could bargain with foreign companies, while they were negotiating imports of products or technology. In this sense, the learning experiences involved in developing the microelectronics industry proved to be highly beneficial for China's computer and telecom industries, which can be shown from the experience of the telecom industry reviewed in the next chapter.

6. Building Competitive Advantage: Innovation Initiatives and Technological Capability, 1991-1995

Introduction

In the 1990s, China's information industry has been pressured by international competition in the domestic market. Following basic capacity building from the development of the consumer electronic industry in the mid 1980s and the technological progress in the microelectronic industry in the late 1980s, to establish a competitive advantage of the industry became a key issue to both government policy makers and the industry. At this stage, the government policies were very much concentrated on lifting the overall capacity of the information industry. Promoting innovation initiatives and technological capability were the main concerns. Computer and telecommunication equipment are the two types of products that attracted most international competitors in China's domestic market. They brought about the question of to what extent the government should intervene in this area and what kind of policy was needed. It is very obvious that the attraction to the foreign companies to put their capital and technology into China was the huge Chinese domestic market. From the Chinese government's point of view, on the other hand, foreign capital and advanced technology were the vital factors in promoting economic growth, especially for the development of China's information industry. Thus, policy orientation had to be carefully directed to satisfy the interests of both sides. From our later discussions we find that policies initiated in the 1990s have been set to attract major international companies and acquire advanced technology.

As the largest potential market in the world, China's telecommunication market gained the world's attention. The significant memos signed by SPC and the two foreign telecom companies, AT&T and the Northern Telecom of Canada, reflected the importance of China's telecommunication market and the government's engagement in promoting the industry. It is a unique case that demonstrates the direct participation of the Chinese

government in business cooperation with foreign companies. The description of this case in this chapter helps to understand how the government played its role in promoting a specific policy.

The centre of the attention of this chapter will be given to the government policy intentions in the building of the competitive advantage of China's information industry and the institutional reforms in the science and technology system. To overcome the organisational barrier, China's foreign investment policy was re-shaped to direct foreign investment inflows and to facilitate technology imports in the 1990s. An anatomy of the practice on promoting microelectronic industry development and international cooperation illustrates the respective significance of government and companies in the implementation of relevant policies. The situation of the telecommunication industry, its investment requirements and problems, reforms in science and technology system, government engagement in integrating its development with the development of microelectronic industry, and foreign companies' reaction are all interrelated factors and will be detailed later in this chapter.

This chapter is arranged as follows: Section one, building competitive advantage by promoting innovation initiatives. An institutional change was initiated to overcome the organisational barriers in transferring technology from research institutes to industries. The science and technology system reform had forced companies to build their technological capacity based on market needs, and to encourage joint efforts of research institutions and companies seeking to intermix production capacity with research interests to enrich the technological development. Section two, government policy reorientation, especially in the case of computer and switch products. Section three, shaping the direction of foreign investment to fulfil the government strategy in the development of the information industry. Section four, a case of government engagement in key technological areas. It demonstrates how the government carried out its technology adoption strategy through opening the domestic switch market to more foreign manufacturers in exchange for key and up to date technologies from these companies.

6.1 Promotion of Innovation Initiatives

Technological capacity is critical to build competitive advantage in China's information industry. There are basically two sources to acquire such capacity: domestic and international. China had developed a reasonable science and technology infrastructure, which provided the information industry with the capability to obtain technologies from both domestic and international sources. The tasks faced by the government in the 1990s were to ensure the maximum utilisation of its existing S&T resources, acquire foreign technology selectively, improve production efficiency, and gradually increase domestic technological capabilities. Under certain circumstances, imported technology may result in marginalisation of domestic S&T system and contribute little to develop new technological capabilities. Therefore, the efficient management and utilisation of domestic S&T resources is vital to achieve China's S&T objectives. Domestic technological capacity not only lays a foundation for China's own technological development, but also affects the effectiveness in the use of foreign technologies. So, an understanding of China's capacity of the industry is important for the analysis of the development strategies. The two factors that affect the strength of the capacity include: (1) institutional framework; and (2) resource management. The institutional framework is the most important factor that determines how well all the other factors act in technology development. This section gives particular attention to the Chinese S&T system, the organisational barriers to technology transfers and reform requirements to the whole system.

The inflexible organisational and institutional framework had significantly affected the development of China's information industry, particularly, those high technology intensive companies. Centrally planned economies lacked the organisational mechanisms to translate S&T resources into industrial or commercial products (Schumpeter, 1934). They lacked the incentive structure for promoting innovation as well as organisational channels between S&T research units and production enterprises (Berliner, 1976). The key reform requirement, therefore, was 'to create novel institutional and organisational

arrangement conductive to translating the accumulated S&T resources into the commercial capabilities of enterprises' (Lu, 2000, p.5).

6.1.1 Organisational Barrier for Transferring Technology to Industry

The structure of the S&T system and allocation of S&T resources in China was initially based on the Soviet model with some modifications. The system had largely remained intact for nearly 30 years until the end of 1978 when the reform started national-wide.

For years, a significant proportion of human, financial and material resources had been concentrated in the formal S&T sector, not in the production sector. This was especially true for R&D resources. The formal sector was composed of five major actors: (1) the China's Academy of Sciences, which oversaw over a hundred research institutions; (2) military-industrial research labs and industrial research labs under the authority of various industrial ministries; (3) R&D units run by local governments; (4) the higher education sector; and (5) the defence sector.

China had a history of weak technological connections between R&D and production resulted from relatively independent research centres and production units. The allocation system of S&T resources and the structure of the S&T sector had restricted constructive working relationships between research institutes and enterprises. Research institutes and their research activities were not designed for meeting the requirements of enterprises or the market. Firstly, the most talented scientists were concentrated in the labs of China's Academy of Science, military research labs and universities that were inaccessible for most of the industrial enterprises. Secondly, although the industrial research institutes under various industrial ministries were designated to serve industrial needs, they were entrapped within the vertical authority of their respective ministries or industrial bureaus. Almost no direct horizontal channels existed in the system allowing research institutes to seek their industry partners across the authoritative boundaries of various industrial ministries or bureaus, and vice versa. Thirdly, within the same administrative authority, ie. in the same ministry or bureau, communication between research labs and enterprises was more or less the same. Their activities were carried out through separate vertical

channels via administrative organs at the top. The horizontal links between labs and enterprises often came secondary (Lu, 2000).

The financial side of the story, which amplified the separation of research and production activities, is that: (1) there was no direct government funding for technology transfers from research achievement to industrial production; and (2) research funding, whether it was for the research units within ministries or universities or elsewhere, was allocated directly from the central budget. This indicates that, no matter what research results had been produced, there was no direct incentive for research institutes to promote the use of them. Even for those research institutes within industrial ministries, they would not have the incentive and pressure to serve the industry needs. Instead they were very much self-contained and independent from enterprises. Consequently, very few scientists and technologists seriously took industrial needs into their consideration when choosing research projects.

To a large extent, the organisational barrier had hindered technology development in industries and became one of the major targets of the government to reform the S&T sector.

6.1.2 Institutional Reform to Facilitate Innovation

To promote commercialisation of technology, two important programs were launched by the State Science and Technology Commission (SSTC) in 1986 and 1988, namely Domestic High Technology Plan (named the '863 program'[1]), and the Technology

[1] The '863' Program: It was designed to build up China's own R&D capability in high-tech areas such as information and communications technology, to catch up with the developed countries, and to be independent of foreign suppliers. Through competitive grants, the State Council earmarks research funds and designates research programs or projects to universities or research centers. Information technology was included in the 863 program as follows: the computer system was developed to perform preliminary intellectual behaviors and of the function of intellectual application, accelerating theoretical and technological reserves for the development of China's own practical intelligence computer system before the year 2000; surrounding two major development orientations in the establishment of a photoelectronics technological centre and the application of phototelecommunication and photocomputation, 10 target products were developed, traced after and 10 key elements and parts were developed and seek for breakthroughs in 5 units technology; centring around an earth observation system and a space target monitoring system, develop 5 information collection technologies and 1 supporting technology and seek for some breakthroughs.

Commercialisation Plan (TCP). Both were designed to promote mobilization of domestic resources, and gain access to foreign technologies. One of the important aspects of these programs is to strengthen the competitive capacity of both research institutes and enterprises by building the links between the two parties.

It had been struggling for both companies and research institutes to position themselves in the wave of market shocks while maintaining research interests of the research institutes. The links to be built was considerable as the research institutes carried out research projects with the involvement of firms once the designed specification stage was reached (STC, 1989).

Since 1986, research institutes with research activities that were closely related to specific industries would no longer receive government appropriation for their research apart from basic salaries for the formal staff of the institutes.[2] Government research funding now was concentrated on specific projects that were included in the national research and development programs and on a competitive base. These specific projects were aimed at developing particular high and key technologies for an industry. This new development had at least two major implications for the research institutes. Firstly, research institutes had to consider how to effectively use the government funding and to produce what was expected in meeting the needs of the industry. Secondly, they had to seek for other funding sources, mainly from firms, to survive. In this regard, the prospects of commercialising their research output are vital, whereas before, whether their output had a market was not their concern at all. They were now pressured to understand the market and to take part in commercial activities.

Normally after a research institute develops a prototype, the process of product development would be to produce a small quantity in their pilot plant, for defining the production process before transferring to manufacturers for mass production. A prototype does not necessarily mean it can be actually produced by manufacturers, because the

[2] This policy was started from 1986, for the details see 'Temporary Regulation of State Council for Science and Technology Appropriation Management', January 1986.

technical requirements for mass production are quite different from that of the design of a prototype. Mass production needs a comprehensive knowledge of the manufacturing equipment to be used, e.g. the level of tolerance and speed, the production methods, and cost-effective analysis. This requires a close working relationship between research institutes and enterprises.

Another need for such closer relationships between firms and researchers is market requirements. If a research institute was to design a prototype, it had to know what the targeted consumer groups were and then to find appropriate enterprises to manufacture it. In most cases, contacts with the customers are likely to be made by the enterprises when they sell their products. Marketing and sales are inter-related, enterprises are the ones who know the market and their own manufacturing skills, so that they are in the position to give research institutes specified feedback on what is needed in the market place. Even in those cases where MEI or research institutes initiated the development of a new technology or product, the cooperation between research institutes and enterprises by no means would lose its importance. The initiatives made by the MEI or research institutes had to be based upon their understanding of the market, which would mostly be gained from enterprises.

Setting up engineering research institutes was one of the government efforts to link research with product manufacturing, especially for the technology transfer to smaller enterprisers. Some research institutes (eg. The 54th Research Institute)[3] were really interested in becoming engineering research institutes, because they had the technology capacity and a relatively close relationship with manufacturers. They knew they would benefit from being an engineering research institute. Some enterprises (eg. The Nanjing Radio Factory) planned to transform some of their research establishment to engineering research institutes, because they understood the needs of the industry and had the high technology capacity to develop the particular products that met industry requirements.

[3] The former military research institutes were titled by number for confidential purpose, like the military companies mentioned in last chapter.

This functional transformation of research institutes had proved to be successful in facilitating companies to upgrade telecommunication and microelectronic technologies.

6.2 Policy Initiatives for the Development of Computer and Switch Industries

Computers and switches are two highly competitive products in the market place. Government's practices in building competitive advantage in these two industries are examples of policy intentions and results.

6.2.1 Supportive Policy for the Computer Industry

China's computer industry started from assembling imported kits of parts and components in semi-knocked-down (SKD) or completely knocked-down (CKD) conditions, with the purpose of localising the production of parts and components, and moving up the technological ladder in the process (Lu, 2000). The companies undertaking this task were given foreign currency quotas (which allowed them to purchase foreign currency from the Bank of China) to import the kits. As mentioned in Chapter Five, computers, as one of the four products, has enjoyed low import tariffs from 1987, zero product tax and 50% income tax. The companies assembled the kits into final products and sold them in the domestic market. Imported whole PC sets needed import quotas and foreign currency quotas which were allocated by the central government to protect the development of the infant computer industry. Computer imports were highly centrally controlled, local government and individual ministries needed to submit their proposals to the Import and Export Examine Office under the State Council to check if they met the guidelines first, then the outcome of the examination would be sent to the State Council for final approval (Lui, 1994). One other factor that affected the import of foreign PCs was that they did not support Chinese-character input and display at that time. However, domestic PC makers developed proprietary Chinese-language supporting systems, which better met their customers' needs. Thus the market demand was in favour of domestic products.

In this period, government initiatives focused on certain supportive policies to the domestic PC industry through financial and administrative measures. Such as:

- Government funding provision to state owned computer companies, through SPC's five year plan approved by the State Council.

- Priority policies. As one of 'four products'(see note 10 of Chapter 5, and section 5.3.1), computers had enjoyed not only tax benefits on products, but also tariff benefits on imports of production lines and equipment. If the required import of production lines or equipment were part of MEI's plan (for a construction project with an investment of RMB 50 million and over, or a technological upgrade project with an investment of RMB 30 million and over), or projects undertaken by the science researcher and Electronic Industry Development Fund and with an investment of RMB 1 million and over, they were exempted from import tariffs.

- Specialised Fund. This was the Fund of Electronic Industry Development (see section 5.3.1).

- The state-owned entities were encouraged to use domestically produced PC. Some government supported projects were requested to purchase PCs from domestic producers (Lu, 2000).

The protection of PC the industry was by and large abolished in the early 1990s. Between 1981 and1990, the market share of the domestic brand was more than 50% annually. In 1992, the government disposed of the quota system and reduced the tariff rate for PC imports. Foreign PCs were able to come into Chinese market, and foreign manufacturers started to build factories in China. Market share of the domestic brand PCs dropped dramatically to only 23% in 1995. Because of the competition pressure from foreign products and foreign manufacturers, the domestic PC manufactures were forced to upgrade their production technology and improve their quality of services, all of which

had led to a picking up of the market share of domestic brand PCs to 46.8% in 1998 and domestically produced compatible PCs to 25% (Liu, 2000).

In the 1990s, government policy also focused on facilitating competition in the industry. In March 1991, the National People's Congress approved the Summary of the Ten-Year Plan for National Economic and Social Development and the Eighth FYP, it was stated that the ICs and computer industries would be strengthened and the application of electronic technologies in other industries would be promoted. Important policies regarding the electronic industry were drawn upon in line with the decision that: (1) computers and ICs were identified as key development sectors; (2) the electronic industry was chosen as one of the national backbone industries; and (3) MEI was to be rebuilt. As computer and IC were chosen as key products and the electronic industry as a national backbone industry, an organisational change, ie. rebuilding MEI was proposed. This, in fact, followed the government tradition that a high level of commitment would be backed by a totally focused administrative agency to carry out the development strategies. In March 1993, the electronic departments of MMEI were detached and became the major departments of the newly formed MEI. Fourthly three Golden Projects[4] were launched by MEI in July 1993. It was firmly believed by the government that these three projects would lay a foundation for the development of China's National Economic Informalisation. Fifth, the intention of entering General Administration of Tariff and Trade (GATT) made it important to encourage domestic manufacturers to build their technology and production capacity in a short period of time to prepare for the potentially fierce competition from foreign companies.

In this very supportive policy environment, China's computer industry had accumulated experience and capacity not only to produce computers but also be able to provide after-sale technical support to consumers.

[4] Three Golden Projects: The Three Golden projects were Golden Bridge, Golden Customs, and Golden Card. They were designed to comprise the key infrastructure elements that drove the informatization of China's economy in 1993. They not only provided means to transmit and exchange social and economic information, but also aimed to offer information services to all the government's administrators and agencies, and ultimately to the general public. The short-term goal of the three projects was to build a

Compared with international companies, however, Chinese manufacturers were still in a relatively minor position in terms of their technological level and financial capacity. The latter had been a major constraint to the development of China's electronic industry. In the USA, many computer manufacturers and software companies developed rapidly in 1980s, because of the marginal profit was high enough to be reinvested for larger scale production (MEI, 1993). While in China, in 1989 and 1990, the computer industry's average annual sale profit was about 5% before tax, and the ratio of capital return was about 8%, which was too low to accumulate capital for further investment. As public finance, banking, and the state-owned enterprises had been undergoing vigorous reforms since the mid 1980s, the state-owned companies could no longer receive central budgetary funding for capital investment projects. Instead the major funding sources for these companies came from low interest bearing policy loans of the state-owned banks. However, they were far from sufficient to meet the development requirements of the computer industry set by the government. Therefore, foreign investment as a financial source became a choice to the industry. On one hand, there was a strong willingness of foreign companies to penetrate into the Chinese market when they saw the government intention in developing this industry through the three 'Golden Projects' etc., and the subsequent opportunities for them; on the other hand, computers were products subjected to import quotas to Chinese users, which was a hurdle for both foreign computer providers and the Chinese users. Direct investment was an option for avoiding the non-tariff protection. In 1993, many famous international brand computer companies came to China to set up R&D facilities, undertake training and production activities, and network their local sales agencies for the promotion of their products. There were three major joint ventures built in this year (see Table 6.1).

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medium-speed information highway in order to connect the majority of private networks, and promoted the sharing of existing and future network resources.

Table 6.1 Computer Joint Venture in 1993

Joint Venture	Starting time	Investment (million US$)	Annual production capacity (unit)
COMPAQ & Stone	9 July 1993	10	100,000 PCs and 150,000 Motherboards
AST & Tianjin Zhonghuan	9 Sep 1993	16	185,000 PCs and 380,000 Motherboards
DEC & Founder	22 Nov 1993	30	70,000 PCs
IBM & Great Wall	Feb 1994	10	n.a.

*Source: Electronic Industry Yearbook 1994,*Electronic Industry Publishing House, Beijing, pp.iii-33.

China's computer market became more competitive. All the players, including large foreign computer manufacturers, domestic computer makers, and many small vendors who provided locally assembled computers, were either aggressively or passively involved in competition of various forms, ranging from price cuts to improvements in product quality and customer services. All the major computer suppliers in the world had entered the Chinese market and tried to get a bigger market share and build a solid base for their future development. The Chinese computer industry was disadvantaged in meeting international competition not only because of its lower technology level in key areas, but also its small scale. For example, for the China Great Wall Computer Company (CGC), one of the biggest domestic computer makers, its output in 1991 was 18,000 units and its accumulative total domestic output throughout the years was 93,400 units. The typical scale of an international computer factory, however, was one million units. As mentioned earlier, domestic PC makers shared only one third of the domestic market in the early and mid 1990s (Lu, 2000).

The strong role that foreign computer companies played in the Chinese market had forced domestic PCs makers to readjust their overall strategies. Firstly, in order to keep up with the technology development worldwide, domestic PCs makers relied more on imported PCs components, from making 'purely nationalised' products to 'internationalisation'. Secondly, they focused more on the standardisation and compatibility of their products.

All Chinese-language support functions were made completely compatible with the industry wide standards. Thirdly, the large domestic computer makers had been rearranging and reorienting their production structure, marketing strategies and business partnership to improve their competitive position. For example Great Wall partnered with IBM, and Stone partnered with Compaq.

The new development of the market made the government policy support switch from protection to facilitation of the competitive capacity-building of the industry. The initial protection to the industry was necessary to cultivate the infant industry, such as encouraging using domestic PCs and low import custom duty on assembling computer needs components. As soon as the market matured, the policy focus shifted to building the industry's competitive advantage by directing foreign investment to key areas, such as encouraging large scale production and cooperation with big international companies to catching up with new technologies. At this stage, no matter whether by choice or by force, government policies had to be adjusted and become competitive and effective as well.

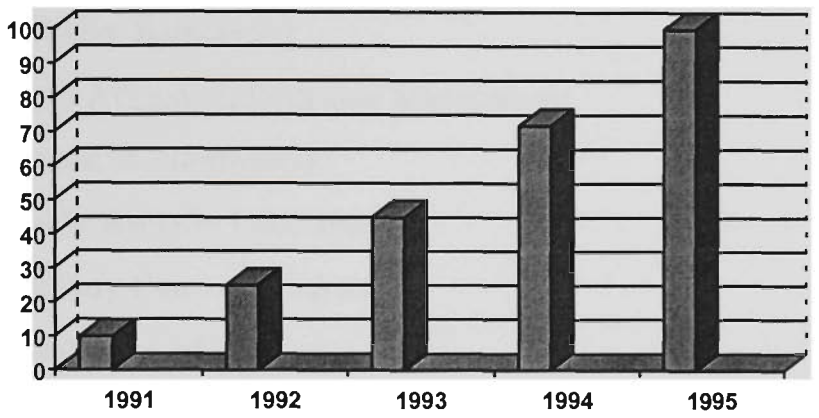
However, in some cases, the policies towards the computer industry were not coherent and did not provide effective stimuli to the industry, due to the fact that different government agencies issued their special purpose policies without consulting each other. A classic case of such inconsistency was the policy on the control of social group spending on PCs issued by the Ministry of Finance at the end of 1991. This policy had largely hampered the development of this industry. According to the policy, all PC acquisition plans of any companies and organisations had to be approved by the Controlling Office for Social Group Acquisition from the Ministry of Finance (COSGAMF) [5] (25 December 1991, People's Daily). When a firm, government department, or institution, etc. was to buy a computer, it had to apply for a permit from the Office. Any PC suppliers had to sell the PCs to the permit holders. Banks paid and

[5] For the detail of the Controlling Office for Social Group Acquisition of Ministry of Finance, see the documents of the State Council (1) 'Emergence Notice of Stringently Control Social Group Acquisition and Shorten Cost', 24 Feb, 1988, and (2) 'Decision of Stringently Control Social Group Acquisition', 6 Oct, 1988.

cleared the purchasing bills according to the permit. The purpose of the purchasing power control was to avoid too much spending on luxury office goods, and a PC was defined as one of them. The PCs purchasing control had widely affected China's computer industry. Later on, because of the strong opposition to this regulation from the computer industry, this policy did not last long. According to the *1994 China Financial Yearbook*, approved by the State Council, the controlled items of COSGAMF were reduced from 29 to 8 from 1st May 1993, and PCs were not among the remaining eight items (p.151).

Despite the 16 months interruption of the above policy made to the industry, the supportive policies specifically issued for the industry had nevertheless resulted in high growth. China's computer industry output value increased from RMB 5 billion to 50 billion between 1990 and 1995. On average, its annual growth rate was 58.5%, which was much higher than the total electronic industry (27-28%) in the same period, exports were US$ 2.8 billion in 1994, 280 times that of 1986. The gap of new model PCs between China and international leading computer manufactures had shortened from three years in 1984 to three months in 1994 (MEI, 1995). The share of total output of the computer industry in the whole electronic industry grew from 7.2% in 1990 to 18% in 1995. The share of total output of China's computer production in world computer production grew from 0.3% in 1990 to 1.2% in 1995 (CEIYB, 1996). By the end of 1995, China had 15,500 computer enterprises, in which more than 1000 firms were engaged in computer manufacturing activities, more than 1000 firms were in the area of software and information services, more than 50 were R&D institutes, and about 13,000 firms were involved in delivery and related services. Total employment of China's computer industry was about 300,000 in 1995, the number of people engaged in promoting the use of computer was 550,000 (CEIYB, 1996).

Chart 6.1: China Computer Market 1991-1995, 10,000 Units:



Source: 'Economy and Information' 2/1996, published by Economy and Information Publishing House, Beijing, P.29.

6.2.2 Competitive Switch Market

Switches are another highly competitive product internationally. The government policy maker in the 1990s undertook a serious task to meet with the challenges posed by market competition. The MPT drafted a document entitled 'Long-term Development Plan for the Telecommunication Industry' in 1982, which initiated an intensive development program for the telecommunication industry. The State Council approved this document in 1984. Since the plan was issued, the telecommunications industry's growth has accelerated rapidly. Its growth averaged at 20% per annum between 1985 and 1990, and more than doubled to 46% per annum between 1991 and 1995 (Xie and Liu, 1996).

Since switches are the key to the building of telecommunication networks, sustained supply of switches is important to the development of this industry, as well as to the information systems broadly. In the Eighth FYP, the information system construction was given a high priority for the existing development and improvement of the twelve national information systems, including:

- Post and Telecommunication

- National Economic Information
- Financial Services and Administration
- Electric Power Network Management
- Railway Management
- Weather Forecasting
- Civil Aviation Information Management
- Scientific Information
- Public Security Information
- Military Command System
- Aerospace Information
- Fiscal and Taxation Information

Source: *China Machinery and Electronic Industry Yearbook* (1991), China Machinery and Electronic Industry Yearbook Publishing House, Beijing, p. I-31.

This list indicates clearly that government policy choice had focused on building a basic information infrastructure. At this initial stage, sufficient equipment supply and production capacity was critical to China.

However, at the time, the capacity of the domestic switch industry could not meet the huge demand required for the growth of the information industry. Firstly, technologically China fell behind about 15 years in the important equipment production field of transmission, network control, and network management, comparing with leading western countries in the period of the Eight FYP (He, 1997). Secondly, the size of domestic production was not sufficient to gain economies of scale, and that had affected the efficiency of this industry. There were many enterprises whose scale of production could not accommodate the most advanced equipment. This led to higher cost and lower quality than the optimum. In 1990, total domestic output of switches in China was 185 million lines which was very modest (it was equivalent to the output of a single standard factory in the western countries) (CEIYB, 1991). Thirdly, due to the poor ability of self-development and severe duplication in investment, locally made products took up a small fraction of the domestic market, about 30% to 40%. Lower technological content production like SKD and CKD assembling dominated the production of this industry. It

implied that technology-wise domestic produce was still in a follower's position, which largely restricted a self-sustained development. Other factors like lack of marketing skills, modern production management technique and effective quality control were all contributed to the inability of firms to fit into this ever-changing market.

The advantages that China's enterprises had mainly in high quality technical personnel within the MEI telecommunication enterprises, lower labour costs and familiarity with the local conditions.

Therefore, to effectively utilise the available technological ability and overcome the weaknesses, and at the same time to catch up with the pace of change in the industry worldwide, was a huge challenge to not only the Chinese manufacturers but also the policy makers.

Different foreign companies shared the switch market and each of them had their own specific system which could not be interconnected. It was joked as 'eight systems from seven countries'. The major contributing reason to this situation was that the financial resources for switch acquisition were mostly government loans from western countries. Usually foreign government loans contained up to 35% in aid components. By 1992, total government loans financed switch imports amounting to 7 million lines, which was about 39% of newly installed switches in China.

In February 1992, OECD member countries signed a new agreement to restrict its members from providing government loans to developing countries for commercial projects in areas such as the manufacturing industry, telecommunications and power generation. Therefore loans with an interest subsidy provided by exporters became an alternative for both Chinese users as well as foreign switch manufacturers. These type of loans had an average of a 20% aid component which in fact was interest subsidy offered by foreign equipment providers. The first loan of this type used by the MPT was a US$ 0.182 billion loan from the Belgium Bell Telephone Company in 1992, to import Bell's S1240 switch equipment production line. After that, more and more international

telecommunication companies followed suit. From 1993, a total of US$1.23 billion loans were coming from North Telecom, Bell, Siemens, Xisha of Spain, and Ericssion for switch equipment imports (Hu, 1994).

This situation of firms importing from different manufacturers with different systems made it very difficult for the nation to run efficient telecommunication services. Although this had caught the attention of the government, the thirst for advanced capital goods at the initial development stage of information industry, the already installed systems and the high cost would be involved if discarding any one of the systems, had all constrained the government's ability to effectively address the problem. What the government had done to seek the solution was to form a foreign investment policy that would meet the needs of technology, investment and management in this industry. It was not a direct approach but it had eventually regulated the market to a large extent.

As locally made foreign brand switch equipment would be more competitive in terms of price, availability and attracting favourable government policy compared with imported equipment, producing directly in the local market became an option for foreign companies. Foreign investment policy was set to tightly control the number of foreign switch manufacturers producing in China. The major points of the policy were: (1) to select a few systems; (2) to ensure the majority of switch systems operating in China were of limited numbers, and (3) to ensure the selected systems were upgraded technology. This policy played a key role in the 1990s. It firmly controlled the number of switch companies entering into China. Table 6.2 shows there were three joint ventures producing switch equipment in China between 1994 and 1995, two more joint ventures joined later on. All five systems had upgrading technologies (CEIYB, 1996), which underlined the performance of government policy in promoting technology transfer and its adaptation from foreign investors. This policy had also protected domestic market as well as showing a clear indication of import substitution. The policy details will be discussed later in Section 6.4.

Joint ventures had dominated switch production in China in the 1990s (see Table 6.2). By the end of 1995, the total switch output increased from 185 million lines in 1990 to 1400 million lines, of which 800 million lines were produced by joint ventures and accounted for 57% of the total. In 1996, all the switch manufacturers in China had reached production capacity of 100 million lines or over, which indicated that all the firms had achieved economies of scale (Kang, 1996). Although the joint ventures remained the major switch producers, the production capacity of local brand switch equipment had gone up to nearly half of the local produce. The leading local brand switch equipment, HJD-100, reached its production capacity of 500 million lines, and shared the top position with the leading foreign brand switch equipment, Shanghai S-1240. The government control over the switch market not only benefited the network interconnection and management efficiency, but also provided the space for domestic switch equipment makers to reduce their cost through enlarged production capacity.

Table 6.2: Output of Switch Products in China: million lines

Product brands	Output 1994	Output 1995	Capacity 1996
Shanghai S-1240*	440	440	500
Beijing EWSD*	160	160	250
Tian Jing NAEX-61*	100	100	150
AT&T 5ESS2000*		50	2 by 100
DMS-100*		50	100
HJD-04	200	400	500
SP-30		60	200
C&C-08 EMS-601		60	100
Other	130	80	100
Total	1030	1400	2100

*: Joint ventures.
Source: 1996 Market Outlook for China Electronic Products, Published by China Ministry of Electronic Industry and Its Information Centre, 1995, DEOSR and IC of MEI (ed.) (1995), p.77.

6.3 Foreign Investment Policy

Setting up joint ventures with world leading companies was considered as a short cut for China to gain up to date technology, experience large scale production, and obtain capital investment. For both the computer and switch industries, a policy re-orientation in attracting FDI seemed vital in the development of the information industry at this stage. The policy needed to directly address where FDI should be directed and how to promote technology transfer. The characteristics of China's foreign investment policies in this period were: (1) encouraging FDI to flow into the priority industries; and (2) promoting technology transfer.

SPC's Role in Facilitating FDI Flows into Information Industry

The information industry, SPC officials believed, held the key to national competitiveness across a whole range of industrial sectors, not only high technology industries but also the traditional industries and the services sector.

Since the 1980s, China's government had paid great attention to high-tech development. The national informatisation program launched later in the 1990s was to follow the international trend in information technology development. Establishing local technological and manufacturing strength had been one of the major objectives of the 'open door policy'. The government strongly believed that modernisation could only be achieved through greatly increasing local productivity which could not be bought from any other countries. Therefore, foreign investment and foreign technology would be key capability enhancing tools. However, the international political environment and domestic economic situation that the government faced was not easy to fulfil the goal to gain foreign investment and technology.

At the early stages of China's reform, China tried to attract foreign investment by giving up market shares, to help Chinese firms acquire technology and improve local manufacturing capabilities. But foreign companies were not keen to invest. The reasons were: (1) they did not want local manufacturing companies to become competitors and

reduce their direct sales; and (2) the U.S.-led Coordinating Committee on Technology Transfer prohibited the transfer of most information technology to China by European, Japanese, and North American producers, which further clouded the flow of direct investment. In recognition of foreigner's attitude, China launched a strategic policy known as 'combining direct import with technology acquisition'. Under this policy, certain level of technology transfer was compulsory for every import of large production technology and production lines, and the same applied to establishing joint ventures. It succeeded in bringing many technology transfer agreements into the manufacturing sector of China's information industry. It was very unfortunate, however, many of the technology transfers were not successful. Although foreign suppliers were pressured to transfer technology in order to get direct-sale contracts, they did not have long-term commitment to the successful transfer of technology. Whether the technology could be fully utilised by the Chinese, or sustain a reasonable period of time was not their concern.

Things had changed since the national informatisation program was initiated in the 1990s. Undoubtedly China's information equipment market, especially the telecommunication equipment market, had become very attractive to foreign companies. The demand-supply relationship for direct investment had reversed completely to favour the demand side. China's telecom market began to grow at an extremely fast rate. Since then China had been in a position to be selective, and the new criterion for selection was aimed at choosing those foreign partners that would benefit the local industry. In pursuing their strategies to get into Chinese telecommunication market, most telecommunication companies would often try to use political and economic power to influence the Chinese government and win favourable treatment. The swing of AT&T's attitude towards China and their Chinese market penetration strategy could reveal this point.

Considering the relationship between China and U.S. and the demand for technologies, the Chinese government decided to issue two entry tickets (market access) to foreign telecommunication equipment manufacturing companies. Vice Premier Zou Jahua remarked this step as 'to use market share in exchange for technology', he also gave very

detail commons to direct this matter, for example, for the ownership of the potential joint ventures, he authorised to 'permit foreign companies have up to 49% share in joint ventures', and for maximising the advantage of the telecommunication market, he approved the strategy of packaging switch and IC as a whole to negotiate with foreign switch companies. Furthermore, a coordination group was formed for this purpose, members were from SPC, MPT and MEI, and the office was in and ran by the SPC. The SPC controlled the information industry mainly through its power in the approval of projects. Any projects valued over RMB50 million or with over US$30 million foreign investment had to be approved by the SPC at the time. The core technology for telecom equipment was IC' technology, however, its transfer was banned by the Coordinating Committee on Technology Transfer, OECD. Foreign companies had no wish to transfer the technology either. Taking the opportunity of foreign firms eagerly wanting to sale telecommunication equipment to China, the SPC had suggested a package combining telecommunication equipment import, IC designing and manufacturing in China together. The two memoranda of understanding (MOUs) signed with AT&T of the United States and Northern Telecom of Canada by SPC in 1993 opened the door for these two companies to enter China's telecom market, particularly in the area of central office switching equipment. At the same time, China gained advanced technologies and enlarged manufacturing capacity.

6.3.1 Policy Designed to Channel FDI Flows

Since July 1979, in relation to promulgation of the Law on Chinese-Foreign Joint Ventures, over 200 related laws and regulations had been passed by the People's Delegation Conference. These documents have offered considerable and favourable treatment to foreign investors in a range of matters. The Procedures of the State Council to Encourage Foreign Investment promulgated in October 1986 had clearly set out preferential policies to foreign businesses for investing in export-oriented, hard currency generating and technically advanced products production. These preferential policies gave significant discount on income taxes, customs tariffs and land user fees to investors. By the end of 1995 total stock of foreign investment amounted to US$35.849 billion (see

Table 6.3). The growth of foreign investment had stimulated the growth of imports in technologically advanced equipment and improved management skills.

Table 6.3 FDI Stock in China (current US$ million)

Year	FDI	Year	FDI
1982	430	1989	3393
1983	636	1990	3484
1984	1258	1991	4366
1985	1659	1992	11156
1986	1875	1993	27515
1987	2314	1994	33787
1988	3194	1995	35849

Source: CEIdata http://www.cei.gov.cn./

Foreign investment in the electronic industry experienced three stages from the start of the reforms. The first stage: 1981-1985, mainly focused on the import of technology, equipment and assembling lines. In this period, the electronic industry acquired about 1000 technologies, equipment and assembling lines valued about US$1 billion. However, for this particular industry a specific foreign investment policy had not been developed, fearing of uncertain politic risks, foreign investors had no interest to invest in China substantially. There were only 23 joint ventures in the electronic industry in 1985 (Wang, 2000).

The second stage was from 1986 to 1990. In this period, the policy focus was on the improvement of the investment environment for foreign electronic companies. On 11 Oct 1986, China issued 'The Decision on Encouraging Foreign Investment' (Wang, 2000), intended to guide foreign investors to invest in companies with advanced technology or with export capacity. This decision boosted Sino-foreign cooperation in the electronic industry. In 1990, there were 154 Sino-foreign joint ventures in the electronic industry.

The third stage was the period of 1990 to 1995. In this period, more and more foreign companies entered into China's electronics market. As comprehensively upgrading and developing telecommunication infrastructure required intensive investment, both central and provincial policymakers enacted several of policies to attract foreign investment and advanced technology. At the same time, when the national informatization program and the golden projects were activated, demand for computer and telecommunication equipment had increased substantially. Therefore, huge market potential plus policy encouragement had attracted many foreign companies to set up factories in China. In 1994, there were 8000 foreign investment companies in the electronic industry, the total output value of those companies accounted for 28.6% of total electronic companies in China (DEOSR, 1995).

At this later stage, the policy focus was more specific for particular areas of the industry, which had given clearer signals to foreign investors on the priority areas set by the Chinese government. According to the 'Guidelines on the Industrial Catalogue for Foreign Investment' issued in October 1995, foreign investment was encouraged in the following areas:

- New equipment and new materials which were currently unable to be produced domestically but were adaptable by domestic producers, and in high demand in the international market.

- Projects which would meet international market requirements, so that the quality of existing products could be improved, and new market channels could be created.

- Technologically advanced products that could improve production capacity of industry and increase technological and economic benefit.

After about 15 years of promoting technology development, technology transfer and foreign investment inflows, China had cognizance of the importance of foreign

technology in this crucial area. Indicated by Wang (2000), China's electronics industry development strategy could be reflected in the specific product development plan outlined below:

- the manufacture of large-scale integrated circuits
- the manufacture of 900 MHz digital cellular mobile communication equipment
- the manufacture of digital microwave communications systems and measuring equipment
- the manufacture of asynchronous transfer mode (ATM) switching equipment
- the manufacture of key components for facsimile equipment
- the manufacture of satellite communications terrestrial earth stations (TES), data earth stations (DES), and key components
- the development and production of software, commercial satellite manufacture, satellite payload manufacturing, and satellite applications
- the development of new fields such as information and communications networking technology
- information service prevision, etc.

6.3.2 Joint Venture: a Vehicle to Carry Technology Transfer

Joint ventures could bring about technology transfer to the host country with the latest technology and know-how. However, most technology and know-how could not be purchased in the market place, since the specifications of new technology and related maintenance are often known only to those who have hands-on experience. Without such experience, many costly mistakes could be made before the technology can be effectively applied. Additionally, the costs of technology transfer and the amount of time required for such transfer are often greater than what was expected, direct and continuous contact with the originators of the technology as well as their level of commitment on providing technical assistance are frequently demanded by the acquisition party. Therefore, joint

venture arrangements seemed to be more effective than alternative types of business arrangements.

When confronted by the trade and non-trade barriers in their export endeavour to China, the companies from the western countries used the 'trade-barrier avoidance strategy' to invest instead of export. Together with the import substitution strategy pursued by the government for this industry, foreign companies have much to benefit from producing in China.

During the time of the import-substituting investments, the ownership structure of foreign investment in China had been an issue to both Chinese and foreign companies. The success of foreign investment seemed to have been determined not only by the financial capabilities of the investors, but also by the need to acquire local market knowledge. Western companies preferred equity joint ventures with local partners rather than wholly owned subsidiaries, because they were concerned with the accessibility to domestic market information and good relationships with the local governments. With the expansion and the development of the domestic market in the 1980s, the dependence of firms on the government officials and the involvement with the Chinese partners had lessened (Wang, 2000).

The foreign investment policy had enabled China to obtain advanced science and technology from foreign manufacturers. China as one of the largest users of foreign capital among developing countries had made great progress in significantly narrowing down the technology gap between China and the developed countries. In 1994, electronic industry foreign investment companies were accumulated to 8000 with a total of US$4 billion foreign capital investment. In the telecommunication sector, the former MPT had established as many as 67 Sino-foreign joint ventures (DEOSR, 1995). By the end of 1997, their products were successfully installed all over the country's telephone, mobile phone and optical telecommunication networks. In 1997, two telecommunication companies were among the top 20 foreign invested companies in China according to

sales revenue. Motorola China Electronic ranked number two, and Shanghai Bell Telephone Equipment ranked number six (CEI data, 11/11 1998).

Since the change of the FDI policy, the characteristics of foreign investment in the information industry have changed greatly:

- Large foreign companies had been the major investors instead of medium or small-size companies. A significant case was Shanghai: in 1994, total foreign investment was US$527 million, of which a total of US$256.8 million was invested in 17 projects by 11 international large-scale companies (DEOSR, 1995). It represented 48.7% of total foreign investment in Shanghai in 1994.

- Large-scale projects (more than US$10 million) increased dramatically. US$500 million contracts were signed by AT&T and Chinese companies in 1994. An additional $150 million were to be invested in setting up switching equipment joint ventures, micro electronic joint ventures and R&D laboratories in the subsequent two years. Canadian North Telecom was going to invest US$130-150 million in China's electronic industry between 1996 and 2000. US$425 million was invested in 42 electronic cooperation projects in Shanghai, so on average each project had more than US$10 million foreign capital input.

- Technology transformation and technology cooperation sprouted as a new trend. For example, Shenzhen Great Wall Internal Information Production Pty Ltd is a joint venture of China Great Wall Computer Corporation and America IBM, with IBM's key technology and Great Wall as brand name. China Great Wall Computer Corporation was the first Chinese computer manufacturer. Due to the gap in key control technology between the Chinese and the world leading manufacturers, like many other computer manufacturers in China, Great Wall needed to import some key parts for its products, such as CPU. The upgrade key parts were not easy to acquire and high tariffs on the imported parts were obstacles to its price competitiveness both in the domestic market and the international market. Thus to build a joint venture

with the world leading computer manufacturer was a way to produce large mass computers with up to date technology. Total investment of US$10 million was used to produce PCs and provide services to the Chinese market (Liu, 2000).

6.4 A Case of Government Involvement in Technology Development

In the period of the Eighth FYP, the rapid development in the communication industry was steered by two driving forces. One was the government policy engaged in promoting the construction of information infrastructure. The orientation of the policies was tuned to improve the development environment and explore a best road suitable for China to catch-up leading countries in the world. The other one was the attractiveness of the huge market potential that excited all international communication companies. In this period, one obvious change with regards to policy making was that the technological development policy and foreign investment policy issued for the information industry became more consistent with other industrial policies. Building the national information infrastructure based on improved domestic capacity had been the focal point of the central government strategy. An intensive plan _ the '908 Program[6]' _ for core technology development of computer and communication equipment had enhanced the independent capability of the nation in designing and producing key products, was underway and premeditated thoroughly by the central government. An important action was to promote the development of a vital technology _ large scale IC technology in China, which was fundamental to the future of information technologies.

6.4.1 Government Engagement in Key Technology Areas

In order to develop large scale IC in China, in August 1990, a national ICs special program called '908' program was planned by SPC. This program included 29 projects, such as ICs CMOS chip manufacturing line, ICs encapsulation manufacturing line, CAD, ICs exactitude, specialised ICs equipment and test instruments. The total investment was

[6] The '908' program was named by the time the microelectronic program was planned - August 1990. It also reflected the planned technology level, which was to build production capacity of 0.8 inches CMOS chips.

RMB2.9 billion. By the end of 1991, feasibility studies of most of the projects in the program had been handed in to SPC for approval. Among all the proposed projects a CAD project was the first started. The rest of the major projects started operating at the end of 1995. It took more than five years to get the program finally operate from the time it was planned in 1990. This was due to the long time discussion and negotiation with foreign equipment and technologies suppliers. '908' was a national key program. To show the commitment of the Chinese government to this program, a leadership group was formed. On 23 January 1993, the State Council issued the first document of the year, 'Document No.1: the Recommendation on Setting up a Leadership Group for the IC Specialised Program'. In this document, the then Vice Premier Zou Jiahua was nominated as the group leader, and the Vice Chairwomen of the SPC, Ms Hao Jianxiu and the Vice Chairman Mr Zeng Peiyan was nominated as assistants to the group leader. The members of the group constituted of high level officials from SPC, MF, MEI and other institutions, and totalled 22 members. An operating office to conduct daily administrative works for the program was set up in the MEI.

To ensure the success of the program, the Leading Group and the operating office made an enormous effort to improve the coordination between companies and government agencies. Important policy supports set out by the Leading Group to domestic IC producers had been to pressure domestic IC end user companies to use domestic products, and help IC companies capture suitable technologies from foreign companies.

The desire to acquire the best Western microelectronics technology was made loud and clear to the world by the Chinese government, especially to the international telecommunications equipment manufactures, who intended to enter into China. Seeing the potential of the Chinese telecommunication market but constrained by the tight control of the central government, many international leading telecommunication companies tried to explore ways to attract the Chinese government's attention and gain government cooperation. This had given the government a good position to acquire national popular technologies.

Bringing in advanced microelectronic technologies with upgrading capacity was a necessary condition for any potential foreign companies who intended to build switch ventures in China. It meant that to build telecom equipment manufacturing joint ventures in China, foreign partners were required to make the commitment to bring up to date microelectronic technologies to the joint venture and build an ICs plant. This was part of the strategy mentioned earlier to use market share in exchange for advanced technology from foreign companies.

However, the strategy had not achieved the expected result in the telecommunication industry partly due to the limited opening of the market to foreigners and partly due to the ignorance of some local governments and companies. Some local governments and individual companies were keen on foreign investment itself for various reasons but not for specific technologies. Therefore, in a lot of cases the microelectronic technology brought in by foreign joint venture partners was not up to date (Wang, 2000).

Recognising the above problems in the microelectronic technology transfers, the central government, through SPC, intervened to re-stress the supervision role of the central government and its commitment to pursue the 'market for technology' strategy.

Such intervention was carried out through various policy measures administered by the SPC. As discussed in Chapter Three, in China's economic transition the SPC has lost its direct control over companies' activities in principle, local governments and companies would follow the recommendations made by SPC only when they thought there would be benefits to them. However, there were still a few things that SPC could strongly influence on companies' performance. Outlined below are the major policy tools that SPC had practiced to ensure the local government as well as companies following the strategies laid down by the central government.

(a) The State Council Directives

These Directives are a series of documents issued by the State Council and enforced by the SPC to stress particular intention of the central government when needed. It is a very powerful tool and the issues covered by these documents range from national economic structure to company behaviour. For example, in 1990, to respond to the US government trade sanction to China, the State Council issued No. 56 Directive, within which foreign switch companies permitted to set up joint business in China were limited to three, so the US switch company AT& T was kept out of the Chinese market (William, 1994).

(b) The State Council Cipher Telegrams

Like the Directives, these were issued by the State Council for a particular intention, but they would directly address a particular local government when something happened that deviated from the central government intentions (Lui, 1994).

These measures (a) and (b) both had political and economic implications for local authorities. They would include serious punishment to local authorities if they were not complied with. If local governments did not follow the principle of a State Council Directive or the Cipher Telegram, they would no longer be considered in the forthcoming national projects. The most seriously punishment for officials of local government was the forced retirement from their official positions.

(c) The right of project approval on behalf of the central government

Projects are the primary means through which governments of developing countries translate their plans and policies into action (Rondinelli, 1993), and the approval of a project sometimes forced local government to comply, as any deviation in relation to a central government's decision in a particular project could cause the central government to exclude them from any forthcoming projects.

(d) The right of approval of assembling equipment

SPC and State Council Imports Approval Office controlled the approval of assembling telecom equipment. In order to train workers and technical staffs for a new joint venture, a factory started operation by assembling the same type equipment, which was imported

from the foreign joint venture partner. It needed about a million lines SKD for the purpose of training. There was big difference between approved and non approved projects in relation to customer duties on the imported parts. The import duties could vary anywhere between zero for approved projects, to as high as 200% for unapproved projects (Lui, 1994).

6.4.2 Switch Market and Up to Date Technology

In the interest of foreign telecom equipment manufacturers, cooperation with the Chinese government was vital to their long-term benefits in the Chinese market. Positive communications could win strong support from the Chinese government. One example is AT&T's Chinese strategy.

Like many US companies, AT&T might market or transfer products and procedures containing the technology that was permitted by the American government *Export Control Guidelines.*[7] AT&T sold over $100 million of telephone equipment to China per year before 1993. According to an AT&T Federal Government Affairs report (1993), between 1993 and 1997 its sales to China would be over US$1 billion and exports from AT&T factories in the USA to customers and joint venture facilities in China would reach nearly $200 million per year. Using standard US government exports/jobs ratios, this meant AT&T's sales to China alone would create about 2000 jobs in the USA.

However, AT&T's performance in China and its relationship with its Chinese customers and partners, such as various Chinese government departments, multinationals located in China, and Chinese private consumers, had always been subjected to the political swings in the relationship between China and the United States (William, 1994). China's Most Favored Nation (MFN)[8]status was one of the most difficult issues between the two countries. Every year the debates on the renewal of China's MFN would create a round of

[7] *Export Control Guidelines* was issued by the American government to control technology exports to the former communist countries.

[8] Most Favored Nations statures are a bilateral arrangement in which two countries agree to reduce or eliminate trade barriers and tariffs on trade between them. Reduced tariffs help make trade more economic in both directions. For more details see, 'The economic importance of Chinese MFN to AT&T' release, May 1993, AT&T Federal Government Affairs.

uncertainty for US investors and Chinese customers. 'From AT&T's point of view, it would be very damaging to their global business if the MFN for China was revoked. MFN was one of the most important issues to AT&T's Chinese business too' (William, 1994). 'In the testimony given before the US Congress in the autumn of 1993, Mr. Robert Allen, Chairman of AT&T, estimated that export controls maintained by the US will cost AT&T approximately $500 million in sales over the next five years' (William, 1994, p.271).

It is very interesting to see how AT&T using MFN as a bargaining chip to deal with the Chinese government, and to adjust its China Strategy according to the change of political and economic situations.

As mentioned earlier, the issue of No. 56 State Council Directive in 1990 had left AT&T out of the Chinese switch market. The relationship between AT&T and its China customers and government was in a downturn. In 1990, AT&T shared only 1% of China switch market comparing with 31% for NEC, 24% for Alcatel, 20% for Fujitsu and 19% for Ericsson.

In the following years, AT&T started planning to shift its attention to China for the potentially huge commercial benefits. They started work by canvassing the officials of MPT, but the way they dealt with Chinese officials was unpleasant. They warned the Chinese officials that if AT&T could not enter Chinese market, they would lobby American government to cancel China's Most Favored Nations status. Chinese officials sensed the warnings threatened the continuation of the trade sanctions, which irritated them the most. As one can imagine the result could not be what AT&T was expected. To change the hostile situation, the head of AT&T China was replaced by a person with totally new ideas from the AT&T head office in 1992. Following the new appointment, AT&T's China strategy changed accordingly, the MFN was still the tool to knock on the door of China's switch market, but the attitude was more positive. From the major media in China in late 1993, such as the People's Daily and Xin Huashe, AT&T played a

leading role in lobbying the American government for China's Most Favored Nations status in 1994.

In November 1992 AT&T dispatched a small team of business unit heads to meet informally with officials in China's State Planning Commission. That was the beginning of a new era of AT&T's China business. There they presented their idea of comprehensive cooperation with the Chinese government encompassing all of AT&T's capabilities to the then Vice-Chairman, Mr. Ye Qing.

By the time China was considering attracting leading technologies in the world to build its own telecommunication infrastructure, AT&T was already a top international communication company with leading technologies. In addition, the national key program, the '908' program had run into difficulties in finding an appropriate cooperator who would like to supply up to date technology for the main projects, the CMOS chip manufacturing line and the ICs design centre. Communication ICs are ICs with leading technology and the growth of the ICs market is largely driven by the high demand for communication equipment. Developing China's switch market had created great opportunities for its microelectronic industry. But China's microelectronic companies were blind to the opportunities, since there were no existing connections between most microelectronic companies and switch equipment producers. In this situation, the central government intended to develop a domestic switch market through which it could gain the much needed microelectronic technology. The possibility of realising such ambition depended very much on how keen AT&T was to get into the Chinese switch market and the level of the central government's commitment to handle all the subsequent issues.

The positive attitude and the idea of comprehensive cooperation held by AT&T gained a positive response from the Vice-Chairman of SPC. One of the important steps was that SPC appointed a team of Chinese officials to handle the business with AT&T specifically. In order to understand the actual situation of AT&T's technology, product and how they managed the business, a group of people headed by Mr Ye visited AT&T at the end of 1992.

The Chinese were interested in finding out AT&T's commitment to China and to China's development, and assessing the areas of long-term cooperation beneficial to both parties. The result of the visit was a draft note outlining the proposed areas of cooperation between the Chinese government and AT&T, including specific technologies, training provisions and tentative timetables for the phases of work. An important point in the note was that advanced microelectronic technologies, particularly specialised telecom ICs constituted a big part of the cooperation.

This document later became the Memorandum of Understanding (MOU) between SPC and AT&T. SPC's Vice Chairman Ye and AT&T's Vice Chairman Randall Tobias signed the MOU in February 1993. The agreement fulfilled strategic objectives of both parties. The MOU was not a sales contract, it established a long-term comprehensive partnership between China and AT&T. In China's interest, the MOU would contribute to the development of a national telecommunications infrastructure, and upgrade related industries and technologies, not only switch equipment technologies but also microelectronic technologies. In the agreement the switch ventures and the microelectronics plants were bundled together as part of the whole package. That was the switch ventures could be built only if the microelectronics plants were equipped with up to date technology. This was critical for China's microelectronic industry to get up to date microelectronic technologies and fulfil the goals of '908' program. For AT&T, the agreement gave them the market entry for a wide range of products and services. AT&T had actually worked directly with the central government with regards to their China business. This had given them a much-privileged position in competing with all the potential foreign competitors in China's telecommunication market.

In October 1993 the US and Chinese governments concluded a Market Access Agreement, of which, China agreed to remove restrictions on market entry for US firms in a number of sectors including telecommunications. The direct benefit to AT&T was that this agreement opened the door for AT&T to compete in the switching business in China.

With experience from the case with AT&T, the Chinese government decided to set up a telecommunication market coordination group to directly control and monitor the entry process of international telecom equipment manufacturers into the Chinese market (CEIYB, 1994). The group consisted of the officials from SPC, MEI and MPT. A number of high level officials were involved in the process. The highest ranked leader of the group was Vice Premier Zou Jiahua, who supervised SPC, MEI and MPT at the time. The group leader was the Executive President of SPC Mr. Ye Qing. Other members of the group were the Director Generals of the Department of Machinery and Electronic Industry of SPC, Department of Comprehensive Planning of MPT, Department of Microelectronics Industry of MEI, and some other senior staffs. The mission of the group was to coordinate among relevant ministries and agencies, with AT&T and some other international telecommunication companies' involvement, to identify the Chinese partners for cooperation. It was with the two ministries, MEI and MPT that the international telecommunication companies registered their joint ventures, negotiated specific business cases and got ministry approvals and cooperation. In addition, the group worked as an advisory board to oversee the general implementation of the agreements signed with the international telecom companies, AT&T and Nortel (of Canada), and identify new opportunities for joint endeavours. According to the guidelines of the agreements signed by SPC and the switch companies, the switch ventures and microelectronic plants were built later, both with up to date technologies. China's telecommunication infrastructure construction stepped into a new era, and that was when the '908' program finally was up and running. On 18th December 1995, the main project of the '908' program, the ICs CMOS chip manufacturing line started its construction work. To support the project, SPC appropriated 0.3 billion RMB as national capital investment. This was the first project that used national capital (CEIYB, 1996). It was expected that within 16 months the manufacturing line would be in full production. This project imported 0.9-Micron ICs technology from AT&T to produce telecommunication specialised ICs and supply local assembly of AT&T digital program exchange equipment in China.

Conclusion

An important strategic choice for the information industry was to improve the competitive capacity in the period that this case study covered. The Chinese government implemented this strategy by undertaking: (1) institutional innovation to promote the innovation initiative of the industry; and (2) policy reorientation to enhance the competitive advantage.

The institutional innovation of science and technology system reform broke the organisational barrier for transferring technology from independent research institutes to the industry. That was a fundamental change to the high technological intensive electronic industry. Apart from pushing the research institutes to commercialise their output, it was critical to the electronic industry to take in domestic technological sources to compete internationally.

Continuously adjusting policy orientation was necessary for a transition economy to undertake strategic innovations, and this was determined by the path dependent nature of the transition. The process of policy making in this period had been very challenging and demanding, which was illustrated through the policy re-orientations from nurturing an infant computer industry by supportive policies, such as government direct investment, specialised funding and favourable policy concessions, to facilitate industry capacity building by ordering and shaping the competition, such as setting the numbers of foreign switch companies who could build joint ventures in China, and guiding foreign investors to invest in priority industries. The performance of computer (annual growth rate 58.5% from 1990 to 1995), switch (output 185million in 1990 to 1400 million in 1995) and microelectronics (0.9 micro IC technology successful imported from AT&T) industries was a strong indication of the success of the innovative policies implemented in this period.

With ongoing government learning, (the previous practice gave many lessons to Chinese policy makers), the strategic choice of building competitive advantage was strengthened by a series of innovative decisions: (1) computer and telecom equipment were chosen as driving engines for the development of the information industry in the eighth FYP; (2) 'Golden Projects' were launched to build China's information infrastructure; and (3) an institutional change was initiated, the rebuilding of the MEI, to meet the organisational needs for the transition of the electronic industry and broadly for the development of the information industry. All of these decisions were interactive and pushed the information industry to build its competitive capacity. Government policy makings in this period had been systematic and interconnected.

The government involvement in the '908' program and switch market worked well in the balance of national interests, because it not only shaped the switch market in building a simple connected communication network, but also assisted the microelectronic industry. The technology choices in the Memo signed by SPC and two telecom companies directed the Chinese telecom industry. It also upgraded the technological level and industrial foundation for building a national information infrastructure.

7. Control and Competition of the Telecommunications Sector, 1990-1995

Introduction

In the 1990s, the biggest challenge to Chinese policy makers in the information industry was the globally liberalised environment and domestic development in the telecommunication sector. The booming demand for rapid development of China's telecommunication sector had created opportunities, but the grasp of such opportunities became an issue to the sector. One major problem was that there was no significant improvement in the monopolistic situation of China's telecommunication sector, which resulted in an enlarged gap between the supply of and the demand for telecommunication services.

This chapter outlines the gradual process driven by the government to break MPT's monopolistic power. To promote the national informatisation program, the government had opened a window to new telecommunication service providers whom became the rivals of MPT. The emergence of new telecom companies had challenged MPT's monopolistic position in network operation. As the government encouraged more domestic telecom equipment manufacturers to supply the domestic market, MPT's monopoly in the equipment manufacturing area was severely affected. MPT responded to these challenges by trying hard to keep its monopolistic position and upgrade its network.

To break up MPT's control in the sector, MEI played an important role. Jitong and Unicom were two good examples. The Golden projects and the national information infrastructure construction were undertaken by these two companies (for the details see section 7.4.2).

Because of MPT's special role in this sector as both regulator and operator, the existence of conflict of interest between MPT and other telecommunication companies had demanded the State Council to intervene and balance the interests of different parties. The policy focus at this stage was to address the coordination issues between different players. As more and more players were participating in the provision of telecommunication services and battling for departmental interests, the State Council found it extremely hard to square the interests between different groups. A united administration system was therefore in urgent need to solve the problems arisen from the monopoly of MPT and to cultivate fair competition in both telecom service provision and equipment manufacturing between MPT's and MEI's companies, and other players, like China telecom and Unicom. Through a complicated process, MPT and MEI finally came together to form a new ministry, the Ministry of Information Industry (in 1998). This was one of the important steps towards a coordinated institutional management. The new ministry was expected to eliminate the conflict of interests of the previously separated ministries and promote a healthy development of China's information industry. The new ministry was also expected to meet the requirements of the rapid growth of this industry and to facilitate the realisation of national informatisation.

7.1 Situation of China's Telecommunication Industry

Public Networks

In 1990, 8 million lines were connected in the main networks, and 4 million lines were connected in rural areas. The large users of the networks were diversified from oil fields, railways, to mines etc. They were also encouraged to develop their own networks, and partially interconnect their special purpose networks to the public network. Table 7.1 shows the public switching telephone lines between 1990 and 1994.

Table 7.1: **China Public Switching Telephone Network (PSTN)** 1990-1994), million lines

Year	PSTN	Yearly Increase	in Urban	in Rural
1990	1969	266	826	405.8
1991	2337.8	368.8	1033.1	459
1992	3000	662.2	1355.5	571.1
1993	4206	1206	2217.4	851.1
1994	6162	1956		

Source: Edited from 1996, 1997 *China Electronic Products Market Outlook*, Department of Economic Operation and System Reform of the MEI and Information Centre of MEI, Beijing.

The number of connected main telephone lines per 100 populations was 0.86 in 1988 and had risen to 20.1 by year 2000 (MII 2002). The fixed capital investment in the public network had risen from RMB 8.4 billion yuan in 1991 to 16.21 billion yuan in 1992 and 98.5 billion yuan in 1995 (CEIYB, 1996).

Extensive use of private branch exchanges (PBX) provided extended telephone services in offices and residential areas. In 1990, 48% of all urban telephones were connected to PBXs, which is much higher than in other countries (India 8%, Japan 2%) (Zhao and Liu, 1994).

Mobile phones, cellular telephones and pagers have proliferated in urban areas, to compensate for the lack of cabled telephones. By the end of 1990, there were 23,700 mobile phone subscribers in 12 major cities, and 436,600 radio pagers in 200 cities. Many more mobile phones were manufactured for dedicated uses, for instance the number of 450 MHz mobile phones produced was around 400,000 in 1993 (IDIL, 1993c).

Dedicated Networks

In 1993, there were 39 special dedicated networks owned by ministries other than MPT and used in systems of defence, railways and other means of transportation, power supply, petroleum (oil rigs), irrigation systems, public security, meteorology, TV broadcasting, ground microwave links, and banking.

The largest of these networks was that of the Ministry of Railways (MOR), with 250,000 lines connected to automatic exchanges in 750 locations. Some 3000 railway stations without telephones were connected by radiotelephones or via train dispatch lines. The MOR's long distance network consists of 35,000 km open wire lines; 17,000 km symmetrical pair and coaxial cable; 600 km of digital microwave, and 500 km of optical fibre (IDIL 1993c). However, there was only a limited inter-linking between the dedicated systems and MPT's public networks.

An investment of 20 billion yuan in dedicated networks was planned in the Eighth FYP (1991-1995).

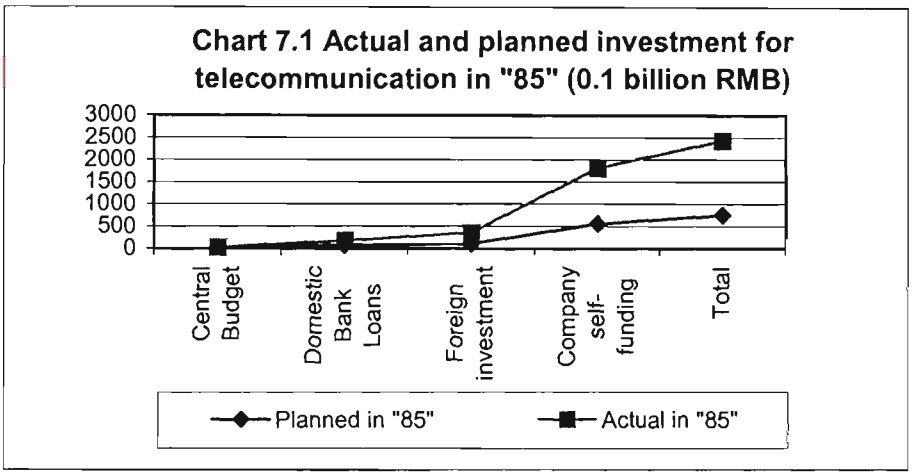
7.1.1 Investment and Capacity

China's telecommunication infrastructure and its capacity have experienced a continuous progress. In the period of the Eighth FYP, the telecommunication infrastructure boomed dramatically, the scale of investment multiplied each year. Policies on revenue distribution between central government and local government, user-pays policy and foreign investment policy played key roles. The most distinctive policy among these three was the 'user pays' for telephone connections, which was learnt from other countries in the development of the telephone networks. The revenue distribution policy allowed local governments and branches of MPT to retain 90% of the revenue generated from telecommunication service provision. This had motivated the local governments and branches of MPT to expend their services.

The features of the development of this industry in the Eighth FYP can be summarised as follows:

(1) Actual level of investment was much higher than what was planned

In contrast with the planned investment of 75 billion yuan for telecommunication industry was in the Eighth FYP period, the actual investment reached a total of 242.4 billion yuan (see Chart 7.1). It was 3.2 times of the planned investment, and 7.55 times of the total of 32.1billion yuan investment from 1949 to the end of Seventh FYP (see Table 7.2). Table 7.3 shows the changing perspective to the development of China's telecommunication service. The target of telephone per 100 people of year 2000 changed from 2.5 in 1998, to 5 in 1993, 8-9 in 1994, 10 in 1996 respectively. Accordingly, the target demand to switching equipment for year 2000 changed from 48M in 1980 to 95M in 1993, 116M in 1994, 170M in 1996. The scale of telecom investment stood of 4% in national fixed capital investment in the Eighth FYP comparing with 1% in the Seventh FYP (MPT, 1996).



Source: Data is edited from The Summary of 8th Five Year Plan of Post and Telecom, MPT, 1996, MPT internal paper.

(2) Technological upgrading attracted more financial resources

The investment structure had changed dramatically, between the 7th and the 8th FYP. The investment in technological upgrading was 10.38 billion in the 7th FYP, accounted for 51.4% in the total investment of the industry. In the 8th FYP this

investment reached 177 billion yuan which was 73% of the total investment (MPT 1996).

Table 7.2: Telecom Investment by FYP (0.1 billion RMB)

Period	Investment	Period	Investment
'15'	5.6	'55'	19
'25'	9.4	'65'	59
'35'	10.7	'75'	202
'45'	15.8	'85'	2424

Source: Edited from *The Summary of 8th Five Year Plan of Post and Telecom,* MPT, 1996, MPT internal paper.

Table 7.3: Comparison of Telephone Lines in 1980 and Planned Figures for Year 2000 (million line)

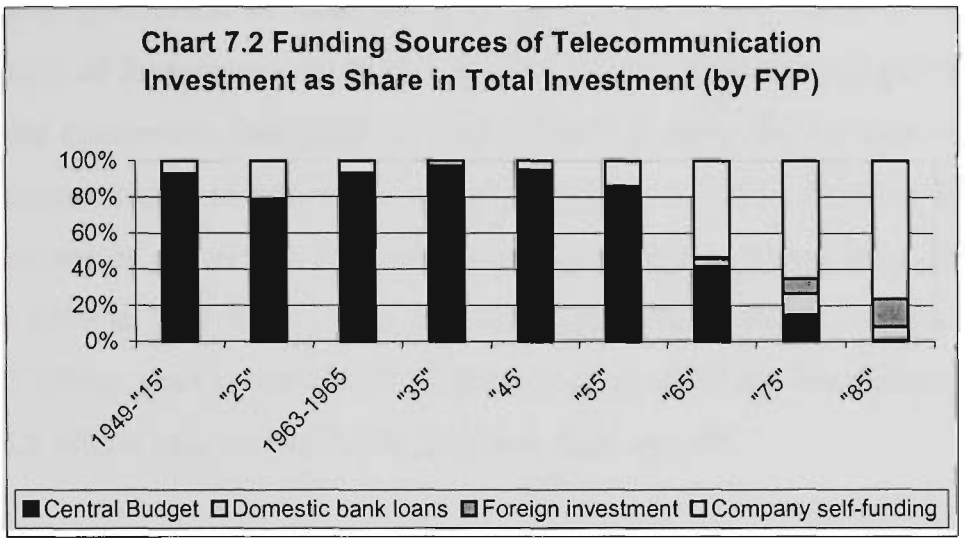
Year	1980	2000 planned in 1988	2000 planned in 1993/ 1994/1996
Telephones	4.18M	31M	65M(1991)/130M(1996)
Telephones per 100 people	0.4	2.5	5.0/8.0-9.0/10
Switching equipment	6.64M	48M	96M/116M (160M includes Unicom)/170M

Source: Edited from 1996, 1997 China Electronic Products Market Outlook, Department of Economic Operation and System Reform of the MEI and Information Centre of MEI, Beijing.

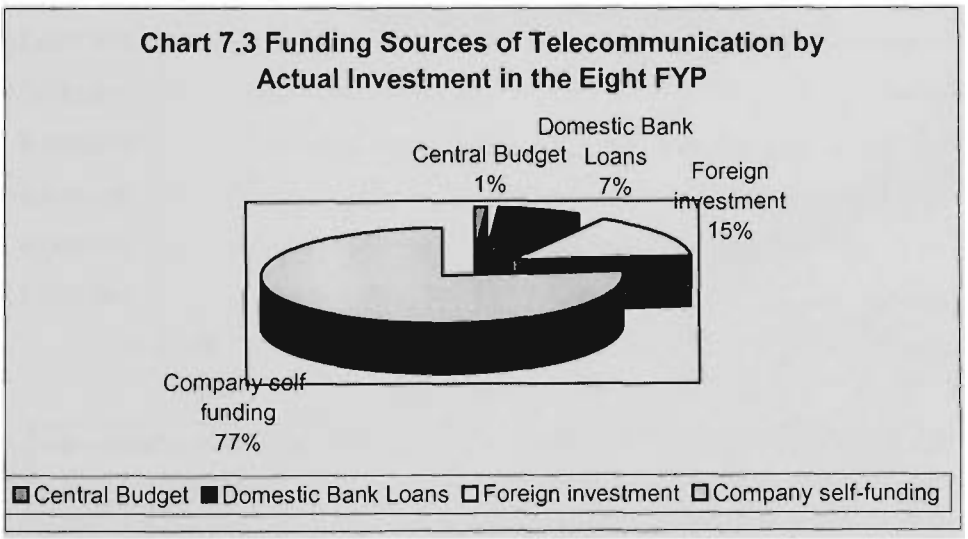
(3) Multi funding sources

To ensure adequate capital input in the industry, funding sources other than central government investment was also needed. From establishment of the People's Republic of China in 1949, to the end of the 5th FYP, the Central budget has been the major funding source, and company self-funding played a small role. Starting from the 6th FYP, Company self-funding replaced the Central budget becoming a critical source of funding and foreign investment and domestic bank loans appeared (Chart 7.2). By the end of the 8th FPY, Company self-funding shared 77% of total investment, foreign investment 15%, domestic bank loans 7% and the Central budget

1% (chart 7.3). The Central budget was no longer the main source of telecommunication investment in China.



Source: Data is edited from The Summary of 8th Five Year Plan of Post and Telecom, MPT, 1996, MPT internal paper.

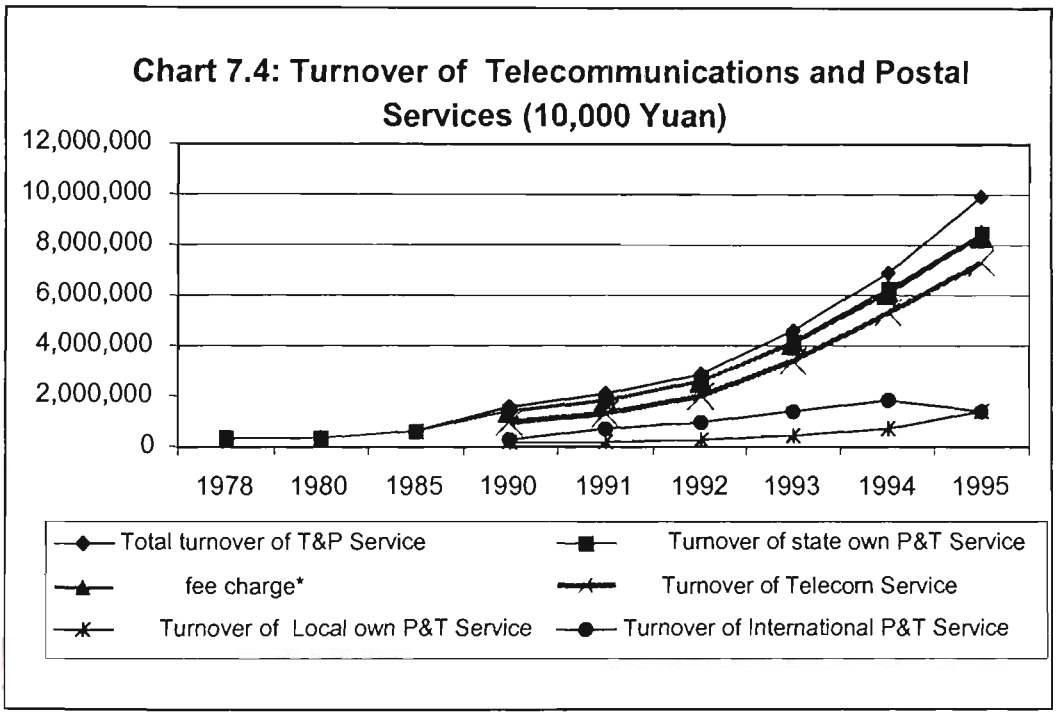


Source: Data is edited from The Summary of 8th Five Year Plan of Post and Telecom, MPT, 1996, MPT internal paper.

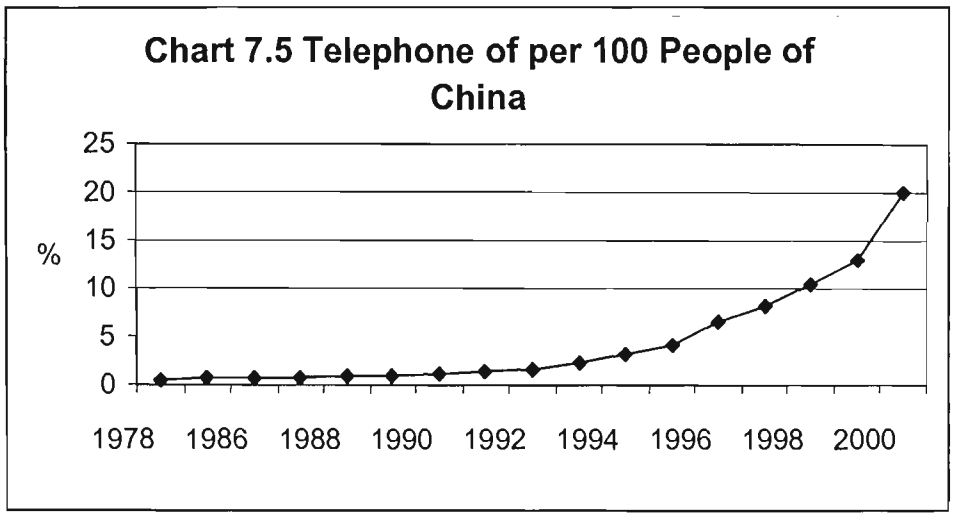
(4) Increased revenue from telephone installation charges

The 'user pay' policy had generated the telecommunication sector an extra amount of revenue. The amount of the installation and connection fee charged varied between 2000 yuan (US$250) and 6000 yuan depending on the charging policies of different

local telecommunications bureaus. The fees immediately recovered most of the installation cost of telephone lines. It was estimated that this revenue itself raised nearly 27 billion RMB during the 8th FYP period, an amount represented about 36% of the total investment in fixed assets (IDIL 1993c). According to a World Bank report, 66% of investments by MPT could be funded by its operating surpluses and subscriber connection fees (IDIL 1993c). Chart 7.4 given the turnover of China's telecommunications, in which fee charges played a key role. Starting from 1990, total turnover of postal and telecommunication service increased from 15.6 billion yuan in 1990 to 98.9 billion yuan in 1995. Telecommunication services increased from 9.5 billion yuan in 1990 to 73.3 billion yuan in 1995; and fee charges increased from 13.8 billion yuan in 1990 to 83.2 billion yuan, in 1995.



Note: Fee charge is part of the turnover of the state owned P&T service.
Source: Data is edited from The Summary of 8th Five Year Plan of Post and Telecom, MPT, 1996, MPT internal paper.



Source: MII (2002), *Development of Postal and Telecommunication Service,*
http://www.mii.gov.cn/mii/hyzw/tongi/nb/2000nb/page2000203.htm

Chart 7.5 portrays an increasing trend of telephone lines per 100 persons from 1978 to 2000.

(5) High investment requirement

According to the national plan, the number of connected major telephone lines per 100 population was to exceed 5 by 2000 (actual number has reached 20.1 see Chart 7.4). Following this plan, an annual growth of 18% was expected. The new installation of telephone exchange lines was planned to rise to 10M by 2000. Again, this was aimed at a rate of increase by 18% per year. To achieve this goal, a 22% of increase in investment was needed (IDIL, 1993c).

In 1988, MPT investment was US$1.5 billion (IDIL, 1993c). And the estimated[1] annual investment value by MPT from 1993 to 2000 is shown in Table 7.4. The total amount of investment in telecommunications nation-wide should be higher if the

[1] For statistical reason, there is no updated data from current statistic sources. Data cited here is from a survey by International Development Ireland Limited which cooperated with MEI in 1993: *Strategies for Developing the Telecommunication Industry in China,* Final report to the Ministry of Machinery and Electronic Industries.

investment of other network suppliers was included, such as Ministry of Railways, Ministry of Energy, Ministry of Public Security, oil rigs, and private branch exchanges owned by MEI enterprises. According to the World Bank, the estimated capacity of networks owned by organisations other than MPT was about 10% of the MPT's capacity. As the MPT network expanded rapidly in recent years, the relative position of other investments outside MPT fell rapidly (IDIL, 1993c).

Table 7.4: Estimates of Investment in Telecommunications (US$ million)

Year	Purchases by MPT	Manufacturing Investment
1993	4050	220
1994	4950	270
1995	6050	340
1996	7350	400
1997	9000	490
1998	10950	610
1999	13300	730
2000	16300	900

Source: Strategies for Developing the Telecommunication Industry in China, p65, Final report to the Ministry of Machinery and Electronic Industries, by International Development Ireland Limited (1993c), Research Report, Beijing.

Although MPT had made operating surpluses and extra revenue from telephone installation charges, they were all in RMB terms which could not be easily transformed into hard currencies required by imports of foreign equipment under the exchange control system. In 1990, telecommunication equipment exports were sufficient to meet only 21% of import requirement of this sector (IDIL, 1993c). It was quite a challenge for the industry to meet its year 2000 target, even with that increased scale of investment.

7.1.2 Challenges

It became substantial that difficulties in making telephone calls had become one of the major aggravations of ordinary life in China (Chang, 1994). Before the economic

transition, the household telephones were only installed for the heads of big companies and senior government officials, most people were not allowed to have a telephone line connected at home. Until the late 1980s, there had been less than 5 million lines to serve the entire nation, public telephone services were almost non-existent. In a country with approximately 250 million households, only about 1,000 of them had telephones (MPT, 1993). Many small towns had no phone services at all.

Since the economic reforms, the restriction on household telephone connection was removed, but it was still a luxury to most of the Chinese people in terms of both intolerable long waiting periods and high installation fees at the time. The local branches of the MPT required subscribers to pay 'connection fees' up-front before a phone was installed. As mentioned earlier, the fees could be as high as 6000 RMB, which was more than a factory worker's whole year salary. Nevertheless, thousands of people were on the waiting lists, hoping that in one or two years they would finally receive telephone services. The waiting period for telephone installation service in the cities ranged from 18 months to two years and 60-90% of the installation requests were from residential households (MPT, 1993). Waiting list had not been getting any smaller until very late in the 1990s, indicating a substantially suppressed demand for telephone services.

Despite the sustained and rapid growth in telecommunication services, public demand still exceeded supply by a large margin. According to some estimates, a country with China's average per capital income should have more than 3 phone lines per 100 people nation-wide, whereas China had only achieved 1.63 in 1994. SDD and IDD in south and central China were so busy that only about 15% of the calls dialed could get through. The completion rate for local calls was only about 60% (IDIL, 1993c).

Facing such huge market potential in telecommunication services, large dedicated network operators and manufacturing ministries confronted the MPT in the arena of policy and regulation makings. Large telecommunications service users and local governments also wished to have a more liberalised policy towards public telecommunication services, as they were not satisfied with the services provided by the MPT. From the equipment manufacturing side, the Ministry of Electronic Industry as well as some other user ministries were the traditional competitors to the Post Telecom Industrial Corporation which was directly under the MPT.

At the same time, as mentioned in several places of this thesis, policy making in China has been segmented with many players such as local governments or different ministries making their own policies without consulting each other, which led to a confused market situation. More and more pressure was put onto the central authority to coordinate and balance the interests between different ministries and local governments.

In response to the high demand of telecommunication services and the strong appeal from various interest groups for creating a fair competition environment, the government had finally opened the door to other players in telecommunication services.

The introduction of other players into telecommunication services spurred a dramatic growth of this industry. In 1995 China became the third largest mobile phone market in the world with 3.2 million subscribers, while in 1990, there were only 18,000 mobile phone subscribers. Although the phone line per 100 people for the whole country was still low at only about 3.5 by the end of 1995, in most of China's big cities this ratio was about 30. The huge construction program of the 8^{th} FYP had made the telecommunication industry achieve an average growth rate of more than 45 percent from 1990 to 1995. In 1995 more than 12 million lines were added to the network (MPT, 1996).

The increasing of intensity and scale of investment led to intensified integrating capacity of telecom networks. By the end of December 1995, newly installed inter provincial optical cable mainframe were 22 lines (about 107000 km), and newly installed provincial local optical cable was 193000 km; the capability of SDD&IDD auto exchange equipment increased to 3.519 million ports (MPT, 1996).

Despite such an impressive overall growth of the industry, there were about half a million Chinese villages that did not have access to a telephone in 1995.

7.2 Institutional Framework of the Telecommunication Industry

The national policies with regards to the development of China's telecommunications industry has been tied to the complex interplay of the MPT, the MEI, the SPC, the Ministry of Foreign Economic Relations & Trade (MOFERT) and other related ministries who have some involvement in either telecommunication service provision or equipment manufacturing. The whole institutional framework of China's telecommunication sector can be viewed at two levels _ regulatory and administrative levels. The regulators made regulations for the whole industry, and the administrative bodies supervised the companies which were under their umbrella.

7.2.1 Regulatory Structure

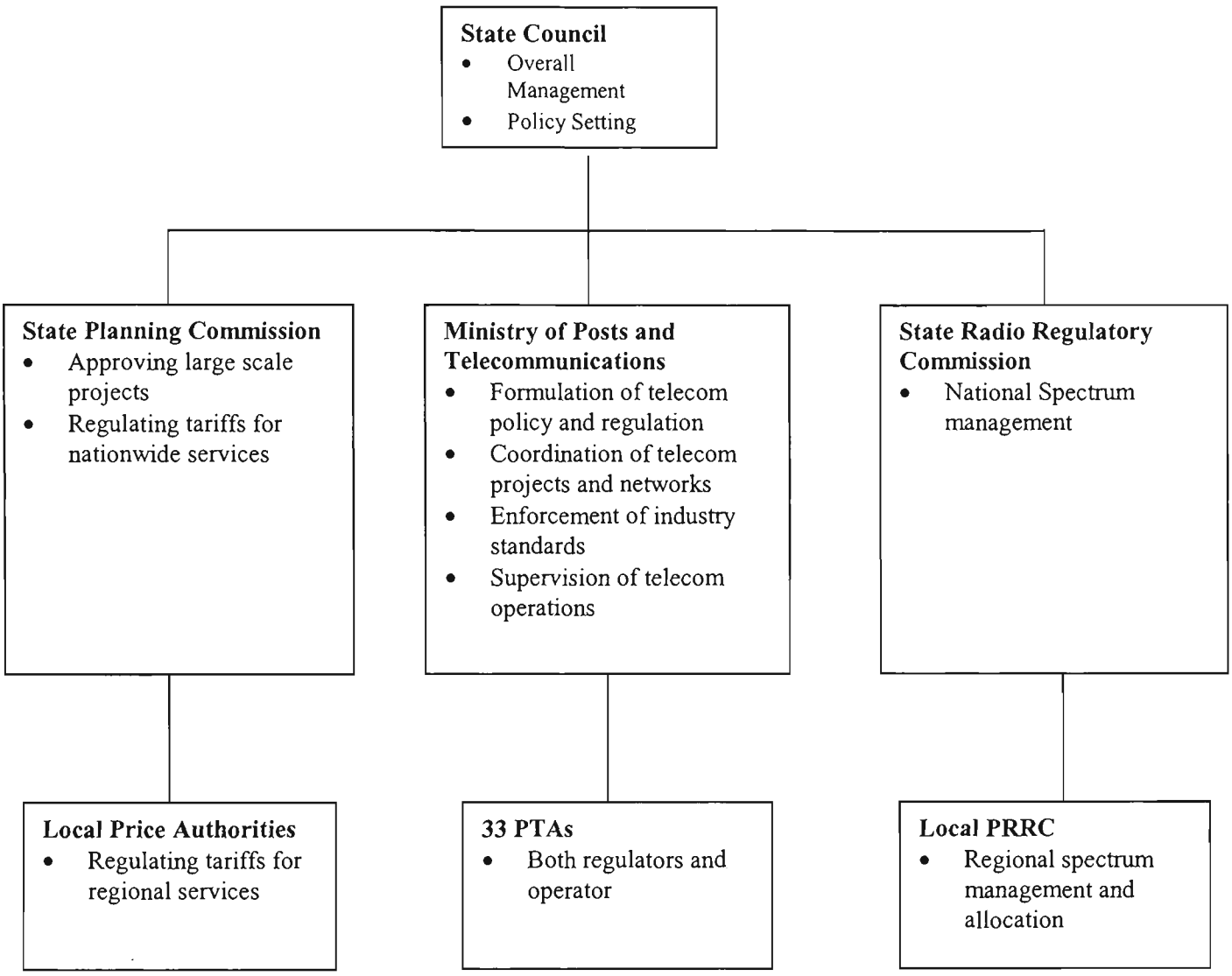
The regulatory structure of China's telecommunication can be briefed as, the MPT sets the rules for the telecommunication services; and the MEI and MPT were both manufacturers of telecom equipment with MEI being responsible for all the equipment production related regulations. Corresponding with these two ministries, there were three departments in the SPC overseeing the activities initiated by the above ministries related to the industry. MOFERT exerted its influence on the determination of national import policy, foreign capital and direct foreign investment

in domestic production ventures and technology transfers. Most policies would be issued by the State Council.

The telecommunication policies formulated by the MPT were mainly in areas of network standards and public network interconnections. It also had influence on the regional supply within the national MPT system. The MPT also oversaw the planning, coordination, and development of inter-provincial trunk facilities including domestic satellite installations and domestic fibre optics backbone projects. The National Radio Regulatory Committee under the MPT and its local branches were responsible for allocating radio frequencies used in both public and dedicated networks. The MPT shared responsibility for public network tariff regulation with the Ministry of Finance, and the National Price Bureau. Service revenues were divided between the MPT and the provincial PTAs and PTBs. Chart 7.6 outlines the regulatory structure of China's telecommunication services.

The most influential factor that led to the development of China's information industry has been the telecommunication regulatory policies, among which the 'user pay' policy (mentioned in 7.1.1) was very successful and made possible for the telecommunication sector to become self-sustained and expand further.

Chart 7.6: The Structure of China Telecommunication Service Regulators



The following policies and regulations also played important parts in the development of the telecommunication industry:

- Lower income tax rate: before 1994, telecommunication industry had enjoyed a very low 10% income tax rate compared with 55% income tax for other industries.

- Rise of telecommunication service charges: before the 1980s, the same low charge for telecom services had been maintained for 30 years and that resulted in huge losses to telecom enterprises and made it impossible for them to accumulate capital for development. After the 1980s, the service charge was lifted so that the financial situation of the enterprises had been greatly improved.

- Increased charges for local telecommunication services: in order to develop telecom infrastructure, local governments allowed local providers to increase charges to customers for developing the local telecommunication infrastructure.

- Development fund for the electronic industry (mentioned in 5.3.1): the objective was to promote the acquisition of products and services that offered better value for money and to foster the development of the information industry in China.

- Preferential policy for four kinds of electronic production: IC, computer, software and switch equipment (MPT, 1993) (mentioned in 5.3.1).

7.2.2 Administrative Structure

There had been a number of administrative bodies governing China's telecommunication sector. These bodies included the MPT, the MEI, the Ministry of Broadcasting, Film and Television (MBFT), China Aerospace Industry Corporation (CAIC), and China Aviation Industry Corporation. Apart from its regulator role in telecommunication services, the MPT was also engaged in the manufacturing of related equipment. The MEI was the dominant manufacturer of telecom equipment. The MBFT was in charge of cable TV related production and services. The CAIC was the manufacturer of radar, radio and communication equipment, such as switch equipment, satellite earth station, etc. China Aviation Industry Corporation was the

manufacturer of electronic parts. All these administrative bodies, in the management of their respective industries, could initiate their own policies in line with the regulations set by the regulators mentioned in the previous sub-section. Because the structure of the administration was very complicated and severe overlaps existed in the administrative system of the telecommunication sector, the State Council had to put enormous effort into resolving conflicting decisions made by different bodies. Consequently, the decision making process was slow in this system.

The major difficulties in the coordination of policy issues came from the clash of interests of the two ministries MPT and MEI. The MEI had been the most significant manufacturer of telecommunications equipment in China. Compared with the MPT's 29 factories, the MEI had 106 factories producing electronic components, computers and telecommunication systems. Because of the huge amount of research grants and orders from the traditional dedicated networks, the MEI had a more advanced R&D capacity and manufacturing facilities than the MPT (MEI, 1993).

However, the gradual reductions in the military R&D budget in telecommunications were softening the MEI's R&D edge. The MEI was losing its market despite the rapid expansion of the telecommunication market. Two main reasons had contributed to this situation: (1) a demand shift of MEI's traditional customers from domestic produce to international suppliers for new and advanced equipment and technologies; and (2) MEI was disadvantaged in the competition with MPT in the supply of telecom equipment as MPT was giving favourable treatment to its own manufacturers through the exclusive rights in issuing licences for manufacturing telecom products which were allowed the access to the public network.

7.3 Strategic Innovation (1): Breaking the Monopoly of MPT

7.3.1 Monopoly of MPT

The MPT was the only provider of postal services and public voice and data communication facilities and services to the end users in China. The MPT had ten administrative departments, two major posts and telecommunications academies, two designing centres, and three manufacturing and engineering units. The primary duties of the MPT included planning, regulating, service administration, engineering, manufacturing, and research and development.

The MPT had both functions of regulation and production in itself, and was the only commercial operator of public telecommunication services. It monopolised all the information exchange and delivery through the public telecommunication networks. Most of the telecommunication policies were made by MPT. It had overall responsibility for most of the public telecommunication facilities and administered national long-distance and international direct-dial voice and data telex telecommunications. Its three main functions were: (1) policy and regulation making; (2) service provision; and (3) equipment manufacturing. The Directorate General of Telecommunications (DGT) and the Communication Department in the MPT were the actual policy designers. The DGT was also responsible for the operation of the national public switched telephone networks, and its maintenance and development. It was also in charge of the approval of dedicated networks and their coordination with the public network. When MPT restructured in 1994, the DGT became an independent company.[2] The DGT, together with the MPT provincial branches, was the sole provider of international, domestic and local telecommunication services in

[2] The DGT was established in 1988. In the 1994 MPT restructuring, DGT was combined with the Department of Business, Department of Construction, Department of Network Operation and Maintenance and the Department of International Affairs in the MPT. The newly founded Data Communications Bureau and the Mobile Communications Bureau were also put under its professional supervision. On 27 April 1995, the DGT was registered with the State Administration of Industry and Commerce as a company named the Directorate General of Telecommunications, P&T, China or CHINA TELECOM in short. Since then, it had no regulatory responsibilities any more but only business operations.

the country. Through the licensing system, the MPT was able to influence China's telecommunication services as well as the product manufacturing in a big way. There were 26 products under the control of licences such as telephones, facsimile machines, CODECs, PABXs, terminals, etc. Without licences, none of these products could be used in the public network, and hence there would not be any market for them. The MPT's monopolistic position was also manifested by the restrictions on the service provision of the dedicated networks to their own respective systems only. For example, the network of Ministry of Railway could only provide telecommunication services within the railway system nation-wide.

The efficiency of the telecommunication service provision in China, according to the World Bank (1996), was among the lowest in the world and the service quality was lower than the average international standard. Users of telecommunication services had suffered high prices and low quality for a long time (Tan, 1994). The MPT's monopoly had attracted enormous criticism from the public.

The MPT's monopoly had set high entry barriers to any potential competitors for the provision of telecommunication services. Those barriers included established customers, huge initial investment, technology competence, skilful workers and a long learning period. Potential competitors had to overcome those barriers to compete with MPT (Tan, 1994).

The monopoly of MPT not only constrained competition in the area of telecommunication services, but also affected the development of telecommunication equipment manufacturing. The feedback of telecom service from users was absolutely essential for the equipment manufacturers, but at the time the telecommunications market was blocked by the MPT to other equipment manufacturers outside MPT. Thus it was hard for non-MPT manufacturers to gain access to the market information as well as to provide the market with quality products. So there was little chance for other manufacturers to compete with MPT companies on an equal footing.

The factors that constrained the competition in this sector and had affected the expansion of domestic equipment production are outlined as follows:

- Local protectionism: some local governments set regulations to protect local manufacturers by demanding the local users to buy locally made equipment only. The products made in other cities or provinces could hardly find their market there (IDIL, 1993c). Only foreign equipment suppliers were accepted. In fact, some local governments were more in favour of foreign equipment suppliers whom would normally come with foreign government low interest bearing loans (discussed in Chapter 6).

- Departmental isolation: the MPT equipment users would normally acquire equipment from MPT manufacturers, but the MEI manufacturers found very difficult to sell their products to the end users of the MPT.

- The domestic communication industry and its products were difficult to enter into main lines of the telecommunication network in an unequal market environment monopolised by MPT. They had to look for areas where the communication services were not covered by the main network of MPT.

In many cases the MPT companies could not promptly respond to the demand from telecommunication services users. The MPT monopoly gave no chance for competition and consumers suffered from this inefficient and expensive system. Proved by other countries' experiences, a certain level of competition from dedicated networks would provide a valuable supplement to the development of the telecommunication industry and economic growth (Chang, 1994).

7.3.2 Promotion of Competition

The competition in relation to the telecommunication equipment manufacturing industry and the public network services was a central point of arguments in terms of telecommunication policy making. In the equipment manufacturing industry, there was a strong view on urging the government to push the MPT to grant licences to MEI's companies for the production of certain telecom products, and provide a fair entry opportunity for these companies to share the domestic network service market. The MEI was a strong force behind the argument to push for competition.

MEI competed with MPT both in developing and importing technology to produce digital switching and PBX equipment, optical fibre and transmission systems, and a broad range of telecom equipment and components. The centre point of the argument from the MEI's companies was that the MPT companies should not be superior to other companies in market competition. However, this idea met with strong opposition from the MPT (He, 1994).

Answering the call for market competition, one significant policy change in China's telecommunication area was made to allow a few companies to jointly competing with the MPT, and investors to participate in limited areas of value-added telecommunication operations (Zhao and Liu, 1994). Two telecommunication companies, China Unicom and Jitong, were established to serve this purpose (related issues will be discussed more in details in the next section). Unicom was allowed to expand the dedicated networks of some ministries, such as the Ministry of Railways (MR) and the former Ministry of Electric Power (MEP). It became the second nationwide basic and value added service operator in the local and long distance markets. Jitong was formed to provide domestic information services, and services for research institutes. There were about 30 state-owned enterprises involved in Jitong, and they were closely related to the MEI.

The competition weakened the monopolistic position of MPT. The fruits of competition were not only the emergence of Unicom and Jitong, but also the involvement of many other companies. By the end of 1997, over 2,900 companies throughout the country had been authorised to operate value-added services and 90% of them were operating paging services (MII, 1998).

7.4 Strategic Innovation (2): Introduction of a Second Player

7.4.1 The Role of Dedicated Networks in China

Starting from 1976, the Ministries of Aerospace, Transport (roads, rivers, canals), Energy Resources (oil fields, mines, electricity grid), Railways and the PLA, etc. were authorised to develop their internal networks to meet the requirements of international communication service. Those networks were generally called dedicated networks. China's dedicated networks consist of both fixed-wire and radio-based facilities. Each dedicated network was generally a complete communications network within the ministry. These networks had played a very important role in the efficient and safe operation between ministry departments located in many different areas of the country. Each dedicated network had its long-distance trunk network and many LANs. Most of these networks were complete systems, with their own transmission, switching and terminal equipment. They covered the regions normally not covered by the public network. A typical example was the railway network. Its coverage was a complement to the MPT's public network, since it went as far as the railway reached and thus many remote border and rural areas were covered by the system.

By the early 1990s, China's total network capacity was 32 million lines, of which 19.26 million were for public use and 12.74 million for private or specialised use (China Business Weekly, 1993).

It was very unfortunate that the interaction between the dedicated networks and the MPT public network was not well coordinated. Because the dedicated networks were not fully interconnected with the MPT public network, communications between users of dedicated network and the public network were very difficult.

Dedicated networks had imported up-to-date equipment and technologies, including digitized circuits, digital switching systems and optical-fibre or satellite transmission systems. The MEI's involvement would strengthen both the competitors' technical capacity because of MEI's position in equipment production and supply. This made dedicated networks more competitive in the telecommunication service competition.

Dedicated network spending had helped to decentralise much of the transmission equipment procurement, but the localisation of telecom equipment production remained a lower priority for all but a handful of ministries. The import-substitution goals of MPT and MEI, have forced China's other influential government ministries (such as the MOR and the Ministry of Aerospace Industries (MAI)) to purchase telecommunications equipment manufactured in China.

The MOR, MAI, and the military, on the other hand, maintained their own manufacturing and R&D facilities and continued to produce a variety of products for their own use and for the other dedicated networks. Although production of earlier locally designed crossbar switching and analog transmission equipment was on the downswing, the MOR and MAI had been trying to remain active suppliers of digital equipment in China's dedicated network market. The MAI had licensed production of Siemens HICOM PBX in its plants in Shanghai and Beijing. The MOR was said to be exploring foreign collaboration in digital switching and transmission equipment production (IDIL, 1993c).

However, both the MOR and MAI production capabilities were dwarfed by the MEI, China's largest domestic dedicated network supplier and non-MPT telecom

equipment manufacturers. Like the MPT, the MEI had a vast pool of affiliated plants, R&D centres, and marketing channels. In addition, MEI affiliated plants had built up production lines for a plethora of export-oriented consumer electronic products and domestically-oriented components, which provided MEI with sufficient foreign currency, the technology and experience to manage the large scale production, that is a challenge to MPT's telecom equipment manufacturers.

Non-MPT paging services and non-MPT cellular services offered as private services by other ministries and private companies have been in operation in a few areas of China for over five years. Although MPT prohibited the sale of private paging services to subscribers which were not affiliated with the provider or associated with the interconnection of private cellular services and public telephone services, the structure and the culture of Chinese state enterprises and the Chinese government would often blur the lines between 'public' and dedicated private services.

As other ministries in the Chinese government increasingly became involved in the production of telecom equipment and in the operation of telecom services, MPT's control of telecom services undoubtedly was weakened. This pressure from outside, coupled with pressure from the PTAs and PTBs, would help to further reduce the monopolistic power that MPT enjoyed. With the weakening of the central control of MPT, local competition in pay telephone services and foreign involvement were not far off on the horizon.

There was a severe imbalance between the utilisation of dedicated networks and the public network. Some dedicated networks had plenty of unused capacity, whereas the public network was often overloaded (Lu, 1994). To solve this problem, the State Council issued Directive No 54 in 1990 to enforce coordination between the public and dedicated networks (MPT, 1993). Since then some dedicated networks had been successfully connected to the public network.

7.4.2 China Unicom

In 1992, the MEI, the Ministry of Energy and the Ministry of Railways jointly submitted a proposal to the State Council suggesting the establishment China United Communications Corporation (Unicom). The proposed Unicom would combine MEI's manufacturing and technology expertise with the well-established nationwide dedicated networks of the Ministries of Railways and Energy. For the purpose of promoting the reform of communications management and effective resource distribution according to the principles of a socialist market economy, it was very important to fully develop the potential of China's dedicated networks and the production capabilities of China's communications equipment manufacturing industry (Ure, 1994; He, 1994). For that, it was proposed that a proper competition system should be introduced to strengthen and enlarge communications development in China, and at least two national companies, Unicom and Jitong, should be allowed to operate.

After receiving the proposal, the State Council took immediate action by delegating the State Economic and Trade Commission in consultation with the SPC to conduct an inquiry. After a process of exchange of opinions among the relevant ministries, the State Council turned down the proposal. Not only because of fierce opposition from the MPT, but more importantly because the State Council considered it was not the right time to accept the proposal under the existing economic and political conditions (Ure, 1994; He 1994).

During the inquiry, the MPT defended its monopolistic position by addressing the following points:

- Since 1980, the public network had been greatly improved so that it was able to provide telecommunication services for most of the large users. Based on this, any new dedicated networks would be approved only if the MPT was convinced that the public networks could not able to meet the requirements of the users.

Private users needed to approach the public network first instead of constructing their own dedicated networks (MPT, 1993; Lu, 1994).

- The MPT believed only a unified planning and construction of the public network could make full use of the national resources and avoid unnecessary duplication of facilities. The MPT argued that competition would sacrifice the national interests. With only 1-2% telephone penetration rate and poor long-distance facilities, China should concentrate its limited technical capability and capital resources on the improvement of general basic services. Allowing dedicated network operators to enter the market freely would only lead to competition in the most profitable areas or routes and in some value-added services, and that would not be helpful to national capacity building (MPT, 1993).

- Effective telecommunications required an integrated local and long-distance network with unified technologies and service standards. Communication was a basic social service. The MPT had the obligation to provide services to the whole nation. Communication is a country's nervous system and thus has implications for national sovereignty and security. Unified planning and management of the basic network would be extremely beneficial and promote rapid growth during the early development stages of telecommunication sector in China.

- The national communication sovereignty was to prevent the betrayal of national secrets and to ensure the control of China's communication markets under its domestic carriers.

So that, instead of approving the proposal, a compromise emerged to balance the interests of different ministries: (1) more opportunities should be given to existing private communication networks to participate in telecommunications markets; (2) it was necessary to set up a united, comprehensive and technologically advanced

national communications network to increase the integrated communications capability in China; and (3) the two principles should be followed with the introduction of competition, namely to seek an appropriate way to bring new players into the telecommunications sector but have the leading role of the MPT maintained. That was to say the MPT still functions as network administrator and market regulator (Ure, 1994; He, 1994; Li, 1998).

Nevertheless, the continuous pressure of launching the China Unicom came from at least two sources: (1) the MEI and other ministries with spare network capacities; and (2) the large users such as the Bank of China, the China International Travel Services, the airlines, print media and others, who were not satisfied with the poor services provided by the MPT (Ure, 1994, He; 1994. Li, 1998).

The MEI had persistently raised the issue of making dedicated networks as competitors for public long-distance or international services for other commercial users and/or individuals. They claimed that the Unicom would significantly speed up the development of the sector, as well as improve the quality of the communication services and efficiency of the utilisation of the available resources, and that they could meet the requirements of large users and private individuals. As one of the greatest challenges China faced was to adapt into the new globalise economy, by introducing competition, China would be able to enhance its competitive ability, customers would obtain better services, and foreign investment would increase. Thus, competition was necessary to promote China's telecom development. Backed by large users of telecommunication services, the MEI finally succeeded in establishing the Unicom.

In December 1993, the State Council (1993) Document No 178 approved to the establishment of the China Unicom. In July 1994 it started operation with the intention of offering long-distance data communications to compete with the MPT. There were two companies that formed Unicom, China Lianhe Communication

Corporation and Jitong Communication Corporation (Jitong), that were both backed by the MEI and the China International Trust and Investment Corp. (CITIC). The birth of the Unicom marked the beginning of competition in telecommunication services and in equipment manufacturing. Unicom was to provide domestic long distance services in competition with the MPT and to be managed by the MEI for most parts of its services.

Jitong Communication Corp. was formally established in April 1993. Jitong was previously under the umbrella of the MEI, whose capacity in telecommunications equipment manufacturing was already competitive with the companies under the MPT. At that time, the Vice-premier Zhu Rongji was responsible for economic reforms. He noticed that in the process of economic transition, accompanying the high economic growth were also relatively high inflation, a deficit in the trade balance, unofficial credit creations, and an increase of speculations and corruption. It was quite obvious that any realistic attempts to monitor and manage the national economy would require a much greater flow of information from different parts of the country to the central government.

The idea of having a specialised information system was therefore very attractive to the central government, and that was exactly what the MEI and Jitong had proposed to the State Council. In March 1993, the Vice-Minister of the MEI, Mr. Hu Qili and the Vice-Chairman of the SPC, Mr. Zheng Peiyan submitted a proposal of the 'Golden Bridge' project to the then Vice Premier Zhu Rongji. Jitong was selected to manage the development of the Golden Bridge project. In coordination with the State Information Centre, Jitong had signed agreements with twenty-four provinces across the country to build Golden Bridge Network information centres and other facilities in the major provincial cities. Licensed in 1994, Jitong was seen as the 'builder' or integrator of the new network.

By the end of 1994, Jitong had 25 shareholders, including the city governments of Beijing, Tianjun, and Shanghai, and the provincial governments of Jiangsu and Guangdong. Jitong was to build at least three of the 'Golden Projects'.

Unicom had 13 shareholders including the Ministry of Railways and the Ministry of Electric Power. The company's targets were to increase by 1% of the national penetration rate by the year 2000, and to share 10% of the country's national long-distance calls and 30% of the cellular mobile phone market. Unicom started operations of its GSM network initially in Beijing, Shanghai, Tianjun, and Guangzhou in the first half of 1995. Many companies had signed agreements for the installation of telecommunications equipment with Unicom.

Apart from launching the Unicom, another result from the pressure of the MEI, other dedicated network operators and large users were to end the situation of the MPT being both regulator and network operator. Two important decisions were made by the State Council. The first decision was to set up a 'Unified Roundtable Conference for National Informatisation' to coordinate the interests among different ministries and users. In December 1993, the State Council appointed Vice-Premier Zou Jiahua as the Chairman of the Roundtable, Mr. Hu Qili as the Deputy Chairman, and Mr. Wang Chunzheng (the Vice-Chairman of the SPC) as the Vice-Chairman. The second decision was to restructure the MPT in 1994. This was to re-position the MPT in relation to its role in the industry so as to ensure a fair competition environment for every player in the market. The significant result of this was that the national network operators, the DGP, was detached from the MPT and became a financially independent state-owned enterprise. From then on, the MPT was no longer a telecommunication network operator.

The launch of Unicom brought a little change to the decision-making system of telecommunication policy. That was whenever MPT's policies were thought to be seriously affecting the Unicom's business or creating unfair competition, members of

Unicom would raise their concerns with higher levels of government authority to seek support and they often could succeed.

However, this change would not guarantee a fair competition. Unicom was still disadvantaged in competition and negotiation. MPT could still make policy largely according to their discretion. To the members of the Unicom, to push the issue to a higher level of authority would cost their political resources, although such resources enabled them to survive.

Faced by China Unicom's participation, the DGP had rapidly upgraded its services. In October 1994, it launched a high-quality, dedicated-line communications service, ChinaDDN, for transmitting digital data at high speed. It also upgraded its existing packet-switched data network, Chinapac. Thus, by 1995, with Jitong and Unicom together committed to build the 'Golden Bridge' project, China was in fact constructing three national information backbones at the same time. The presence of the second operator had such a big impact on the tariffs and services, that mobile phone prices (both handsets and connections) went down by up to 50 percent when Unicom's GSM networks were finally up and running in 1995. Almost overnight, the waiting period for the connections to the basic fixed-line network dropped from up to two years to less than 30 days (Liu, 1998).

As more and more competitors plugged in, it was necessary to shape the function and restructure the administration in responding to the changing environment. The creation of a new ministry to manage a more competitive market environment was on the agenda of the central government. Early in 1998, the National People's Congress approved a radical change to the structure of the central government led by the newly elected Premier Zhu Rongji. As part of Premier Zhu's strategy, the total number of ministries was to be reduced from 41 to 29. One of these changes was the creation of the Ministry of Information Industries, which emerged by linking together the MPT, MEI and parts of the Ministry of Radio, Film and Television, China

Aerospace Industry Corporation and China Aviation Industry Corporation. The MII became the only ministry in charge of telecommunications, multimedia, broadcasting, satellites, and Internet.

The primary purpose for creating the MII was to increase the efficiency of the government agencies through assigning the responsibilities for information related matters to a single ministry and to provide a nurturing environment for the information industry. This way, one agency, not several, would be better positioned to deal with any particular issues. The MII's role was to formulate policies for the development of software, information and broadcasting industries.

On April 8, the MII took over the responsibilities of two agents: the former 'State Council Informatisation Leading Group Office', which had served as an interagency coordinating group, and the 'Radio Regulatory Commission' which had been responsible for radio frequency allocations.

Although the MII was formed based on the MPT, its creation would bring about a significant change to China's telecom regulatory environment, as many companies associated with the former-ministries that made up MII were becoming independent entities. Officials in the Unicom believed that the new administration structure would create a fairer regulatory environment (Li, 1998).

In the past, China Telecom had benefited from preferential policies, subsidies and tax concessions. Its remarkable growth in capacity, revenues and profits of telecommunication services tended to be challenged under the more competitive condition created by Unicom and the independent regulator. China Unicom in the past had purchased most of its equipment from foreign companies, while China Telecom purchased equipment from state-owned manufacturing operations associated with MPT. Now both MPT and MEI had come together under the MII,

there would be pressure on China Unicom to purchase equipment from domestic companies. This would give more surviving space to domestic manufacturers.

Conclusion

This chapter started from a review of the institutional framework of China's telecommunication industry, the core of the strategic choice at this stage was promoting competition by introducing a second player and shaping the regulatory structure. Promoting competition was critical to improve the quality of services of the industry.

From the discussion of this chapter, one can find that in the telecommunication industry, the decision making process was overflowed with balance of power and interests between different ministries, and most of the policies were outcomes of the bargaining and balancing between different ministries which was very costly.

The experience of promoting competition in the industry revealed that a sound institutional framework was urgently needed. A single regulator and administrator structure could be beneficial to the industry. The institutional change manifested by the formation of the MII has given enormous space to policy makers to construct innovative policies without organisational barriers, and provided competitors with a relative fair environment under the same organisational structure.

8. Conclusion

8.1 Innovation, Institutions and Plan to Market Transition

The more theoretical chapters of this thesis, Chapters One and Chapter Two, have provided an overview of some current literature on innovation, institutions, learning and economic growth, and on the debate about abrupt and evolutionary approaches to economic transition.

The conceptual framework of this thesis is based on recent work on the theory of growth, which identifies innovation as an endogenous factor in economic growth. It recognises that innovation and technological change are the central drivers of economic growth (Abramovitz and David, 1996; Carter, 1996; Freeman and Soete, 1997). However, the mechanisms by which innovation is transformed into growth have not been substantially discussed in that literature, especially for the case of transitional economies. The discussions of North (1990 and 1996) and Barbier and Homer-Dixon (1996) have shed some light on the general direction for such studies, which is to look at the institutional frameworks of different economies. For institutions, institutional changes and the organisations that are associated with them form the superstructure under which different countries perform differently even if their initial state of development is the same.

Summing up the discussions of the initial chapters of this thesis, there are a few important points that need our special attention and they are stressed in the following sections.

8.1.1 Economic Transition – A Strategic Innovation

Economic transition itself is a strategic innovation, which consists of a series of innovations in policy making and institutional frameworks.

In the discussion of innovation and economic growth, we know that although innovation and technology are essential for economic growth, the institutions and organisations of the national innovation system provide the networks for innovation and technological change to be effectively delivered to the economy. Although many innovations are small and incremental, there are times when strategic innovations are required. Strategic innovation undertaken by the government happens when critical economic, social and political issues are to be solved in innovative ways, which would fundamentally change the course of action of governments or the institutions of society in more than an incremental way. In the process of creating new institutional structures or interactions, and of forming the new forms of behaviour required by economic transition, organisational restructuring and policy innovations are of particular importance. Economic transition is a typical case of such a strategic innovation, or of a series of strategic innovations.

As the economic transition from a centrally planned system to a market oriented system demands a profound institutional change (Walder, 1996), change in the incentive structure built into the old system is unavoidable. Economic transition leads to a change from a highly centralised social and economic system to a system where the market can play a significant role in economic development. This requires the economic administrative agencies and policy makers to seek innovative policies and new ideas or ways of doing things that strongly depart from convention, and to develop new forms of behaviour and interaction between all actors.

In a centrally planned system, the function of government and government agencies is to draw up detailed economic plans for resource allocation, based on the assumption that national resources are best distributed through finely tuned plans to achieve their most effective use. The institutional environment under such a system is highly geared to drawing up and fulfilling these plans in a very detailed way, which leads to a rigid economic operating system with low efficiency and waste of resources. The transformation of the economic growth model from plan to market involves looking for ways in which such system of constraint can be broken up. Therefore, a series of radical changes with regard to government functions, the economic management system, incentive mechanisms, and ultimately a switch of the institutional framework, is crucial.

A market oriented economic system requires that: (1) the government lets go of direct control of resources and seeks to achieve resource allocation through market forces; (2) the management role that the government plays is highly concentrated on providing a favourable economic environment for firms instead of direct involvement in detailed firm or project management; (3) the economic incentive system would greatly encourage productive activities instead of unproductive activities like rent seeking, pursuit of political status, and so on; and (4) a totally new institutional framework is created, which would foster sustained economic growth. The magnitude of the changes involved in moving away from a central planning system indicates that economic transition itself is a significant strategic innovation. Policy innovations and institutional and organisational restructuring are the two most important ways to undertake this transformation in the institutional framework to ensure the success of economic transition.

The efficiency of the strategic innovation depends on the structure, operating systems and human resources of an innovative government

The success of economic transition depends very much on how innovative and effective a government is in addressing various issues arising from the transition process. Many factors play significant roles in this regard. One is the role of powerful individuals, which influence the direction and speed of the transition. The generation of increasing knowledge and skills within the society, and their effective application to the economic system, is also crucial. This process in turn requires effective interconnection between many groups of people, both within organisations and across organisations, and, more generally, human resources are fundamental in transforming the stock of knowledge into sound policy and industrial development. Thus a central determinant of the efficiency of the transition process will be the quality of the structures, operating systems, human resources and learning processes of the government driving the transition process.

8.1.2 Institutional Change is Critical for Economic Transition

Institutions play a central role in the achievement of economic growth

In recent neoclassical theory, innovation is taken as an endogenous factor that is one of the determinants of economic growth. There are basically two strands of view on the

contribution of innovation to economic growth. One is focused on the outcome of capital formation and technological and organisational progress, including progress made possible by the enlargement of scale (Abramovitz and David, 1996; Carter, 1996). The other one emphasises the process of transformation in the use of a country's resources, principally in the size, intensity of use, and training of its labour force and its occupational and industrial structure. Freeman and Soete (1997) addressed the critical role of innovation in terms of sustaining or accelerating the rate of economic growth in their own and other countries, and in changing the direction of economic advance, or the concentration of resources on the improvement of the environment.

The endogenous growth models, however, focus on the basic determinants of growth, but have neglected the background and the mechanisms through which the basic elements operate and in which growth takes place. North (1996) addressed the ways in which institutions, institutional change and organisational change affect economic growth through innovation. North stressed that it has to be the incentive structure embedded in the institutional and organisational structure of economies that is a key to unravelling the puzzle of uneven growth among countries. Therefore, (1) the institutional and organisational structure that determines incentives is the primary source of economic growth; (2) it is necessary to create impersonal political structures and economic markets for sustained economic growth; and (3) the belief systems of societies, and the way they evolve, are the underlying determinants of institutions and their evolution.

Although various strands of recent work on growth are not able to provide a consistent explanation of the different rates of growth characterising given economies in different circumstances, it is widely held that institutions have a fundamental impact on economic outcomes and on the long-term performance of economies. Institutional and policy failures have prevented poor countries from generating or using new technological ideas to reap greater economic opportunities (Barbier 1996; Barbier and Homer-Dixon, 1996). Thus, institutions are important in that they influence economic efficiency and provide the foundation for the achievement of growth through innovation.

For the poor economic performance of the Third World countries, North (1990) pointed out that the institutional constraints define a set of political and economic activities that do not encourage productive activities. These countries have now begun to appreciate that the underlying institutional framework is a source of their current poor performance. They are attempting to grapple with ways to restructure the institutional framework to create incentives that in turn will direct organisations along productivity-increasing paths. Some governments have chosen to change organisational actors and institutional rules to develop the ability of the public sector to pursue innovation policy. Such creation or redesign of organisations and institutions is likely to prove to be a more important policy instrument than subsidies and other financial instruments.

Institutional changes call for a continuous interaction between institutions and organisations

According to North (1990), the simplest way to describe the relationship between institutions and organisations is as the rules of the game and the players in the game respectively. 'Organisations and their entrepreneurs engage in purposive activity and in that role are the agents of, and shape the direction of, institutional change' (North, 1990, p110). Competition forces organisations continually to invest in new skills and knowledge to survive. The kind of skills and knowledge individuals and their organisations acquire will shape evolving perceptions about opportunities and hence choices that will incrementally alter institutions. The institutional rules that influence interaction among firms and between firms and other organisations in the field of learning and innovation are particularly important. 'The specific institutional constraints dictate the margins at which organisations operate and hence make intelligible the interplay between the rules of the game and the behaviour of the actors. If organisations devote their efforts to unproductive activity, the institutional constraints have provided the incentive structure for such activity' (North, 1990, p.110). Therefore, as the economic situation changes and firms and other organisations interact with each other in an unproductive way, a change of institutions is necessary.

Organisational change and the evolution and design of new institutions have been very important in the development strategies of the successful Asian economies as well as in the ongoing transformation of Eastern Europe (Edquist, 1999).

The transition process is path dependent

As the process of plan to market transition has been interpreted as a process of strategic innovation in the institutional and organisational structures of a society, given the nature of institutions and organisations in both the public and private sectors this process is likely to be highly path dependent. This means that the future outcome is heavily influenced by past realities. A process is path dependent when its evolution over time is inherently influenced by past events, in that it cannot shake off the effects of those past events. The economies of scope, complementarities and network externalities implicit in an institutional matrix generate such feedback mechanisms, and make institutional change overwhelmingly incremental and path dependent. Because economic transition is a process of strategic innovation in the institutional and organisational structures of a society, extensive learning by all actors in the economy is involved during the whole process. Therefore, we view the plan to market transition as a highly path dependent process.

8.1.3 Evolutionary Approaches and Government Learning

Institutional change in an evolutionary economic transition process is an unavoidably long process which requires government learning to take place

In general, transitional economies lack the basic market-supporting institutions and human capital to operate a market system, and these usually take many years to develop. Therefore, it is important to avoid an institutional vacuum in such a long process of change. Existing institutions should be dismantled only after new ones are in place, or new institutions should be allowed to emerge from the old ones. Considerable growth is possible with sensible but imperfect institutions, mainly because some transitional institutions can be more effective than inadequately developed best-practice institutions for a period of time (Qian, 2000). 'Recent experience of deregulation, privatization and deficit reduction in the main market economies confirms that institutional change requires a lengthy reform process involving the passage of time as well as extensive interaction among governments, enterprises and citizens'(Rawski, 1996, p.198).

In this thesis, the gradualism in Chinese reform is interpreted as providing the basis for modes of learning behaviour among economic agents that are necessary for successful transition in the economy.

The planning system reform in China is an example of an evolutionary process. It has taken a long period to shift the central government's role from direct intervention in detailed economic activities to the current state, which substantially involves indirect management through a set of macroeconomic levers and other policy instruments. The intention of China's transition initiated in 1978 was to achieve the country's modernisation goals and to allow China to become an active participant in the international economic arena. Accordingly, as the major body in China's economic management system, the State Planning Commission has changed its role to perform indirect supervision of national economic activities.

In an approach to transition based on strategic innovation and institutional change, the role of learning (especially government learning), and it's inevitably protracted and path dependent nature, suggests that

- an evolutionary approach to transition can facilitate substantial learning exercises, which are necessary to generate positive results without disturbing the whole society in a dramatic way; and

- the most important learner is the government, for what the government learns would be incorporated in the new policy initiatives and therefore affect the direction of economic movement.

The fact that China has diverged so sharply from other transitional economies both in the transition model and in economic performance gives us reason to investigate the existence of a positive relationship between evolutionary transition and development success, mediated in part by learning processes.

The learning process is a dynamic movement

Government learning is inevitably a highly complex, networked or systemic activity, and therefore it is an iterative process, involving trial and error, feedback and revision. The efficiency of government learning depends on rich information sources and on

sound cooperation in a whole series of complex iterative relationships, both within and external to the organisations involved.

As an iterative process, both actual practice and the review of experience are significant features of learning. It is necessary to compare policy mechanisms, strategies and outcomes as well as the plurality of government policies and development models available to the decision maker, drawing on their own experience and on international experience. The learning processes can be extremely varied and complex, depending on the problems faced by particular industries, the growth of the external market, the state of competition and the ability of the economy to assimilate new technologies and institutions. Learning processes in decision making can influence the efficiency of the allocation of resources, help determine appropriate government policies and identify the capabilities of local firms in the industry development process. Therefore, the effectiveness of government learning is particularly important in (a) making sound decisions on development strategies and related policies, and hence (b) avoiding expensive costs resulting from poor decision making. Through learning, government policy effectiveness and its capabilities for ensuring effective and sustained structural adjustment will be improved.

The source from which government learned

Government learning generally comes from two sources, namely other countries' experience and the experience within the country in question. The unique historical circumstances and the distinctive economic, social and political characteristics of each country make it hard for a government to borrow the policies and technological and institutional innovations successfully implemented in another country. However, there is at least a possibility that an understanding of other country's experiences will foster a readiness in leaders in developing countries to rethink past policies and previously held strategic positions. The factors that should be considered while locating learning sources include the similarity of a country's social system, its level of economic development, and the nature of the relevant institutions and organisations. The most important thing is that the organisation or country should have some similar characteristics with the learner.

Another important feature of government learning is that governments learn from their own experiences and that they can modify their present actions based on their interpretation of how previous actions have succeeded or failed in the past. Even so, many of the fundamental elements of such learning remain conceptually unclear and the entire phenomenon of experience-induced policy change remains difficult to operate. However, an acquaintance with the experience of strategic innovation itself can help governments to think afresh about complex problems to which solutions may lie well beyond current traditions of policy making.

Key elements to sound government learning

Some of the key elements in government learning are likely to include:

- Organisational and institutional structure: Creating a sound organisation structure which enables them to adapt intelligently to changes in their operating environment is very important in the learning society. The efficiency of government learning depends critically on the structure of the economy's institutional framework, because the institutional structures affect the operations and strategies of organisations.

- Culture: The dominant culture of a country defines behaviour, bounds individuals and defines values (Hampden-Turner, 1990). If a country's culture values activities that are critically important to innovation, like openness or risk-taking, innovators will feel supported and encouraged in their innovative activities.

- Sound communication: The success of government learning depends on the establishment of sound internal and external communications, effective linkages with external sources of information and sound methods of deriving ideas from external sources. Learning requires all departments to be involved from the earliest stages.

In addition, flexibility, adaptation and innovation are coming to be seen as critical ingredients in the success of government learning. They are all captured in the notion of learning (Mathews, 1996; Storper, 1996). Thus, learning and knowledge application at

the various levels of government level have come to be seen as central activities of successful economics, particular economies in transition.

The hypothesis: An evolutionary transition process, facilitating learning, has been central to China's success since 1979

In summary, plan to market transition is a process of strategic innovation, and its success largely depends on an effective institutional framework. In the process of establishing an effective institutional framework for an economy where market forces prevail, government learning in handling issues arising from the transition takes place. It is an iterative process and an evolutionary transition model allows such a process to happen and to generate positive results. It is fair to say that learning happens in both abrupt and evolutionary cases of plan to market transition. In the abrupt case, however, learning as a process must be limited, since the government is required to respond to economic issues quickly and also has to target all the problems at the same time. With an evolutionary approach, learning processes can take place over time. Because the transition is handled in such a way that the feedback gained from small steps of reform through pilot projects is processed and policies are modified and generalised, the transition can be a lot smoother and a stable social norm can be achieved. Learning by doing, especially by the government in its role of driving strategic innovation and institutional change, may have been central to China's achievements in the process of plan to market transition since 1979.

Therefore, the hypothesis of this thesis is that the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning, both government learning and learning by other participants in the economy, in terms of innovation and institutional change.

This hypothesis has broader implications for the debate between abrupt and evolutionary models of transition. For if learning in terms of innovation and institutional change, both by governments and by other participants, is essential to an effective transition process, and if this is inevitability an extended, path dependent process involving trial and error and learning by doing, then there may be strong reasons for supporting the evolutionary approach. If learning is central, and if learning takes time, then an evolutionary process has much to recommend it.

8.2 Strategic Innovation, Learning and Development – The Experience of China's Information Industry

The more empirical chapters (Chapters 4-7), together with the background chapter (Chapter 3), have presented a study of the evolution of industrial development in China's information industry under a complicated economic planning framework. This complicated framework, administered by the SPC, itself has been subjected to huge functional change in the process of economic transition. Particular attention has been given to the significant role that strategic innovation and government learning has played in the development of China's information industry as the economic reforms took place. Two main themes can be found from the discussions. Firstly, government learning has been a major feature of the process of institutional restructuring during economic reforms and, secondly, government learning has led to strategic change through innovative policy formation.

8.2.1 The Construction of a Market Orientated Institutional Framework

The heart of the economic transition in China is to transform the previously centrally controlled economic management system to a system where private ownership of the means of production prevails for the most part. The essential economic objectives of the transition process are to raise economic efficiency and to promote growth. Thus a favourable institutional environment is required.

Government has learned that without a proper institutional framework, economic performance could not be substantially improved

Bureaucratic rigidity, inefficiency and irrationality were seen as the main barriers to Chinese economic development under the central planning system. However, the initial reform approaches employed by the Chinese government showed no indication that the government realised the need to change the rules of the game fundamentally, for it merely sought ways to solve whatever problems occurred at the time. Since the whole incentive system under central planning had not been encouraging rational resource allocation and economic behaviour, these initial solutions to the problems

could not be sustained and were soon suppressed by the unchanged system. Such problems were reflected in the earlier stages of electronics industry reforms. The government then realised that without a proper institutional framework, economic performance could not be substantially improved. To facilitate the change of the rules, shaping player's behaviour became crucial and this required, among other things, organisational restructuring of government agencies.

As presented in Chapter Four, the electronics industry was under the control of the military system when reform started. As the government cut its defence budget, the survival of the military firms in the electronics industry became an urgent issue. Therefore, to put these firms under the civilian production system and to get them to produce consumer goods seemed the only choice to address the issue. The first round experiment of organisational restructuring started when the Ministry of Electronic Industry took over the administration rights of electronic industry from the military system. The purpose of the restructuring was to manage the relationship between the ministries and their subordinated companies so as to provide an organisational shelter for the companies to operate more efficiently. It was not intended to eradicate institutional obstacles, but to reduce the cost and distortion generated from the military cuts to a tolerable level. The re-orientation of military to civilian production released the constraints on the military orientated companies, and created opportunities for them to perform better, which indeed lifted the vitality of the whole industry. The range of observable positive outcomes coming from the change expanded rapidly - not only did an increased production of civilian products result from these favourable policy initiatives, but there was also impressive growth in output of consumer electronic goods and reasonable export performance. Gradually, the experimental success of this organisational arrangement led to new institutional changes, and much later the Ministry of Information Industries was launched and became the single regulator of this industry (Chapter 7).

However, what precise role government should play and how it should play it was not clearly identified. Through the process of MEI being switched from under the military system administration to the State Council in the initial stage of reform to the launch of MII in the last round of government restructuring in 1998, a wide range of restructuring activity showed that the government experienced extreme difficulty in

shaping its agencies' behaviour and in clarifying its proper functions as economic transition proceeded. The changes that combined the Ministry of Machinery Industry and the Ministry of Electronic Industry to the Ministry of Machinery and Electronic Industry, and later relaunched a new MEI, were an indication of the confusion. The resulting costs were high, not only in terms of the resulting low government efficiency, but also in terms of the restructuring cost itself and the costs to the industry. Far from assisting efficiency and industry productivity, the frequent and short term restructuring processes put the companies that these agencies supervised in very difficult situations. They had to spend time and effort to coordinate with the new supervisors, and this was costly and time consuming. Inadequate governance structures could not respond to the challenges of improving government efficiency and promoting industry development, through new organisational settings.

The various organisational changes represent a learning process that the Chinese government has gone through. Government gradually gained an understanding of the appropriate roles for government and of its functions in shaping economic and social development in a market system. The decentralisation of the administrative power of the former military companies from central to local authorities provided another important and much appreciated institutional change for these firms and motivated the companies to raise their productivity and competitiveness (Chapter 4).

Successful restructuring in the information industry has to be based on active learning

The evolutionary transition model has given Chinese government and firms the chance to experiment and to learn from their experiences. The practices mentioned above provided important lessons for Chinese policy makers. It became apparent to the government that developing a sustainable electronics industry required leading edge technology in areas where China could build competitive advantages. A series of innovative decisions were made, including: (1) choosing computer and telecom equipment manufacturing as the focal point to lift up the technological capacity of this industry in the eighth FYP; and (2) launching the 'Golden Projects' to develop China's information infrastructure. These decisions were based on the knowledge and understanding of the market gained through developing consumer electronic products (both through importing technology and promoting export) and on the skills learnt

through participating in international competition (both promoting consumer electronic product exports and exploring microelectronic technology imports). These experiences were interactive and pushed the industry towards building a more competitive capability.

Open competition requires that China learn to manage these problems from a global perspective. The evolutionary transition allowed learning to occur step by step. The telecommunication industry is another example. The Chinese government has played its part in upgrading the technological capacity of firms relevant to this industry, by creating intensive policy support in several stages. One example was capacity building in the microelectronics industry by the supportive policy instruments reviewed in Chapter 5, such as the Four Preferential Policies to support the development of the microelectronics industry. Another example was the commitment to, and the practice of, promoting the microelectronics industry reviewed in Chapter 6, such as pushing foreign switch supplier attaches offer of microelectronic technology to their China's switch market access memos. Consistent with these and other initiatives, government and industry have cooperated in building competitive capacity and in organising the industry with an appropriate incentive structure, and in enhancing learning performance.

There has been a gradual movement toward a more market-oriented, decentralised system and to increasing linkages to the global economy. This has shaped learning behaviour in government, both individually and organisationally. For example, China's industrial policy makers learnt from and applied some aspects of Japanese's experience. The Japanese priority setting strategy can be seen as reflected in China's preferential policies (eg, the four preferential policies for the electronics industry starting from 1987). Promoting electronic product exports is another example of policymaking undertaken on the basis of learning from East Asian neighbour countries. In addition, Korea's experience, such as intensive development of the microelectronic industry (Chapter 5), can also be seen to have left its trace in the strategy of developing China's microelectronic industry.

Through dynamic learning the Government came to several conclusions: (1) Technology is important to shape the future of the information industry, but fair

competition and a sound policy environment are often decisive considerations; (2) In recognising existing realities and committing to an ambitious program of technology acquisition, the electronic industry had taken an important step, but it was only a first step. Both the Chinese government and the companies still needed to learn how to acquire and adapt new technology more effectively, and this would doubtless require a great deal of trial and error; (3) The overall learning perspective needs to be targeted on social and economic performance, not only for government efficiency itself but also for facilitating industry learning, innovation and growth; (4) It was necessary to build firms and institutions for open market competition, and this imposed specific requirements in particular detailed industries.

Gradual institutional changes

The most crucial step in economic reform was the ending of the tight government control over the economy, and especially over industrial production and investment. Many of the Government's institutional and policy changes that marked the reform era can be seen as responses to this changing environment.

The first stage change was to shift the electronic industry orientation from military purposes to civilian purpose. This helped to build a foundation for the development of the civilian based electronics industry, and was the starting point for the transition from plan to market in this industry. The nature of the restructuring could be described perfectly by Deng Xiaoping's caption: 'Crossing the river by stepping from stone to stone'. This is to say that continuing changes had to take place in the process of achieving the final goal, but in an incremental way. Because what is ahead of us is not clear, especially at the early stages, we need to learn and to adjust. Such a process had both costs and benefits: it had given the industry both valuable lessons to learn as well as disturbed organisational arrangements and an unstable policy environment. Domestic institutional arrangements had to bend in the face of external pressures. The uncertain political and economic environment, the impetuous responses of the public and the changing pattern of economic growth all influenced the context of the institutional change and policy innovation in the transition process.

The second stage was mainly focused on technological choices (Chapter 5), including selecting the microelectronics industry as a driving force for technology development.

As strategic innovation in the development of the microelectronics industry had become a new focus, this also involved institutional changes, such as investment system reform and government restructuring, and innovative policies, such as specialised funds and technology import policy.

Investment system reform and government restructuring were two important institutional changes at this stage, which directly generated an effect on the development direction of, and funding sources for, China's microelectronic industry. The institutional change again created a requirement of ongoing government learning, which was embodied in policy making procedures and their implementation.

When competitive advantage was building up, a serious policy issue emerged. This was what the government could do to create an environment of fair competition to facilitate the healthy growth of the information industry. The strategic choices of the government started from two steps: breaking the monopoly of MPT and introducing a second player. Again, an institutional change was involved here, to create a regulator and to separate the regulator from the players (China Telecom was separated from the MPT as an independent regulator of telecommunication services - see chapter 7).

In this context, the organisational change of government agencies did not necessarily mean functional change, and it required a great deal of effort to identify the appropriate direction and principles for institutional changes. One lesson learnt from the experience of promoting the competition process was that a sound organisational framework was an urgent need, because most policies were the result of balancing the interests of different government agencies, which proved very costly. A sound organisational structure would give space to policy makers to exercise innovative policies without organisational barriers, and would support new institutional reforms.

8.2.2 Learning in Policy Development

The year 1978 was a starting point for the fundamental strategic innovations involved in plan to market transition in the People's Republic of China. The case of the electronics industry presented in this thesis has reflected such a process of innovation in policies as well as in institutions. Learning to meet new needs arising at the macro level of the economy by inventing new innovative policies was an objective of the

Chinese Government in accomplishing the economic transition. In the learning process, innovative policies have been invented, tested and where necessary changed.

The tentative nature of government policies

The Government's commitment to undertake economic transition sparked a series of policy innovations, aimed in part at relieving enterprises from unproductive and inefficient administrative systems. Because of the absence of clear goals initially, policy announcements from the central government remained tentative. In chapters 4-7, three themes underline the tentative and evolutionary nature of these policies. These relate to policies seeking to promote the conversion of companies from military to civilian purpose electronic goods production, policies to encourage technology adoption and policies to build competitive advantage.

(1) Policies seeking to promote the conversion from military to civilian purposes

The strategic choices made by policy makers vary over the period being studied. In the first stage, the key strategic policy choices are the two strategic innovations of the reorientation of the military electronics industry to civilian purposes and the choice of the consumer electronics industry as the focus (Chapter 4). The innovative policies of technology and promoting export were crucial to the success of the conversion. These two strategic innovations were vital in that they gave the industry ability to learn the basics of the operation of the market. They were also critical for the industry in terms of building competitive capacity and making the industry capable of surviving in a new competitive environment. The expansion of China's consumer electronic product industry in the early stage of the transition built a foundation for the electronic industry. It not only created a market for parts, components and microelectronic equipment, but various participants also experienced a learning process in terms of foreign technology, administration and skills of negotiation. China's electronic industry benefited greatly from the expansion and the difficulties of the consumer electronics industry.

The CTV case demonstrated that importing urgent needed technologies and transferring the technologies to domestic companies needed to be parallel operations. Although the road of promoting technology policy was challenging, this experience was valuable to further policy making. The process of promoting exports was also a

valuable exercise, contributing to measures to further the international competitiveness of the electronic industry that were undertaken later.

(2) Policies encouraging adoption of foreign technology

The development of the microelectronic industry is a case to demonstrate how China's electronics industry gained experience in terms of policy making, handling importing issues and the local application of imported foreign technologies.

China's microelectronic industry followed an extraordinary development path. Even though the cost was high, it was valuable to the industry itself and to other industries in China. A key lesson was that the development process of the microelectronics industry improved negotiation skills in terms of high technology trading, and gained bargaining power for China's computer and telecom industry in the international technological market. The higher the microelectronic technology China possessed, the higher the level of foreign technology China could bargain with and obtain from foreign companies. For example, if China had 0.8 micro CMOS chip production technology, it would be possible for China to import other equipment which involved a higher standard of ICs than China currently had (eg. 0.5 micro CMOS chips). Computer and telecommunication equipment acquisition was another typical case. In this sense, the development of the microelectronics industry facilitated the expansion of China's computer and telecom industries, as was shown in studying the practice of the telecom industry in Chapter 6.

(3) Policies to build competitive advantage

After ten years development and several strategic innovations, the electronics industry came to the stage where building competitive advantage was the key. Thus, the central strategic choice was about how to build the competitive advantage of the industry. As a result of a number of strategic decisions, institutional change in terms of science and technology reform was undertaken to facilitate the industry's innovative initiatives, and foreign investment policy was re-directed to favour industries identified by the government.

From preferential policy to fostering fair competition

As China continued to seek fundamental ways to improve its economic performance, a number of further innovative policies were implemented in the 1990s. Those policies involved a substantial change in terms of policy direction from focusing on preferential policies, by giving financial support and tax benefits to some particular products and industries, to fostering fair competition. The shift of the policy emphasis underlined the transition of the role and function of government. In the beginning of the transition, the policy focus involved product targeting, as detailed in the case of CTV in Chapter 4. Moving into the 7th Five Year Plan period, more and more attention was given to selecting suitable technologies and products for catch-up in important areas. The case of the microelectronic industry shows the characteristics of the catching-up in new technology areas in China's information industry. At these two stages, the policy orientation was shaped mostly by the requirement of transition, an internal need from China. It focused on building a national capacity for sound development. In the subsequent stages, detailed in the Chapters 6 and 7, the driving force of development came from both domestic industry and from international companies which had investment in China or had extensive business activities in China. In the third stage, a greatly increased number of foreign companies were involved. They not only brought in new technologies and skills to the industry, but also challenged the policy makers to set policies for domestic firms to meet international standard with regards to their products. This helped China to improve its position in world economic activities.

The preferential policies given to the consumer electronics industry helped to build the capacity of domestic firms to access the civilian product market. This had: (1) laid the foundation for the development of consumer electronics - up to the end of 1985, the total output of consumer electronics stood at about 48% of total electronics production; (2) helped to create a group of competing companies in the domestic electronics industry - although the total of 124 imported CTV assembling lines was a result of disorder of macroeconomic management, it late became the base of competition in both domestic and international markets; and (3) not only built the confidence of the management of the electronic firms in dealing with foreign companies and managing large scale manufacturing, but also raised their awareness of market and efficiency, and accelerated the process of switching electronic production

from military to civilian. Even so, the government realised in due course that it was necessary to shift to a policy regime focused more on providing an environment of fair competition.

Evolving responses to international competition

If Chinese firms were to participate successfully in international competition, it was seen as necessary to build domestic capacity and to identify and strengthen comparative advantage. Perceptions in China of how these two goals are best achieved in relation to the information industries have evolved considerably over the period under study. The pre-transition condition of China's technological capacity, together with the urgent requirement to meet surging demand for consumer electronic products in the early 1980s, are the reasons that a simple approach _ enormous imports of both assembling lines and related technologies _ was adopted at that time. However, a more sophisticated strategy was soon seen to be necessary.

China's strategies in building competitive capacity can be seen from China's engagement in the microelectronic industry, which highlighted the long-term pursuit of advanced technology and the serious consideration given to national security. The specific characteristics of microelectronic industry and its critical role to national defence determined that the industry had to be able to compete and to have compatible technologies internationally. It is the most sensitive industry under China's political environment. Therefore, a high level of domestic capacity in this industry continues to be seen as critical to China.

Although it caused a heated debate on the issue of how to develop China's microelectronic industry, a necessary and sensible step was to find ways of importing key technologies. The lesson from the microelectronics case, for a country with low financial capacity and a high level of central control, is that the capacity to obtain foreign technology depended on policy coherence and the prospective returns that could be obtained from this technology in the national economy in the future. For example, China successfully combined its offer to foreign leading telecom companies of the opportunity to access the switching market in China with the requirement to provide advanced microelectronics technology. This evidenced the central government's commitment to the development of the domestic microelectronic

industry, and required some coherence in policies from different ministries. By comparison with the quite different consumer industry, which was supported by big domestic market, the microelectronics industry experienced slower growth. Nevertheless, the capability of the industry was built in this way, and the practice of the competition and market development provided a valuable lesson to the industry.

In most cases, competitive advantage was built in part through long term learning in policy development. The policy evolution of the computer industry is a case of such a learning response. As a result of learning from domestic and international experiences, policy evolved from the protection policy in the early development stage to one of encouraging domestic computer manufactures to compete and cooperate with leading international computer suppliers. Later, the open competition policy in the telecom industry demonstrated the importance of both firm capability and competitive advantage in the most competitive industry in the world. The high international competition and anti-monopoly stream created a specific position for the industry, which weakened the tightly controlled policy environment of the telecommunication industry and required flexible policy responses. Intensive competition pushed the foreign companies to bring up-to-date technology into China. This has given government the opportunity to exercise new regulatory methods in line with international standards, and gave the domestic industry the opportunity to learn new technology administration methods. Again, it provided valuable lessons to enrich the policymaker's knowledge and experience.

8.3 The Policy and Theoretical Implications

8.3.1 The Lessons of the Economic Transition

The policy making process is a learning process, which requires policy makers to have considerable experience and theoretical knowledge, together with a methodology that enables them to learn from _ but not to copy without regard for national differences _ foreign policies and experiences. In this way they may produce high-quality policies appropriate for China's unique circumstances.

Successful reform involves changes to economic institutions to accelerate economic growth. Even though the effects of innovation are hard to measure, the main indicators of the economy, such as output growth, the inflation rate and so on, are useful to illustrate how well the economy performs. A transitional economy undergoing profound institutional change involves changing incentives and constraints facing all actors whose behaviour has economic consequences. The accompanying organisational changes to shape the behaviour of those actors are critical aspects of institutional change. An important lesson from the transition process is that any individual proposal has to be put in the context of China's economy and society, and successful implementation needs a great deal of policy experience and awareness. The same policy will yield different results if implemented under different circumstances.

The need to learn indirect methods of economic management

One requirement of the transition of economic management from direct controls to indirect methods of management is that government officials need to learn to use policies rather than to rely on direct controls to regulate economic operations. This was found important to policymakers seeking to facilitate competition under transition. So, innovative policy and strategic innovation in the following areas: (1) using economic methods to manage economic issues; and (2) changing the role and function of government according to the needs of social and economic development, were particularly critical in the process of institutional change to foster economic growth. These challenges in turn implied substantial learning requirements for government officials.

The effective implementation of macroeconomic measures is one example of the achievement of the government's policy goals by indirect methods rather than by direct controls. In the practice of using macroeconomic measures, the central government depended on the development of sophisticated indirect macroeconomic controls in areas like tariff and taxation, such as the case of the microelectronic industry. The reforms accomplished to date suggest that the skills and knowledge of government managers are critical to implement such economic policies and to understand the demands of trade and investment. The example of the change in policy orientation in the computer industry showed the importance of government skills to

the successful development of the industry. This policy change was from focusing on nurturing the infant computer industry by direct supportive policies (such as government direct investment, the creation of specialised funds and favourable terms for particular projects), to facilitating the industry's development by shaping a competitive environment, for example by increasing number of foreign switch companies with joint ventures in China and the level of direct foreign investment in the industry. Different attitudes, skills and capabilities were required for both government officials and business managers in the two cases.

Innovative policy needs to break up current power structures

Promoting competition is critical in terms of improving efficiency (Chapter 7), but many difficulties are often encountered in achieving this in practice. In relation to the telecommunications industry, government decision-making was hampered by the different interests pursued by different ministries, and the power struggles to which they gave rise. Experience with reforms in this industry showed that any innovative policy initiatives would face the challenge of breaking up current power structures and overcoming vested interests associated with old policies. The case of telecommunications exemplifies the fact that for competition to become established as a viable institution it was necessary to shape the behaviour of the various organisation participating in the industry. Such institutional change requires extensive bargaining with various interest groups and a high degree of experimentation, as progress is made slowly from the idea of a new institution to the reality of built institution.

Government has played an active role in the high technology area, to some degree in opposition to strong vested interests. The government worked effectively in the involvement with the '908' program and the switch market to balance national and commercial interests. For example, the latter program not only shaped the switch market to assist the building of an interconnected communications network, but also assisted the microelectronics industry to climb out of a difficult predicament. The technology choices expressed in the Memo signed by SPC and two telecom companies (Chapter 6) clearly showed the preferred direction of technological development of China's telecom industry. It also provided a basis for upgrading the technological level and the industrial foundation to build a national information infrastructure.

Learning is constrained by political factors and power structures

The process of learning related to policymaking in China was much constrained by its political environment, even though the reforms were intended to improve economic performance. In a highly centrally controlled environment, it was necessary to ensure that any learning occurring in a policymaking area was that the prospective result did not challenge the existing structure of power and authority. In the early stage of the transition process, when the principle of 'planned economy is primary, the market economy is supplementary' prevailed, any possible technical or policy change had to be in line with this principle. Another important constraint on learning was the need to comprehend and follow the indications from the upper level authorities, especially the national leadership.

Thus government learning in China has typically followed a path of uneven development, based on self-conscious action in which the learner struck a precarious balance as a result of pressures, incentives and compulsions. The evolutionary transition process enabled learning to occur in such a complex environment, consistent with policy development and a fairly stable economic environment. This was a key factor in the sound development of the industry, and contributed significantly to sustained growth in China.

Changes in policymaking are limited by adherence to project specific approaches

The project specific approach was also an important influence on government learning relevant to the case of policy making, because approving projects was an important function for government agencies (such as ministries and commissions). Effective project assessment in an environment of competition and changing technology required extensive learning by government officials schooled in the old ways. However, the approval rights for major projects were a powerful force affecting a leader's political position, as well as his or her ability to build political connections. Thus, leaders at various levels paid a great deal attention to influence the approval process for major projects. Consequently, it was not surprising that accompanying the functional transition from detailed controls to more macroeconomic management, the practice of government agencies changed gradually, but the leaders of the agencies were reluctant to change their way of doing things accordingly. It was a common

phenomenon that 'leaders grasp micro, subordinates lay hold of macro' (Lingdao zhua weiguan, xiaji zhua hongguan). This meant project specific policy making was still a highly favoured way of management for many leaders.

8.3.2 Assessment of the Innovative Policies

The Specialised Fund and the technology import policy implemented during the Seventh FYP played a significant role in promoting the industry and in facilitating technological catch-up. It also marked the start of government taking on more comprehensive indirect management activities.

The selective industry protection approach applied by the government, such as specific protective tariffs, controlled access to specific markets and foreign currencies, provided the means by which newly emerging industries could have the space and time to adapt advanced technologies. The establishment of high export capacity of Chinese consumer electronic products proved the value of such policy. However, the effectiveness of the indirect policy applications has been heavily affected by the poorly developed factor and product markets, the highly oligopolistic nature of the information industry and the continued importance of the control-based planning system and government direct intervention. In particular, market mechanisms were not yet sufficiently established and it became clear that an efficient planning system which supported the operation of market forces needed to be in place to aid the use of indirect measures.

Although Jiao Xie Fei is a common term used to describe failure associated with learning in China, there is a need to take into account the cost of learning when government undertakes learning. Some of these costs are obvious and accountable, others are invisible and hard to account for. However, these costs indicate that, in the whole circle of government learning and policy practice, there are either substantial areas of failure to learn, or that the learning process involved mistakes.

To avoid great costs in government learning, a careful iterative review of what has done and what should have done is critical to direct the dynamic movement of learning.

Conclusion

China has enjoyed continuous economic growth during the reform process, although China's leaders did not have a clear blueprint in mind when the transition from plan to market started. China's transition involved a series of strategic innovations, following a path that might be explained by the theory of induced institutional innovation. Over the period studied, many elements in the economic transition process were induced rather than designed. This suggests that the transition has been a dynamic process in which gradual approaches to strategic innovation have generated significant successes and failures, as well as highlighting the need for further reforms.

China's reform is often criticised for its unsystematic approach without any overall blueprint, it being argued that this has increased uncertainty, encouraged corruption and raised costs. It has also been argued that China's leaders have failed to provide clearly defined rules arising from systematic thinking about reform as an event that government imposes on a society initially in the mode of central planning (Rawski, 1996). The nature of China's reform dynamics must influence the perception of threats to the continued sustained growth of China's economy.

However, China has been pushed forward when the economic, political and social climates have permitted and were propitious, and changes have been made when altered expectations and the urgency of re-addressing newly emerging problems have required action (Stiglitz, 1999). China's reform has experienced successes, difficulties and failures for various reasons. What is important at this stage is to demonstrate that China's learning processes provide a lesson in both policy formulation and implementation approaches.

The hypothesis explored in this thesis is that the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning, both government learning and learning by other participants in the economy, in terms of innovation and institutional change. Learning by doing, especially by the

government in its role of driving strategic innovation and institutional change, has been central to China's achievement.

In respect of this hypothesis, we have shown that, in the information industry at least, learning by doing by the government in terms of policy innovation and institutional change has been both pervasive and of great importance for the development of the industry. As a result, one important aspect of the achievements made during the economic transition is that new policy initiatives have made use of pre-existing institutions and actors, and hence an institutional vacuum has been avoided while the whole economy has been undergoing substantial transformation towards a market economy.

In our view the results of this study provide strong evidence, but not of course decisive proof, that 'the evolutionary transition process undertaken in China has contributed to sustained growth in part by facilitating learning'. Given the tortuous, trial and error learning processes that we document in this thesis, it is quite likely that, had an abrupt process of transition been attempted in China, it would have had consequences as disastrous as those in many countries of Eastern Europe.

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