

**INFORMATION TECHNOLOGY AND
ECONOMIC GROWTH:
THE CASE OF THE BANKING SYSTEM IN
THE PEOPLE'S REPUBLIC OF CHINA**

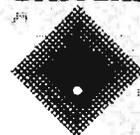
By

MICHELLE WYE LENG FONG

**Submitted for the degree of Doctor of Philosophy
September 1998**



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of the banking system in the

ACKNOWLEDGMENTS

I wish to express sincere appreciation to the following people who have made my thesis possible.

My sincerest gratitude goes to my supervisor, Professor Peter Sheehan, for his valuable support, direction and insightful comments. His patience and understanding certainly helped in making this thesis a reality.

My thanks are due also to the Centre for Strategic Economic Studies, Victoria University of Technology, the Victorian Education Foundation and ANZ Bank for administrative and financial support, and for trip sponsorship for this PhD program.

I am also especially grateful to many staff and colleagues at the Centre for Strategic Economic Studies for encouraging me in my work. In particular, to Dr Fiona Sun who has always been so ready to lend a helping hand in clarifying the thoughts behind some of the Chinese publications; to Mrs Margarita Kumnick who has been a great help in library information and in putting my thesis in presentable form; and to Mrs Gordana Volkanoska for her tireless administrative support.

My sincere thanks are also given to the scholars in the People's Republic of China - Professor Chen Yun Qian, Professor Wu Jia Pei, Professor Zheng You Jing and Professor Tang Xu - for their assistance given to me during my field trip in the country.

I like to thank my family members - in particular, my mother, Madam Yam Ng Mui, who taught me the importance of perseverance no matter how difficult the circumstances; and my youngest sister, Dr Fong Kah Leng, for calling me from the UK every week to ensure that I take a break from my thesis. Finally, sincere thanks to my friends for their encouragement, beautiful friendship and delicious cooking during my days of PhD pursuit.

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OVERVIEW

OBJECTIVES OF THE THESIS

Information technology has gained considerable prominence among both researchers and practitioners concerned with economic development in recent years, because of its potential to transform fundamentally both economic activity and the global relationships within which development takes place. *Developed countries* have set out to harness this potential, as is evident in the increasingly pervasive profile of this technology in these countries and the importance attached by these countries to its adoption and diffusion. These trends in the developed countries and the implications generated by the revolution in information technology have made it critical for the *developing countries* to be also involved in the race to exploit information technology for rapid economic development.

The ability of developing countries to adopt new information technology systems and to diffuse those systems through their economies will constitute an important factor in achieving rapid development in forthcoming decades. The literature reveals that there is no standardised method of adoption and diffusion for the developing countries to emulate; rather, adoption and diffusion processes are shaped by the contextual factors specific to individual countries. Thus these technologies do not provide a simple or straightforward path to economic development.

The emerging market economies - countries seeking to achieve rapid growth from a low base through market based economies, in some cases in transition from command systems - have as yet attracted very little attention in the literature in relation to this issue. *Therefore, this thesis aims to contribute to the literature on emerging market economies, by studying the factors influencing the adoption and diffusion of information technology in such economies.*

This general aim is pursued by undertaking a detailed study of the adoption and diffusion of information technology in one of the information-intensive industries (the banking industry) in the largest emerging market economy (the People's Republic of China). *Thus, the specific aims of this thesis are to obtain a better understanding of the factors that affect the adoption capabilities of the Chinese banking industry in information technology; to determine the role of the Chinese banking industry in the diffusion of information technology to other sectors of the economy and to provide initial insights, as a subsidiary aim, into the rationale for technological leapfrogging and the capability of the Chinese banking industry to leapfrog to the use of advanced information technology.*

STRUCTURAL OUTLINE OF THE THESIS

The thesis thus aims to contribute to filling a gap in the literature pertaining to emerging market economies. The People's Republic of China was chosen as the country for the investigation or study of the information technology adoption, diffusion and leapfrogging processes, because of its importance for both economic development and technology adoption in the 21st Century. The banking industry in the Chinese economy was the choice of focus because the banking industry has been known to be a major user of information technology, as evidenced in the advanced countries. It also presents a good example of an information-intensive industry. It is thus likely that this industry is a suitable testbed for investigating the forces that may favour or inhibit the adoption and diffusion of information technology, as well as those determining the possibility of information technology leapfrogging.

The thesis is comprised of eleven chapters following this Introduction, as noted below:

Part I: Introduction

Chapter 1: This chapter provides some of the basic technological and banking industry background to the thesis. It describes the revolution in information technology and the enabling power of information technology for economic development, exploring also the concept of the information superhighway and the

potential role of information technology in the banking system. The choice of the banking industry and the country (China) as the focus of the thesis is substantiated through a literature review. The implications of information technology applications for economic growth are illustrated through the role of the payments system, which has been a core foundation of the development of emerging market economies. Overall, the chapter provides further justification for the thesis objectives, which are the investigation of information technology adoption, diffusion and leapfrogging in a newly emerging market economy - the People's Republic of China.

Chapter 2: This chapter defines the concepts and presents literature review pertaining to information technology adoption, diffusion and leapfrogging. From the literature review conducted in this chapter it is evident that there is a wide range of possible factors influencing technology adoption and diffusion within a country. The chapter also lays out the analysis framework, the research approach, the methodology employed and the sources of information and data utilised.

Part II: The Chinese Information Technology and Banking Industries in Historical Perspective

Chapter 3: This chapter considers the overall Chinese technological capability in the information technology industry, in both the manufacturing and services aspects. The electronics industry is the key focus in the manufacturing aspect. This chapter serves as a background for determining the relevance and importance of a strong domestic information technology industry for the technology adoption, diffusion and leapfrogging processes within the state-owned banking sector.

Chapters 4 & 5: These chapters narrate the development of the financial system in the People's Republic of China in different periods. Chapter 4 focuses on the 1949 to 1978 period, whereas Chapter 5 considers the 1979 to 1995 period. They contrast the differences in the financial system between the central planning economy and the market economy, and document the structural and institutional background to the operations of the Chinese banking industry in the period under study.

Part III: Adoption of Information Technology in the Chinese Banking System

Chapters 6, 7 and 8 provide the detailed description of the adoption of information technology in the national banking system, and hence provide the basis for investigating the factors influencing the pattern of adoption and diffusion of information technology in that system.

Chapter 6: This chapter examines the profile of information technology adoption within the banking system, identifying the state-owned specialised banks as the main adopter of information technology in the banking system. The nature and business objectives of information technology adoption in these banks as a whole over the 1979-1995 period is detailed.

Chapter 7: This chapter describes the development of the financial system infrastructure and the applications that rely on this infrastructures. In particular, it explores the development of both China's National Financial Network (CNFN) and China's National Advanced Payment System (CNAPS), and the inter-relationships between these two systems.

Chapter 8: This chapter presents the profile of information technology adoption in the foreign banking sector and the individual Chinese state-owned specialised banks. As well as documenting patterns of adoption in each of the four main specialised banks, it brings out that they were ahead of the other state-owned enterprises in the application of the technology. This chapter also shows that foreign banks have not been employed fully for their potential in technology transfer or diffusion by the Chinese government, because of the latter's priority in retaining control of the local banks and of the market. This made the Chinese state-owned specialised banks the potential channel in technology transfer and diffusion.

Part IV: Analyses of Adoption and Diffusion

Chapter 9: This chapter reports on the analysis on information technology adoption at the organisation level and provides an account of the role of the organisational

factors in explaining the conclusions reached in Chapters 6, 7 and 8. The Galliers and Sutherland's (1994) model is adapted to provide a broader framework for analysis, which is used to determine the influence of the organisational factors influencing technology adoption.

Chapter 10: ATM and POS are the banking technologies addressed in determining the ability of the Chinese state-owned banks in the diffusion of technologies to the consumer sector. The reasons for the limited diffusion pattern found are examined through focusing on factors at the organisation level and on factors external to the organisation.

Part V: Technological Leapfrogging and Implications for Policies

Chapter 11:

This final chapter considers two matters. One is the possibility of technological leapfrogging in the Chinese banking system. The features of advanced and intermediate information technologies are contrasted to ascertain the value of technological leapfrogging for the emerging Chinese market economy. In addition, various possible approaches to technological leapfrogging are examined and applied to the situation of the banking system in China. Finally, some implications for policy from the findings of this thesis are considered.

THE PATTERN OF ADOPTION AND DIFFUSION OF INFORMATION TECHNOLOGY IN THE CHINESE BANKING SYSTEM, 1979 TO 1995

In this section some of the main conclusions of the thesis in relation to the pattern of information technology adoption and diffusion in the Chinese banking system are reviewed. Subsequent sections will review my main conclusions in relation to the explanations for this pattern, and in relation to the broader implications of the findings.

1. The historical context of Chinese banking – the gradual move from a mono-bank system towards a market based system – is crucial, and focuses attention on the state-owned banks.

The financial activities undertaken by the Chinese banking industry during the reform period (1979 to mid-1990s) was comparatively more significant and complex than during the pre-reform period (1949 to 1978), but nevertheless were deeply influenced by the characteristics of the previous system. The state-owned specialised banks continued to be the core financial unit in support of economic activities.

2. In general, the adoption of information technology in the state-owned banks has been slow, both relative to official plans and to global trends, and shallow, in the sense that information technology usage tends to be concentrated in a few branches, and is not widely spread through the operations of the banks.

Since the opening of the Chinese economy to world trade and the abolishment of the monobank system in favour of a market-oriented two-tier banking system during the reform period, the adoption of information technology within the Chinese banking industry has been on the increase in line with these developments. Despite this increasing trend, there is limited knowledge of the pattern or coverage of information technology applications, which warrant investigation into the pattern of information technology adoption. The case for investigation implies a need to focus on the state-owned specialised banks, which have been the main adopter of information technology in the Chinese banking industry.

Although information technology was initially adopted by the state-owned specialised banks during the Sixth Five-Year-Plan period (1981 to 1985) and government support for information technology adoption in the banking industry became increasingly apparent in the Seventh Five-year-Plan period (1986 to 1990), the information technology adoption process during the reform period was considered slow, relative both to official plans and to global trend, and shallow, in the sense that work systems were not fully automated.

This conclusion was reached in light of the several aspects of information technology adoption. Firstly, the actual stage of computerisation achieved by the banking

industry in the Eighth Five-Year-Plan period (1991 to 1995) remained at the 'setting the foundation' stage, although it was the period pre-destined by the government to involve widespread adoption of information technology ('popularisation'), in time for 'full computerisation' in the Ninth Five-Year-Plan period (1996 to 2000). This pace of information technology adoption is considered slow when viewed from the fact that the Chinese state-owned specialised banks had started to adopt technology in the mid-1980s. Furthermore, the coverage of the information technology adoption is regarded as shallow for the reason that the overall pattern of technology applications still constitutes islands of automation in the 1990s. This is evidenced by the existence of manual and dual processing modes, and the inability of the banks to configure a virtual network that is capable of comprehensive geographical coverage and extensive interbank linkage, despite the availability of networking technology in the country since the mid-1980s. Although the intense pursuit of sophisticated electronic network for strategic purposes by banks in the developed countries has moved into the international arena, the Chinese banks were each still grappling with information technology for transactional and informational purposes within their internal organisation in the mid 1990s.

3. In terms of the role of the state-owned banks in the diffusion of information technology, the analysis concentrates on ATM (Automated Teller Machine) and the POS (Point-of-Sale) payment technologies. The diffusion of these technologies has been limited, with the partial exception of certain major cities, and the banks have been unable to play a major role in this process.

Closely associated with the pace of information technology adoption in the banking industry is the question of whether the state-owned specialised banks are able to play a major role in technology diffusion to the consumer sector. This role was deemed necessary by the Chinese government. The ATM (Automated Teller Machine) and the POS (Point-of-Sale) payment technologies were focused on in this thesis because their diffusion to the consumer sector has been considered important to maintaining monetary control within the economy. Determining the diffusion role of the state-owned specialised banks required analysing the factors that influence the process of diffusion. In the area of diffusion of the ATM and POS payment technologies, the

state-owned specialised banks remained the dominant provider and supplier of these technologies to the consumer sector during the reform period. In the thesis, diffusion of these technologies is considered to have taken place when the consumers and agents used them for payment transactions. Transaction indicators that are used to determine the level of ATM and POS technologies being diffused to the consumer sector reveal a generally limited and superficial national diffusion pattern. On a regional basis, the state-owned specialised banks tend to focus on major cities in providing and supplying the ATM and POS payment technologies. The major cities were the areas that tend to register a higher level of diffusion for these technologies than the less major cities. The rate of acceptance or usage of the technologies by the users shows that, on an overall basis, the state-owned specialised banks have not been able to exercise fully their desired role in the diffusion of these technologies to the consumer sector.

4. Infrastructure for financial communications plays a key role in technology adoption and diffusion in the banking system. China's National Financial Network (CNFN), a financial communications infrastructure, underpins the development of an automated payments system. Although the establishment of the CNFN was slower than expected, the usage of CNFN has been constrained by other factors affecting technology adoption and diffusion.

The importance of the information technology adoption and diffusion process is evident in China's National Financial Network (CNFN). The infrastructure was initiated by the Chinese government in the late Seventh Five-Year-Plan period to accelerate the establishment of inter-bank linkage for the purpose of macro-monetary control and management. The CNFN is a financial infrastructure that relies on both the financial satellite communication network and the public digital network to enable electronic linkage among the banks. It is expected that the CNFN would evolve to support a range of highly sophisticated electronic financial systems for the country in the long run. The construction of the CNFN was initially focused on providing the much needed support and efficiency to the electronic payment system (China National Advanced Payment System - CNAPS) in the country. The country has been experiencing 'bottlenecks' in the manual payment system for a long time, which has

restricted the growth of its economy. The success of the CNAPS to overcome the 'bottlenecks' and to cultivate widespread acceptance for electronic payment facilities is, on the one hand, dependent on the construction progress of the CNFN. On the other hand, the individual banks have to be electronically equipped internally (that is, to have adopted information technology) before each could be linked up to the CNFN infrastructure, so as to instill efficiency in their payment processing system and to enable them to share interoperable systems among the different banks.

Although the CNFN was slow in development and lacked of comprehensive coverage, the completed portion of the infrastructure remained underutilised in the mid 1990s. The slow and shallow pattern of information technology adoption within the banking system is significantly reflected in the operation and utilisation of the CNFN. Although the CNFN does enable information to be transmitted via satellite with a delay of only three seconds, the amount of time taken to further transmit information and to process the payment instruction at the ground level normally takes three days. Although this electronic mode of payment is an improvement over the postal mode of payment, it still falls short of the intended 24-hour payment clearance target. The People's Bank of China found that the electronic interbank connection was made difficult by too many technology incompatibilities and by the different stages of technology adoption within the different banks.

The Ninth Five-Year-Plan has targeted the completion of the CNFN with comprehensive geographical coverage by the early 21st Century, with full computerisation of 90% of the financial branches and widespread diffusion of payment technologies (such as the ATM and POS) by the end of the Ninth Five-Year-Plan period. In total, the aims of the Ninth Five-Year-Plan period dictate a much faster adoption and diffusion rate in information technology than the rate experienced in the Eighth Five-Year-Plan period.

5. By contrast with common expectations, foreign direct investment has not been a significant source of information technology transfer into the Chinese banking system.

The state-owned specialised banks have been and are expected to continue to be the most active adoption and diffusion agents in information technology in the Chinese

banking system, at least into the Ninth Five-year-Plan period. The survey conducted for the thesis revealed that the popular notion of foreign direct investment as a source for technology transfer does not apply in the case of the financial system in China. The priority of the Chinese government in protecting, and retaining control of, the local banks and the financial market has kept foreign direct investment in the banking industry at a relatively modest level. The controlled industry has not provided sufficient incentive to the foreign banks to adopt highly sophisticated information technology for their restricted business operations.

6. In spite of their own limited progress in information technology adoption, and the variability across banks, the state-owned banks as a whole are much further advanced in information technology adoption than the majority of non-bank state enterprises in China.

Interestingly, although the adoption of information technology by the state-owned specialised banks has been slower and shallower than planned, they lead the other state-owned enterprises. This can be attributed to the government's efforts, which have been transmitted through the reform agenda and the specific projects targeted at establishing the CNFN infrastructure for the banking system. In this agenda and these projects, the state-owned specialised banks were identified as beachheads for technology adoption and diffusion within the financial system and within the economy. The government has based its projects on these banks, and thus has created impetus on the state-owned specialised banks to adopt technology.

Among the local financial units, the state-owned specialised banks have been the leading financial units in technology adoption for a long period of time. When the technology adoption process of the different individual specialised state-owned banks is taken into consideration, each is seen to have a different pace of adoption within their own banking system. It is also revealed that some of their individual branches have been, in fact, leading adopters of the new technologies. However, the initiation and adoption of advanced technologies were largely confined to major city areas, and the spreading of the adopted new technology from one city to another has been

limited. This was despite favourable response from outlets which adopted the technology and the attention given to this matter by the State Council. These facts all highlight the necessity to investigate into the factors influencing the state-owned banks' technology adoption and diffusion process.

EXPLAINING THE OBSERVED PATTERN OF ADOPTION AND DIFFUSION

7. The analysis of the reasons for the observed adoption pattern focuses initially on factors at the organisational level. No single model or theory is directly applicable to China's unique circumstances, but a framework adapted from the Galliers and Sutherland (1994) model is employed. Detailed analysis using this framework suggests that deficiencies in a number of areas - business structure and strategy, funding levels, technical and management approaches to technology adoption, business process re-engineering, usage of external experience and the availability of skill personnel - have been the main inhibiting factors in the Chinese state-owned banks' adoption process.

The initial point of information technology adoption is within the organisation, and hence this thesis takes the approach of focusing on the information technology adoption at the organisation level of analysis. Because the external factors tend to be the common factors influencing both information technology adoption and diffusion process, these factors are discussed in further detail in the context of the diffusion role of the state-owned specialised banks. The organisation level of analysis of information technology adoption, within the state-owned specialised banks, provides an account of the role of the organisational factors in explaining the finding of a slow and shallow adoption pattern in these banks. In this analysis, there was difficulty in obtaining an existing representative model for analysing the organisational factors influencing information technology adoption. Both the Nolan (1979) and the Galliers and Sutherland (1994) models were brought into discussion. The Galliers and Sutherland model was found to provide better insights into the framework for

analysis. However, there are certain limitations in the full application of their model for the thesis focus on information technology adoption in China. This model was then adapted to provide a broader framework for analysis, based on organisational context. In the adapted framework, the characteristics of organisational factors such as technology, structure, strategy, task/system, people and culture were tracked, based mainly on pre-reform period (1949 to 1978) and on the different five-year-plan bases in the reform period (1979 to 1995). The thesis model and data lead to the finding that

- the lack of a clear business structure and strategy,
- funding constraints,
- technology application deficiencies,
- lack of a total management approach,
- failure to adopt business process re-engineering,
- failure to adopt external experience about conditions of technology adoption, and
- skill shortages have been the inhibiting factors in the Chinese state-owned banks' adoption process.

8. Perhaps the main inhibiting factor for information technology adoption was the business model which lay behind it. This fell uncertainly between a command model - in which adoption is directed, controlled and funded by the government - and a commercial model - in which information technology adoption is shaped by commercial profit criteria. Thus adoption was encouraged but not funded by the government, while the banks lacked a clear commercial rationale, and the access to internal or external funding sources which might be linked to that commercial rationale, for rapid adoption.

The stage of information technology adoption in the state-owned specialised banks during the post reform period essentially fell between a command model - in which adoption is directed, controlled and funded by the government, and a commercial model - in which information technology adoption is shaped by commercial profit criteria. Government policy support for information technology adoption was given in the interest of creating full commercial banks, but was not supported by much needed funding and infrastructure support that directly accelerated the rate of

information adoption in the state-owned specialised banks. Internally, these banks were also imbued with uncertainty in business structure and strategy which constituted a fundamental hindrance to information technology adoption. The relinquishment of the responsibility by the government for investment funding for internal information technology adoption within its state-owned specialised banks is judged to have been premature. The new funding structure has placed a heavy financial bearing on these banks, which were new to the role of self-funding and independent commercial banks. Unfortunately, the rudimentary stage of market development in the Chinese economy provided limited opportunity to these banks for seeking alternative sources of fund for internal technology investment. In addition, the inability of the local information technology manufacturers to producing reliable quality product has resulted in the banks importing relatively more expensive technology from overseas manufacturer. Such procurement impinged upon the already tight financial position of the banks, and thus resulted in the deliberate prolongation of the equipment usage life span. In turn, this led to the use of different levels of technology and inconsistent technology standards in the operating systems of the banks, which hindered the effective application of electronic linkages for business process integration.

9. The uncertainty about the business model also contributed to inadequate internal processes for the adoption of information technology. This was particularly so in regard to the lack of a total management approach to information technology, integrating all information functions and technologies into the entire corporate system. This led to uneven application of technology and less than full utilisation of the capabilities of new systems.

Although the state-owned specialised banks were no longer constrained by political factors in their acquisition of technology during the reform period, the nature of the utilisation and application of the adopted high-end technologies in these banks indicated inadequate exploitation of the potential they offered. The lack of a total management approach in technology application contributed to the underutilisation of the capabilities of this equipment. The inability to exert a total management approach, that fully assimilates and integrates all information functions and

technologies into the entire corporate system, resulted in pockets of information technology application in the different areas of banking activities. In addition, the slow development of network connections for a national electronic banking system was also aggravated by limited national coordination efforts to ensure the adoption of coherent technology standards among the banks.

10. A further aspect of the management approach was the attempt to apply new technologies to existing business processes, rather than to implement the radical process of business reengineering necessary for effective application of information technologies.

Similarly, the inability of the Chinese state-owned specialised banks to implement business process reengineering of its traditional business areas of activities to efficiently exploit the applied technologies, was an information factor in ineffective adoption. This was the result of the low skill base of the information technology staff, and of the increasingly complex requirements on the work process system brought about by the transformation of the market-oriented banking system. The limited tendency of the Chinese banks to learn from external experience about the conditions of technology adoption also hindered their ability to exploit and assimilate overseas experience.

11. Shortages of skilled information technology personnel also severely inhibited the process of adoption.

In terms of information technology talent availability to support the adoption process, the banks have been facing a persistent problem of skill shortage in the market, and a continuing problem in retaining a stable pool of the talent required for its internal technology adoption process. It is expected that it will remain the responsibility of the banks to cultivate a pool of the required talent over the medium term, in view of the fact that increased output of skilled personnel from the national education system will take a considerable period of time to build up.

12. Infrastructure deficiencies hampered both the process of technology adoption within the banks and the diffusion of payments system technologies to

consumers.

In the area of information technology diffusion, the internal constraints of the state-owned specialised banks impinged on their role in the diffusion of ATM and POS payment technologies to the consumer sector. Besides organisational factors, infrastructure support and policy inadequacy are the external factors which hindered the diffusion process. The inadequate infrastructure support and policy framework have led to the absence of a transparent payment processing system. The limited telecommunication infrastructure has been a blockage to a unified national payment network, while the legislative structure has not been able to provide sufficient protection to the card issuing bank, the agent and the consumer/cardholder in the event of fraud or breach of use. Consumers and agents faced inconvenience and unreliability in using the payment technologies and, therefore, the result was a slow diffusion pattern of the payment technologies. On top of this, the unfamiliarity of the consumers and agents with the use of the payment system have led to the failure of these parties to abide by the existing policies governing appropriate usage and behaviour, and have led them to continue to prefer the use of cash.

13. The key factors hindering technology adoption within the banks also inevitably affected their diffusion role, perhaps especially in terms of the lack of an appropriate business model and of commercial incentives for the banks to pursue diffusion activities.

The analysis of the diffusion role of the state-owned specialised banks revealed that these banks have had an arduous and difficult role in diffusing payment technologies to the consumer sector. In particular, the process is seen as likely to involve a long payback period on the investment in these technologies. As with the analysis of the information technology adoption process, there appears to be a need for the government to provide incentives to build a strong domestic information technology industry and to create the relevant institutions to foster support for, and acceptance of the new electronic payment system within the country.

SOME IMPLICATIONS OF THE FINDINGS

The conclusions from the findings of the analysis of information technology adoption and diffusion offer interesting implications for China in relation to technological leapfrogging, and for appropriate policies to support an efficient rate of information technology adoption, diffusion and leapfrogging, which in turn will be important for the overall economic growth in China.

14. In spite of debates about the relative roles of advanced or medium level technology for developing countries, in the case of information technology in the banking system, the only effective option is to 'leapfrog' to advanced technology. This is above all because of the need to link systems to those of others users, both domestically and overseas, and to link them to many other emerging technologies.

Although the level of information technology adoption and diffusion was found to be slow and shallow in the Chinese banking system, the learning paradigm of most users in the state-owned specialised banks involves advanced technology. In other words, these banks largely opted for the adoption of advanced technology, instead of intermediate technology. Although there were cases of intermediate technology adoption by the rural bank branches, often as a result of technology being passed down from city branches, these were few in number and did not constitute major disruption in the user's learning process because they were confined to base level applications of the intermediate technology. The Ninth Five-Year-Plan has destined these rural bank branches for advanced technology adoption.

This thesis explores the value of technological leapfrogging for the Chinese banking system, in light of the fact that the state-owned specialised banks have many negative factors hindering the full exploitation of the potential offered by the advanced technology. When the relevant features of current information technology are considered, they imply that technological leapfrogging is an inevitable step for the Chinese banking system. The importance of open system features in advanced technology has made technological leapfrogging an ideal choice over intermediate technology adoption, because the latter has inherent inflexibilities for network formation. Current generations of advanced technology tend to endorse ease of migration to future technologies without incurring high replacement costs. In

addition, they tend to impose fewer demands on the users to be equipped with technical operational languages or specialised knowledge. The choice in the adoption of advanced technology is also justified by the developments in the global market. Electronic interconnection between countries is increasingly becoming a central feature of globalisation, enabled and facilitated by the open system features and the network capability of advanced technology.

15. In spite of the inevitability of leapfrogging to advanced information technology, the difficulties of successfully implementing such technologies in a developing country such as China are immense, and were not fully realised or taken account of in planning in the Chinese banking system.

In spite of the strong technical reasons to leapfrog to advanced technology adoption in the banking system, consideration must be given to the factors which make up the work process that complements the adoption of the advanced technology. The situation faced by the state-owned specialised banks does not warrant the adoption of a radical technological leapfrogging approach, in which the work process is radically transformed to complement or exploit the new technology. The radical technological leapfrogging approach would run a severe risk of shocking the traditional system, because of the sudden transplantation of very new work processes, with potential system breakdown. The organisational and economic systems in China are still not capable in coping with the socio-economic repercussions from the radical approach. In fact, the case of the Chinese state-owned banks suggest that, of the various approaches considered in Chapter 11, the high cost technology blending approach and the low cost technology blending approach would be most appropriate. The high cost technology blending approach involves tolerating a high degree of underutilisation of the technological capability of the equipment being installed, while work processes are being evolved gradually to fully complement the new technology over time. On the other hand, the low cost technology blending approach involves the use of intermediate technology for a short period, before progressing to adopt advanced technology in the later stage. In order to successfully achieve the optimal technological paradigm in the long run (that is, to become capable of fully exploiting the advanced technology), the relevant organisation factors, institutional design and

the infrastructure have to be reformed. In the interim, the Chinese government constitutes an essential element in acting as a supplementary force to remedy the deficiencies in the transitional system. Essentially, the state-owned specialised banks require external assistance to proceed at a more rapid rate of advanced technology adoption and diffusion, and this requires strong support from government in institution creation and in policymaking.

16. The state-owned banks need the assistance from the government to support an efficient and more rapid rate of advanced technology adoption and diffusion. There are a number of possible ways that the government could provide assistance to the state-owned banks in this area.

The state-owned specialised banks need strong support from the government to alleviate both the financial constraints and the expertise shortage of the banks, to speed up the development of the telecommunication and power supplies infrastructure, and to help the banks to build up acceptance for the banking technology through its policy making mechanism and through its influence on other state-owned enterprises.

Policy could take the following forms. To alleviate the financial onus on the state-owned banks in the adoption of information technology, central and local government could employ tax policies to support capital formation and capital raising, which would lower the cost of capital. This could include making investments in information technology tax deductible at appropriate rates for the banks. Government's support in the area of indigenous information technology capability development, through the establishment of responsive and nationally coordinated training centres, may help ease the tight internal training demands on the state-owned specialised banks. In addition, the government sector could be employed more vigorously as the channel for information adoption, diffusion and leapfrogging. For example, the government could directly influence the adoption of advanced information technology in its offices as customers of the banks, and also use the state-owned enterprises to diffuse payment technologies through their role in the paying of wages. The government's persistence in reforming the Chinese telecommunication and power supplies infrastructure is also necessary to eliminate the inherent intricacies

within the transitional system. The deficiencies in these infrastructures impose direct constraints on the potential delivery systems in the banking industry, and in turn influences the range of possible products or technologies that can be adopted.

CONCLUSION

Information technology offers potential for economic growth in developing countries, through its capability in integrating different economic systems for efficient development. Although the adoption and diffusion of information technology are not panaceas for economic development, they are essential for developing an efficient national payment system and an electronic network that facilitates the exchange of information. Technological leapfrogging is an inevitable move in the adoption and diffusion of information technology, because advanced technologies tend to bestow unprecedented flexibility and network potential to the adopter. However, all the processes of adoption, diffusion and leapfrogging of information technology have to be carefully planned and conducted, according to the economic, social and cultural context of the nation in question. In the situation of the developing and emerging market economy of China, and in relation to the adoption of information technology in the banking system, it has been demonstrated that special attention must be given to the business model within which adoption is attempt, to adequate commercial incentives for the parties, to the availability of realistic funding mechanisms, to the total management to information technology within the firm, to the necessity for thorough business re-engineering and finally to the critical importance of high quality infrastructure and skilled staff.

PART ONE
INTRODUCTION

CHAPTER 1 : INFORMATION TECHNOLOGY, THE BANKING SYSTEM AND ECONOMIC DEVELOPMENT.

This chapter involves a brief review of literature pertaining to four underlying issues: the information technology revolution, the importance of the banking industry to an economy, banking technology adoption in the developed countries, and the limited role of information technology applications in the payment system in socialist economies. The payment system is discussed as one key aspect of the link between applications of information technology and economic development. The chapter thus outlines part of the background to the substantive investigations of later chapters.

1.1 THE INFORMATION TECHNOLOGY REVOLUTION.

1.1 A) The meaning of information technology. The thesis adopts Tom Forester's (1990, p. xiii) definition of information technology which is defined as '*the new science of collecting, storing, processing, and transmitting information*'. This definition is taken to encompass computer hardware, computer software, computer services, telecommunications equipment and telecommunications services that assist the human capability to transmit, store and process information.

1.1 B) The value of electronic information systems and networks. In the early age of computer innovations, during the 1940s to mid-1960s, advances in computer technology were centred mainly on increasing the computer's ability to process information conveniently, rapidly and accurately, with the objective of cost reduction in information processing (Ralston and Reilly 1993). The computers that were in use during that period were without built-in or direct communication facilities and the transmission of the processed information constituted a separate and discontinuous process from the computing task. Around the early 1970s (Hagedoorn 1989),

advances in the computer and the communications industries led to an initial convergence of these technologies for use in an increasingly large number of information systems (Behan and Holmes 1990), allowing data to be processed by the computer and routed electronically to the destination (or vice versa for information received) in a direct sequential process. The convergence of these technologies (commonly known as information technology) has continued to enhance the potential of each technology and extends both the qualitative and quantitative scope of information flow and sharing. A significant contribution of information technology has been the formation of electronic information interchange networks which provide unprecedented opportunities for sophisticated and advanced levels of interaction. The distinctive electronic networking characteristic of information technology allows interconnection among the various entities existing in the value chain system, thereby providing a potential for efficient flow or exchange of information between the contributors and users. Porter has described this characteristic and its impact as '*....growing sophistication of information systems is also a powerful force in opening up possibilities for interrelationships*' (1985, p. 321) and '*....interconnections within the cluster....lead to new ways of competing and entirely new opportunities*' (1990, p. 151).

The efficient flow of information among entities within the economy promotes performance efficiency as it is related to the creation, use and transfer of knowledge (OECD 1989). This has been shown in best-practice forms of industrial organisation (Weill and Lucas 1992, Rayport and Sviokla 1995) and socio-economic structures (Eager 1994, Bailey and Cotlar 1994, Giffin 1996). The interconnection linkages enabled by information technology to support different best-practice forms of relationship vary in different configurations within the economy. Examples of these best practice forms of relationship are the well-coordinated and coherent system within the networked organisation at the intra-organisational level, manufacturing based on just-in-time relationships between supplier and manufacturer at the inter-organisational level, electronic fund transfer among different business sectors, and information sharing among different countries through the Internet. When these linkages are replicated in the different levels and sectors of the economy, and are connected together to form a national network whereby every entity or sub-entity is linked to one

another, the potential for a national cohesive economic relationship is created. This should have major implications for economic performance.

1.1 C) The advent of information technology. In the information age, each generation of information technology innovations progressively enhances the data processing and communication capability of users, in terms of speed, reliability, cost-performance and degree of interaction. The central technological advance has been integrated circuit technology, which has become very sophisticated since the 1950s. A single integrated circuit, the size of one discrete transistor that was used in the computers of the 1940s, contained thirty thousand transistors and connections in the early 1980s (Eastman Kodak Company 1986), had risen in capacity to accommodate thirty-five million transistors in 1993 and has been expected to make tremendous improvement into the future (Gilder 1991, Port 1994). Such technology has largely enabled the once “bulky and government-affordable” computer model to develop into cost-effective¹ and versatile computers which are fit for a wide range of applications. In fact, the computer has become ubiquitous: in the early 1990s, an estimated 200 million computers were in use worldwide (Ralston and Reilly 1993). There is little doubt that computer technologies will continue to advance to a higher level of capability.

The development of telecommunications has contributed to the rapid transmission of information from one computer to another (Eager 1994). Technological advance in information transmission (communication) facilities has been promising and impressive. In terms of speed, it has registered a progression from kilobits per second to megabits per second and recently, to gigabits per second². In addition, simultaneous transmission of different forms of signals - voice, video and data - has become possible with improved cable and satellite/transceiver technologies, making broadband transmission of interactive video-communication a viable option.

¹ The cost-performance of computer technology has followed a declining trend with each innovation. This is evidenced by the microcomputer which fell by 28% in real price between 1982 to 1988 (Braga 1996) and the trend of PC prices in the 1990s (Wallis Report 1996).

² One kilobyte consists of 1,024 bytes; one megabyte totals slightly more than one million bytes; and one gigabyte is equal to one thousand megabytes or slightly more than one billion bytes (Eastman Kodak Company 1986).

In the convergence of these technologies, the number of computers connected to the communications network have been rising rapidly, especially since 1989 (Gilder 1994a). The development of converging computer and telecommunication technologies has blurred the conventional distinction between these technologies. It is without doubt that this development will continue to evolve to enable a more sophisticated information society. A fully interactive national electronic marketplace (network) that fosters powerful capability in speed, reliability and cost-performance for all forms of data communication will become a reality in due course, based on the fact that the data processing and networking components are becoming more and more 'intelligent' in each step of technological evolution.

1.1 D) The 'information superhighway'. The potential advance of information technologies is so credible (Blake and Tiedrich 1994, Egan 1994) that nations which value information highly are investing heavily for the ultimate communication network paradigm, known as the 'information superhighway'³.

Thus far, the term 'information superhighway' has different diverging definitions. This is due in part to the myopic perspective of the different groups of information technology users, who each define the term in their own limited applications arena⁴; and in part, to the rapidly advancing nature of information technology in which many of the technological capabilities are yet to unfold (Gilder 1991, Fernes 1993).

The definition of 'information superhighway' used here is adapted from Eager's (1994) definition⁵ and based on the vision of the 'information superhighway' being pursued by major countries. Thus, the 'information superhighway' is defined as an efficient electronic network that links up most existing users and is supported by sophisticated information technology and operating environments, enabling information to be processed and transmitted in the fastest possible way (high-speed) and in the most flexible form (voice, video, data) possible. Together, this group of components will generate a synergy that has great potential for enhancing the lives of

³ This term was first established by the current Vice President of the United States, Albert Gore Jr., in 1988 (Otte 1994).

⁴ Refer to Otte's (1994) explanation that each different group of information technology users have their own perspective of the information superhighway.

⁵ '*The Information Superhighway represents a network of networks - millions of computers that link to each other, sharing data, information, and files.*'

the ordinary citizens and in stimulating economic growth, creating value and competitive advantage for the overall economy. On the other hand, the potential of information technology must also be viewed in the light of its downside effects, as is obvious in some of the issues pertaining to data security, digital privacy, intellectual property rights in cyberspace, and children's easy access to uncensored on-line material. This adverse impact of information technology requires a highly responsive framework of comprehensive policies and programs to cope with the negative effects brought about by advancing technology. The determination of the advanced countries to realise their vision of the 'information superhighway' implies that they have judged that the benefits of this pursuit will outweigh the costs incurred. Examples of benefits foreshadowed include telemedicine, which delivers high-quality care to rural or remote areas, teleconferencing for timely business decision making, and distance learning through broadband networks, in which accessibility to quality teaching is not restricted by geographical distance. The emergence of these and other benefits may herald further improvement in the standard of living and efficiency within advanced economies.

1.1 E) The vision of 'information superhighway'. The concept of the information superhighway represents a major force for economic integration and is being pursued by the developed nations, by newly industrialising countries and by some of the trade-oriented developing countries. These countries have decided that such technologies are crucial for the achievement of their economic objectives and for progress. Some of these economies, which are well entrenched in the construction of their national information superhighway, have given elaborate titles to their pursuit - "National Information Infrastructure" in the United States, "European Information Society" in the Western Europe, "Infobahn" in Germany, and "Intelligent Island" in Singapore (Dougan 1994). Their belief that the national information superhighway is central to their socioeconomic development is further strengthened by the intention of the US government and the Group of Seven (G7) industrialised countries to build a 'Global Information Infrastructure' (GII) that consists of interoperable national, regional and international networks (Tarjanne 1995 and Stapleton-Gray 1995). The realisation of this vision will mean extending the national cohesive relationship to the global level

and opening up a new horizon of opportunities. This would speed up globalisation and intensify competition among nations. The GII was first proposed by US Vice President Gore at the International Telecommunication Union (ITU) World Conference in Buenos Aires in March 1994. It became a working agenda of the Group of Seven industrialised countries in 1995 and is still in its early stages of development in early 1998. Despite being in the early stage of development, cooperation and discussion about the GII development has already started to be incorporated into the activities of international organisations, such as the WTO (World Trade Organisation), ITU (International Telecommunication Union), and OECD (Organisation for Economic Cooperation and Development). Between March 1994 and July 1997, the issues involved in discussion and debate were largely related to standardisation, regulation, and assistance to developing countries in support of GII development. A considerable amount of time has been and will be involved in resolving these issues of the GII infrastructure. Among these issues, it has been perceived that a major obstacle to constructing the GII is the difficulty in standard setting to achieve an integrated global communication system. However, despite the worldwide diversity in technology standards, operating systems and protocols existing at the present time, the high level of commitment by the above mentioned countries to accelerate growth in telecommunications and computer applications implies that such diversity may eventually be overcome. In addition, the historical development of information technology has shown that similar diversities have been transcended through time and should not prove major obstacles in the long term. Most interestingly, the actions of the non-G7 countries suggest support for this point. In just a few years, the US and other industrialised countries' effort in building the GII has stimulated many countries' governments to introduce their own policies, parallel to the development of the GII. On 1st July, 1997, the Clinton Administration in the US added further stimulation to the GII through the announcement of its strategy for developing the trade and commerce dimension of the GII. This initiative is aimed at achieving a free and open global electronic marketplace. This is an active discussion and debate in 1998. The pursuit of the 'information superhighway' is an example of the pursuit of a sophisticated information society that is enabled by advanced and powerful

information technology. Information technology adoption and diffusion are important processes in achieving this goal, and are discussed below.

1.1 F) The significance of information technology adoption and diffusion. Many research studies related to the spread of technology have incorporated the technology adoption process as part of the diffusion process, so that often the reference of the latter is unilaterally taken to embrace the former. The diffusion process refers to the process by which the use of an innovation or technology spreads and grows (Mansfield and Mansfield 1993); it is related to the spread of the technological benefits within the economic system as a result of gradual growth of adoption. As such, technology adoption is considered an integral part of technology diffusion because the latter refers to the spread of the adopted technology. Viewed from another angle, the points that make up the technology diffusion pattern are also points that are involved in the adoption of the technology that is being diffused.

Comparatively, the diffusion process has been accorded a higher profile and also been regarded as an important one, because of its cumulative character that is capable of precipitating an impact at the national level. In the case of information technology, for example, the process serves to disseminate the economic development potential of information technology to other sectors of the economy (MITI report quoted in OECD 1989, Antonelli 1991, Hana et al. 1995). The cumulative character of the diffusion process of new information technology is also likely to have effects which contribute to economic development. The more individuals or entities adopt information technology, the higher the likelihood that the society can progress to a more advanced information infrastructure. This relationship between the diffusion of technological innovations and technological synergy is embodied in the vision of the 'information superhighway', and is underlined by the '*Metcalf's Law*' that '*the power of computers on a network rises with the square of the total power of computers attached to it*' (Gilder 1995). In more economic terms, there are substantial externalities or spillovers from the adoption of information technology by individuals or firms.

Nevertheless, information technology adoption and diffusion constitute important and necessary processes in the development of a sophisticated information society. Deliberate policies promoting adoption and diffusion of information technology

applications have been implemented in most of the developed and newly industrialised countries since the 1980s (Mody and Dahlman 1992, Ferne 1993, Hana et al. 1995). Even though the developed countries like the USA, Germany and France have been commonly referred to as technology innovators in one field or another, they are still dependent on the adoption and diffusion of the information technology to other sectors for the spread of the electronic network coverage. Singapore, a newly industrialised country with few achievements in technological innovation, has been relying heavily on the adoption and diffusion of information technology within the economy to realise a great part of its vision, as for example in their construction of Tradenet⁶ (Sisodia 1992, Mody and Dahlman 1992, Tan et al. 1992). This is also the case with Hong Kong's advanced information infrastructure (Dedrick et al. 1995) and is a prerequisite for the development of the trade network in South Korea and Taiwan.

The literature review in Chapter 2 is carried out according to the coverage given to the adoption process (embraced in the term 'diffusion') by the literature. However, in the thesis analysis, these processes are segregated into the technology adoption process (initial point of adoption) and the technology diffusion process (the subsequent points of adoption of the diffused technology in another sector), because of the different analysis scope (organisational and macro level of analysis) involved. Further literature review on the technology adoption process is undertaken in Chapter 9, to narrow the focus on the organisation factors.

⁶Singapore's trade network, Tradenet, is an electronic data interchange (EDI) system that links port custom and facilities, government offices, and private trading companies for goods clearance at the Port of Singapore. Similar networks in Hong Kong, South Korea and Taiwan are known as Tradelink, KTNET and TradeVan respectively (Burn 1995).

1.2 IMPORTANCE OF THE BANKING INDUSTRY TO THE ECONOMY: A REVIEW OF THE LITERATURE

The following section involves a brief review of literature pertaining to the economic importance of the banking industry in developed, developing and former socialist economies. There is no intention of probing into these already richly explored theories and studies in great detail. This literature review has the deliberate aim of taking the literature findings as a justification for selecting the banking industry as the central focus for a study on the linkage between information technology and economic growth.

A developed financial structure is the keystone to the functioning of a market economy, as the nature and interaction of its elements (institutions, instruments and activities) have great ramifications on the development of other sectors in the economy. Gurley and Shaw's (1955, 1967) early contributions highlighted the importance of financial intermediation to economic development. Goldsmith's pioneering empirical work (1969) showed a strong correlation between economic development and development of financial structures, and spurred further research into the cause and effect relationships between financial and economic variables. This point is supported by economic researchers of the later decades, such as Germidis and Michalet (1984), Wellons et al. (1986), and Mikdashi (1993) who consider strong financial structures as prerequisites for economic development. Recent empirical studies carried out by Ghani (1992), in his sample of 50 developing countries, and King and Levine (1992), in their sample of more than 100 developed and developing countries, further confirmed the conclusion that financial structure creation and economic development are interrelated.

The financial structure of an advanced economy comprises the money market and the capital market, with banks constituting the basic mechanism in these markets and hence in the financial market as a whole. Banks were the first institution to appear in the early financial framework of many countries, and have been widely regarded as vital financial institutions in the development of an economy. Examples abound as to the role of banks in the development of advanced countries. The Japanese banks, for example, played a key role in the reconstruction of commercial activities (Pauly 1988) and in the growth of the Japanese economy after World War II (Hugh 1966). Some of

the established Japanese banks have been integral parts of industrial empires (*zaibatsu* conglomerates), which have been key sectors of the economy. The German banks are credited with fostering and building up industries during the nineteenth century (Kennedy 1987). In Britain, the Bank of England directed and initiated much of the corporate restructuring of the 1930s and 1940s for better economic performance (Gentle 1993).

The evolution of the capital market is a natural phenomena in economies open to trade. This type of market is also important in supporting and stimulating commercial activities within economies like the US and some of the Western European countries which have active capital markets. Nevertheless, the banking industry remains a vitally important economic sector, with its importance stemming from its role in the credit system (Corrigan 1990). Capital market activities are generally considered to complement commercial bank financing.

McKinnon (1984) illustrated the key role of banks in economic development by an analysis of bank loanable funds (M_2/GNP index) in the rapidly growing economies of West Germany, Japan, South Korea, Taiwan and Singapore. The analysis was carried out with data at five year intervals (namely 1955; 1960; 1965; 1970; 1975 and 1980), showing that countries that have both money market and capital market, were still largely dominated by the banking system (money market). In Taiwan, Japan and South Korea, national governments opted to support the credit-based banking institutions over the more market driven capital market institutions, as the former were perceived to have a more dynamic investment-led development role and to contribute to the stability of these economies (Wade 1988).

In the case of the former socialist economies, arduous efforts are required for attaining a market-based banking system. The collapse of communism and the conversion of the former socialist economies to market economies are historical milestones that hold the close attention of the international community, and have sparked off studies and debates about these countries' performance in economic reform. Most former centrally planned economies have earmarked their domestic financial system as one of the imperatives in their economic reform agenda, to transform it to a market-based system in which interest rate and exchange rate play active roles in credit allocation. The incompatibility of the pre-reform financial system, which belongs to the past

communist regime, to a market economy is best understood from Goldsmith's (1969) summarisation of its pre-reform characteristics: inactive money market dominated by passive government-owned banks, which have a low profile in the level of economic development and which functioned according to the authoritative dictum of the State. The transition to a market economy requires the banking system to take on an independent and development-oriented role rather than a subservient one, characteristics which are vastly different from each system. To achieve this objective, consistent and committed efforts are required of all the actors in the system, especially credibility from the government (Kornai 1993; Hiemenz and Funke 1994).

Funke's (1993) review of the literature on economic reforms in the transitional economies reveals that no authors dispute the importance of the domestic financial system as being a key candidate for reform; however, there are dissenting opinions on the appropriate implementation timing or reform sequence of the financial system relative to other necessary reform areas (namely institutional reform, domestic price liberalisation, fiscal/monetary stabilisation, privatisation and trade reform). It is hard to disagree with the view of Funke (1993) and Hiemenz and Funke (1994) that financial reform is a necessary, though not a sufficient, condition for the economy's transformation; and that its optimal reform sequence is contextually dependent upon the structure of each economy, on historical factors and on the perspective of the policymakers and researchers. Nonetheless, the timing and sequence of financial system reform does not constitute a topic for discussion in this thesis. Despite the different existing opinions concerning the reform sequence, it is obvious that reform of the financial system (which is effectively the banking system for most transitional economies) is important to achieving economic progress in the newly emerging market economies.

During the communist era, the capital market had been non-existent in most countries as speculative activities were condemned as an undesirable trait of capitalism. The capital market in today's transitional economies is still rudimentary and underdeveloped. State-owned banks are still the key players in the financial structure, and are relied upon heavily by enterprises for credit (Bowles and White 1989, Calvo and Kumar 1994). A sound and efficient banking system and money market are regarded as vital to the development of the capital market and to the deepening of the

overall financial market in these economies (Corrigan 1990, Brainard 1991, Miurin and Sommariva 1993, Mendelson and Peake 1993). By international standards and as is to be expected in the early stage of the transition phase, the banking systems in these economies have a considerable distance to travel to catch up with the modern Western integrated system. The banking sector is, however, expected to remain the core intermediary within the financial framework for a relatively long period of time, in view of the shallow development of the capital markets at present.

The basic economic development role of the banks lies in their ability to function as efficient intermediaries in financial flows and their capacities in managing credit -- bringing together the lenders and the borrowers of funds, and processing fund payment and receipt safely and expeditiously (Corrigan 1990). These interrelated core functions attract substantial attention from governments in transitional economies. Calvo and Kumar (1994) pointed out that there tends to be a positive correlation between real credit and output of the economy. Their analysis shows that the banks' inexperience in credit allocation and creation, in part, accounted for the poor economic performance of the Former East European Socialist Economies.⁷ The once primitive and manual payment systems of these countries have also been known to result in substantial float⁸ locked within the financial system. This has undesirable repercussions in the management of monetary policy (Thorne 1993), for example in the form of an inflationary tendency in the economy (Balino 1994). Besides structural reforms being undertaken to integrate market mechanisms into the banking system and to eradicate the existing bottlenecks within it, information technology has been employed as a necessary tool in the attempt to instill efficiency into the system. The competitiveness of international banking and the importance of a country's banking system to the state of an open economy have made information technology an essential element rather than an optional one.

⁷ Poland, Hungary, Bulgaria, Czechoslovakia, and Romania.

⁸ Float in the payment system refers to funds in transit between banks. It reflects time delay in the transmission of payment information and in the corresponding accounting entries of the transaction.

1.3 INFORMATION TECHNOLOGY IN THE BANKING SECTOR.

The first scientific technology employed in the banking sector was in the US in the 1930s, when accounting machinery was installed and handled by staff specially trained for it (Revell 1983). During the subsequent decades, the development and application of technology in the banking sector progressed at a slow pace. Interest in the impact of information technology (or simply, data processing technology) on the banking system was low during those periods, especially within economic academic circles (Revell 1983).

Goldsmith was a pioneer in admitting banking technology into his field of research in the mid-1970s, the era that minicomputer innovations became central to banking operations (Mills and Willner 1993). Goldsmith's (1975) article, on the identification of financial structure and development indicators for international and intertemporal comparisons, included information technology as one of the factors that warranted analysis. He mentioned that the prevailing research studies on information technology at that time were relatively limited and lacked a quantitative dimension. The latter point has been a real and living issue for a long period of time, particularly in relation to the measurement of productivity. This measurement aspect of information technology still largely remains a statistical challenge, as research studies still lack a well-defined statistical or measurement grounding. Brynjolfsson (1993) has highlighted the fact that this measurement difficulty is more pronounced in services, accentuated by the fluidity of the nature of services. Brynjolfsson and Hitt's (1993) research study on the rate of return to computer investment in manufacturing and services companies shows favourable results, but the financial sector was omitted from the research sample due to difficulties in measuring sales.

Despite these and other difficulties that hinder the conclusive assessment of the impact of information technology on the financial sector, studies and observations tend to support information technology investment. In fact, it is believed that the actual productive capacity of information technology may even be larger than is portrayed by the measurement factors. Brynjolfsson's (1993) review of empirical studies on the impact of information technology in the financial industry shows that there tends to be optimism among the researchers about the returns to information technology investment, despite their inconclusive quantitative empirical evidence. This optimism

is partly justified on a priori grounds. The banking industry serves as a financial support platform to all activities within an economy, and is more information sensitive than the manufacturing sector. Vital to the efficiency of the banking system is fast, secure and reliable information flow and processing. Thus, the unprecedented performance capability of information technology in the transfer of information makes it an important mechanism within the banking system. Moreover, the global trend in banking technology applications reflects optimism for information technology investment and its growth potential.

Touche Ross's (1985) survey raised the questions about the capabilities of banks in handling information technology applications. It revealed that information technology applications in the banking sector could bring about positive returns as well as negative ones. The research survey highlighted the fact that information technology has to be managed as a resource rather than being treated as an independent self-regulating panacea that will automatically provide positive returns. This point leads to emphasis on the capability of the individual, organisation and economy in their adoption and exploitation of technology. It is supported by case studies such as those of the Indonesian banks (McKendrick 1992) and the Brazilian banks (Frischtak 1992). Local capabilities in information technology adoption, diffusion and leapfrogging have direct relevance to the contribution of information technology to banking system development and reform. The capabilities issue is considered an even more pertinent issue in the newly emerging socialist market economies, because of their need to develop an efficient banking system quickly while, at the same time, having an opportunity to reap unprecedented potential from new information technology applications. The link between these two - banking system development and leading edge technology - rests on the strength of the capabilities in adoption, diffusion and leapfrogging of the technology. Therefore, the thesis takes the course of looking at the capabilities and experience of a developing country in adopting and diffusing information technology, and in leapfrogging to higher technology.

1.4 ADOPTION OF BANKING TECHNOLOGY

The origin and adoption of information technology within the banking system has differed vastly between the industrialised economies and the former centrally planned economies. The following brief synopsis provides background to the historical process of information technology adoption in these countries, which should facilitate understanding of the different level of technological capabilities among banking system in these countries.

1.4 A) The Evolution of Banking Technology Adoption in the Developed Countries : A Brief Synopsis

The evolution of information technology applications in the banking industry started in the developed countries in the 1930s. The automation of banking operations was slow and sporadic until the mid-1970s when the process accelerated sharply with the occurrence of several technological innovations and decreases in the prices of information technology products.

The study undertaken by Touche Ross International (1985) on the impact of information technology within the banking sector in the USA, Canada, UK, France, Italy, and West Germany shows that technology adoption began at the transaction processing level ("*back office*" automation), implemented for the internal organisational workflow restructuring to manage the growing volume of paper work. Information technology applications were subsequently extended to the area of product delivery to the customers. These moves were driven by the need to reduce labour costs and minimise branch investment during the late 1970s and early 1980s (National Research Council et al. 1994). The microcomputer revolution in the succeeding phase intensified computerised banking applications. The speed of adoption within the banking industries was also exacerbated by competitive forces - aggressive competitors used information technology as a strategic weapon to gain market share. Interestingly, such competitive strategy has accidentally propelled the integration of some of the banking activities which these competitors had not anticipated at the outset. For example, the pattern of ATM (Automatic Teller Machine) deployment has shifted from proprietary networks to a unified network shared among different

competing banks. What started as competitive tools was compelled by cost reasons to become shared infrastructure. With the advent of further information technology innovations (for example, high capacity digital trunk lines and microelectronics technology innovations) and the internationalisation of banking services, the geographic coverage of domestic information systems began to extend across regional borders.

The above is a very general scenario of information technology evolution within the banking industry in the different developed countries. The forces behind the banking technology applications and development do differ in different countries, due to structural differences in their prevailing monetary systems as well as differences in government participation. However, the latter form of support does not necessarily represent the strongest force. For example, the USA and France were noted to be at the forefront of technology development during the 1980. The latter country's government has been playing an active role in encouraging technology investment within the banking system (Touche Ross International 1985, OECD 1989). The US banking sector's technological trajectory, on the other hand, emerged mainly as a result of the competing commercial banks vying for profits and of their attempts to go around government regulation and restriction (Mayne 1986).

A prominent area of information technology applications that diffused to other economic agents in the economy is the payment system. During the 1980s, there had been growing interest in national payments and settlements systems, particularly involving large value payments, within these countries. Government support and participation in the domestic information technology infrastructure to support this aspect of the banking system is common, though the degree of intervention varies among countries (Hopton 1983, OECD 1989).

Some of the technological innovations relating to payments and settlements systems in some of these developed countries are worthy of mention. Automated clearing houses (ACHs) were the first banking institutions that applied the concept of electronic linkage for payments handling. Like the New York Automated Clearing House, most of the initial "automated" systems implemented during the 1970s were highly manual, with few bank members being connected electronically to the network (Revell 1993). Since the 1980s, the vast majority of these clearing houses are electronically linked up

with their members, operating on a paperless system. The advent of information technology has also enabled same-day payment settlement within the banking system in many developed countries and some of their financial institutions have already achieved real-time gross settlement, as foreseen by the Bank for International Settlements (1994 and 1997). This ensures a sound, secure and efficient payment system for the financial markets and the economy as a whole.

The establishment of SWIFT (Society for Worldwide Interbank Financial Telecommunication), a global payment network, was a breakthrough in international linkage among the world banking communities. SWIFT originated from the fear of the European banks in the 1960s over the rampant proliferation of US banks' private international telecommunication systems (Revell 1993). The success of SWIFT in fostering an international electronic network amongst banks of different countries fundamentally demonstrated the feasibility of achieving agreement to standards and cooperation in establishing a sophisticated international banking system. With advances in technological capability, SWIFT has extended its membership to include non-bank financial institutions such as brokerage houses, central depositories and investment exchanges, as well as the smaller banking institutions who were once ignored. This has facilitated the deepening of the domestic financial market and the building of a closely interrelated network within the world banking community.

1.4 B) The Implications for the Transitional Countries (Former Socialist Countries)

Generally, electronic banking in the developing countries started at a later date than in the developed countries. However, the stage of information technology adoption varies across the different developing countries. Indonesia, for example, has been the slowest among the South East Asian nations in the implementation of banking automation. On the other hand, the former socialist countries were generally even slower than Indonesia.

The Eastern European countries and the People's Republic of China have experienced relatively active information technology adoption during the banking reform period. These countries started their path of banking reform between mid-1980s and early

1990s. During the banking reform period, there were emerging cases of banks undertaking internal adoption of information technology for their banking activities. The initial reform features of the banking system are quite similar across these countries. A sound and efficient banking system became absolutely fundamental to a market economy, and information technology has been increasingly applied in these countries' banking system for this objective. A chief feature of the technology applications is related to the payment system, which is central to the functioning of the banking system. This is because, as noted above, an efficient payment system has major implications for the economic development of a market economy and, also, because an efficient payment system requires automation of operations in the banks. Prior to their reform period (during the socialist regime), an efficient payment system was not important to the centrally planned economy, where production and the physical flow of goods between enterprises were executed under a central plan. In fact, the concept of speedy payment system had no relevance to the communist countries, until after the demise of the monobank system. Enterprises have no need for a speedy payment system as activities tend to be predictable and payment or credit granting is assured.

Miurin and Sommariva (1993), Medelson and Peake (1993), Thorne (1993), and Fleming and Cole (1995) identify the payment system as one of the vital elements to be reformed within the banking system, necessary to support the development of the market economy. Most of the transitional economies are presently modernising their payment systems and, in fact, the automatisisation or computerisation of the payment system within the economy has been a common move among these countries.

In the past, the socialist banking payment system has tended to rely heavily on postal or telegraphic services, and this has created many difficulties. On the technology adoption front, these countries were legally, during the socialist regime era, barred from participating in the technological advances occurring in the West. The restriction was imposed by NATO's special task force, COCOM (Coordinating Committee for Multilateral Export Controls), to prevent a military buildup by the socialist countries using advanced Western technology. Under this technology embargo, only the least powerful technology computers were allowed to be exported. Until 1988, the export

of an IBM 38⁹ to most of these socialist countries was considered to have infringed the export restrictions (Dembitz 1991). Besides this technology transfer restriction, which was commonly faced by these economies, the similar political ideology and structure of the economic system also obviated the need for a sophisticated and automated socialist banking system. Overall, this passive sector received relatively low priority in resources allocation for sectoral improvement during the socialist era.

Those countries, like the People Republic of China, which once heavily relied on postal and telegraphic services (Sundararajan 1990, Financial Technology Insight 1993), are presently in a position to adopt more advanced information technology, such as satellites and inter-bank network linkages for an efficient payment system. Miurin and Sommariva (1993) pointed out that the latest technologies should be employed for an efficient payment system, besides the implementation of institutional and structural changes. As late adopters of information technology, these former socialist countries are freed of the “intermediate but not yet obsolete” technology dilemma commonly faced by the Western advanced nations. In principle, the former are exposed to the opportunity of harnessing unprecedented potential from the latest information technology. This brings to the fore questions about the capability of these countries in adopting and diffusing the latest information technology and, most of all, about their capability to leapfrog to the latest information technology to achieve optimal benefits.

1.5 PAYMENT SYSTEM AND THE ECONOMY

The payment system had been taken for granted in many countries until the financial crisis in the 1970s brought into focus its importance to the stability of the financial system (Bank for International Settlements 1994) and also resulted in the increasing use of technology in this system (Hopton 1983). An efficient payment system is necessary to support efficient trading in goods and services. Because the banking system provides account services to all sectors in the economy, it plays an important

⁹ This 1960s IBM Model series has very low processing power and memory. Its general purpose is data processing systems for interactive and batch processing.

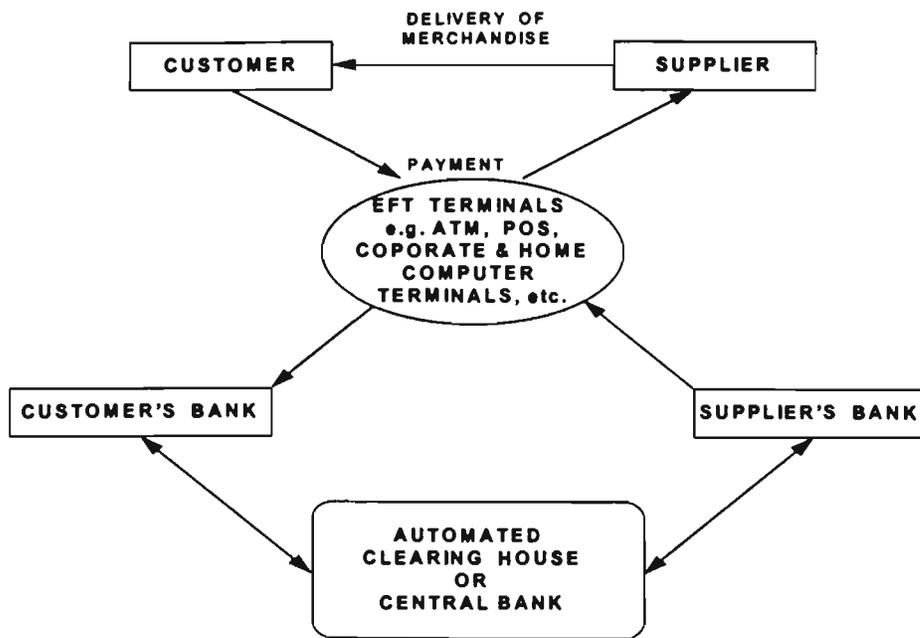
role as an intermediary in the payment system. A survey study on twenty-six developing countries undertaken by Maxwell and Gitman (1990) shows that the banking payment system is vital to their economic development. An inefficient payment system and an unsophisticated banking intermediation in the flow of funds between payer and payee, and between savers and investors, impedes an efficient banking intermediary role. System efficiency is therefore necessary to support business activities for economic growth.

To achieve an efficient payment system, information technology is a necessary tool (Morelli 1986, Folkerts-Laudau et al. 1993, Balino et al. 1994). The use of information technology to execute payment instruction provides unprecedented system efficiency features, relative to manual techniques of processing. In line with the Metcalf's Law, payment efficiency rises with the number of participants that have electronic linkage with the electronic payment system. Hence, information technology adoption and diffusion processes are important to achieving an efficient payment system.

The common technological structure of the payment system in banking services is the electronic funds transfer system (EFTS). It is comprised of an inter-bank transfer mechanism, which may be undertaken by automatic clearing houses (ACHs), automatic teller machines (ATMs) and point-of-sale (POS) systems. The types of trade transactions involved in the payment system can be distinguished as wholesale and retail, where the former involves high value funds transfer while the latter involves low value funds transfer.

The diagram in Figure 1.1 below is a simple illustration of the payment system.

Figure 1.1 - A Simple Illustration of the Payment System



Instead of the physical handling of hard cash in the transaction between the customer and supplier, payment and settlement for the goods or services is finalised through the electronic network via the terminals.

1.6 THE ROLE OF INFORMATION TECHNOLOGY IN THE PAYMENT SYSTEM

The benefits of information technology applications in the payment system to the economy are apparent in the level of speed, reliability and security that the technology can provide over and above manual processing. The material below highlights aspects of the role of information technology in the payment system and hence demonstrates some implications for the economy.

Stability. Compared to the postal and telegraphic modes of payment, information technology instils stability into the payment system by enabling rapid settlement. The antiquated mode tends to have high level of uncertainty and delay in the processing of

funds transfer for payment and settlement. This could bring liquidity risk¹⁰ to the creditor. In turn, the liquidity risk brought about by technical delay in the process of funds transfer for payment and settlement also introduce credit risk¹¹ in the economic system. A creditor, for example, may be forced by processing or transmission delay in a highly manual payment system to take out costly short-term borrowings to cover his cashflow shortage or to go on credit terms with his suppliers (thus, becoming a debtor himself). If such borrowings occurred in most transactions that took place within the economy because of the inefficient payment system, the inability of a debtor to meet outstanding obligations as they fall due may have an adverse reaction on the entire economic system. The liquidity risk generated by the inefficient payment system could cumulate to a point where so much credit is created in the business value chain relationship that a payment default by one party could cause a “domino-collapse” effect on interrelated business activities, including the banking intermediaries within the economic system (systemic risk). This also applies to the banks in the system in which a bank’s liquidity failure could push other banks to fail as a consequence of the inter-bank exposure.

When there is low confidence in the reliability of the national payment system, this will always be reflected in the transaction cost, exhibiting a high opportunity cost. National payment systems that have low integrity aggravate the low trust dynamic and, consequently, impede the growth of an economy.

Information technology provides speed in checking fund availability for payment settlement and could curb the spread of credit risk within the economic system once the system detected the liquidity risk of an economic agent. However, the extent to which risk is eradicated depends on the type of technology and processing structure employed in the payment system. For example, the ‘Real-Time Gross Settlement System’ (RTGS) payment system¹², in which payment instructions between banks are

¹⁰ Liquidity risk refers to the inability to meet outstanding obligations as they fall due, the result of a shortage of readily available funds.

¹¹ Credit risk refers to risk, faced by the creditor, of the inability of the debtor to generate enough returns to cover all expenditures and to continue running the business profitably. Credit risk can arise as a result of costly financial sourcing to discharge pressing payment obligations (Borio and Bergh 1993).

¹² Many countries are implementing RTGS payment system in their economy (Bank for International Settlements 1997).

processed and settled individually and continuously throughout the day, requires advanced electronic systems and efficient processing framework.

Financial Market Development. Float arises when there is settlement delay, which is almost an inherent feature of the highly manual payment system. It is unhealthy to the economy as a whole as it could affect the development of the money and foreign exchange markets. The presence of a huge and highly variable float will affect the banks' demand for reserves in their attempt to maintain liquidity in the banking system and also will affect the central bank's ability in monetary management. The liquidity risk could generate a vicious cycle whereby deliberate excess reserves within the banking systems are created in order to reduce this undesirable risk factor (Folkerts-Landau 1993) and which, in turn, generate further excess reserves.

The inefficient payment system could also discourage the shift from bilateral settlement arrangements to inter-bank clearings, thus impeding the active progress of the latter and aggravate the exposed position of the banks (Miurin and Sommariva 1993). The unprecedented performance capability of information technology in the transfer of information (speed) makes it capable of reducing or eliminating float in the payment system. From this angle, modernisation of the payment system using information technology is a necessity so as to reduce the float caught within the traditional payment system.

Effective Monetary Control. The paper by Balino et al. (1994) shows that the use of information technology in the payment system will facilitate monetary management in the transitional economies of Central and Eastern European Countries. An efficient payment system with low or no liquidity risk will enhance the reliability of term interest rates as indicators of the economy's financial situation, thereby enabling effective monetary control. Payment systems that are plagued with long settlement delays create uncertainties for monetary control and hinder effective pursuit of monetary policy (Thorne 1993).

In a situation of high inflation, the long settlement lag in the payment system puts the individual recipient or payee in a disadvantageous position. The inefficient system could also aggravate the inflationary state when the money base is expanded to

counterbalance the sluggish flows of fund in the payment system (Balino et al. 1994). The modern electronic payment system instituted in the developed countries shows that the settlement lag has been narrowed considerably, over the manual payment system.

Information for Informed Decision Making. Transaction payments that occur within the information technology network are more transparent than postal or telegraphic payments, as the electronic network can more readily provide an updated status on the credit and transaction settlement standing of a company (Bank for International Settlement 1994). This is important for firms in their cash management activity and for monetary authorities in ensuring stability within their national financial systems. A banking system that is cluttered with bottlenecks in its payment clearing transactions crowds out the ability of the financial intermediaries to exercise independent credit judgement, affecting risk management ability (Fleming and Cole 1995).

1.7 CONCLUSION

The revolutionary potential of information technology has led to a growing number of countries setting out to harness it for economic development. The highest vision of information technology applications, the information superhighway, is being pursued by the developed countries and most newly industrialised countries, and this suggests that they perceive the link between information technology and economic development. The GII holds out an even more impressive potential of information technology for world development.

The realisation of this 'network of networks' concept requires the adoption and diffusion of information technology within the economy, before networks could be established or further connected. Thus, the information technology adoption and diffusion process constitutes an important area for investigation.

The literature review supported the banking industry as the ideal case for the study of the information technology adoption and diffusion process, due to its importance to an

economy, its information-intensive profile, and the increasing trend in information technology applications within this industry as evidenced by the developed countries.

The cases of information technology adoption in the developed countries suggest that the banking systems in the emerging market economies, as late adopters of information technology, are exposed to the opportunity of harnessing unprecedented potential from the latest information technology. However, there is the question of their capability in the adoption, diffusion and leapfrogging of information technology.

The payment system is highlighted because of the recognised need to apply information technology in this system in the emerging market economies, for payment system efficiencies and ultimately, for banking system efficiencies. The payment system tends to provide a more explicit profile of the relevant capabilities of these economies, and also forms part of the background for analysis in the later chapters.

CHAPTER 2 : THE ADOPTION, DIFFUSION AND LEAPFROGGING OF INFORMATION TECHNOLOGY - AN AGENDA FOR RESEARCH

Literature on the adoption, diffusion and leapfrogging of information technology is reviewed in this chapter. Controversial findings from the literature are highlighted. The range of factors that are identified in the literature as having affected adoption and diffusion of this technology is presented here. The analytical framework for considering the technological leapfrogging capability of the banking industry in the People's Republic of China is also set out in this chapter. In addition, aspects of the research approach and methodology to be used in this study are outlined. A more detailed account of the approach to be used in analysing the adoption and diffusion of information technology in the Chinese banking system is provided in Chapters 9 and 10.

2.1 ADOPTION AND DIFFUSION OF INFORMATION TECHNOLOGY.

2.1 A) The Study of Diffusion. Technology adoption by individual business units is the foundation of technology diffusion, as technology diffusion refers to the spread of technology adoption. The process of diffusion of technology or innovations has been of great interest to economists since the 1960s, as this process has been associated with technological catch up and with economic progress. Earlier studies of the diffusion process, which traced the spread of manufacturing technology innovations, highlighted the importance of the diffusion process for industrial modernisation and economic performance. Examples of diffusion which have been studied include the spread of the basic oxygen furnace among steel manufacturers, the diffusion of the float glass process, of numerically controlled machine tools, of shuttleless looms in the cotton-type weaving industry, of tunnel kilns in brickmaking, of diesel locomotives, and of

continuous annealing line for tin plate (Mansfield 1961, Ray 1969 and 1988). Findlay (1978) and Lissoni and Metcalfe (1995) highlight the fact that technology diffusion has been a major factor behind economic growth in a number of countries since the 19th Century. However, it was not until 1957 that explicit economic profile was given to technology diffusion by Griliches (1957) and Mansfield (1961), who are pioneers in the study of diffusion of innovations in the economic research field.

Despite a wide body of literature on technology diffusion accumulated over the century¹, the study of information technology diffusion has received little attention until about a decade ago. Even so, initial research interest was predominantly centred on telecommunications technology infrastructure development rather than on information technology diffusion. Around the mid-1980s, information technology diffusion studies began to incorporate both computer and telecommunications technologies. But developed countries and the NICs remain the predominant subjects in information technology adoption and diffusion studies up to today. Research studies on Central Asian and East European countries have been scarce, and this is especially so in the case of the People's Republic of China. This relative absence of studies conducted on these less developed countries tend to be linked to the fact that they are 'late starters' in information technology adoption. In addition, the closed nature of China's bureaucracy impeded an earlier research effort.

2.1 B) The Lessons from the Developed Countries and the NICs. The lessons from the developed countries and the NICs provide an uncertain background for the adoption and diffusion of information technology in the technologically backward developing countries. The perspective offered by the revolutionary potential of information technology outlined in Chapter 1 provides encouraging prospects for the technologically backward developing countries, like the People's Republic of China. It indicates that if information technology is adopted and diffused, the impact on the socio-economic structure and economic performance could be enormous. The studies on the application of information technology in the NICs suggest that the application of information technology for economic progress is not confined only to developed

¹ Studies on diffusion process started in the 19th Century (Soete 1985).

countries that are in the stage of advanced industrialisation. This means that developing countries may enjoy the development potential of information technology. The reality of this prospect for the technologically backward developing countries depends on the success of the information technology adoption and diffusion process within these countries. The pattern of this process in the technologically backward developing countries constitute an important area for research because there are limitations in the application of the technology adoption and diffusion experience from the developed countries. Some of these are noted below.

i) Industrialisation. The cases of Singapore and Hong Kong (Antonelli 1991, Tan et al. 1992 and Dedrick et al. 1995) not only emphasise the importance of adoption and diffusion of information technology, but also dismiss the earlier held perception that an information society² belongs only to the advanced industrialised nations. This view is shown to be mistaken by the history of these countries as industrial latecomers, and by their recent remarkable experiences with information technology adoption and diffusion. It was once thought that the nations who are ideally positioned to take advantage of information technology are the highly industrialised nations (the U.S., Japan, and several Western European nations) where information itself has taken on a greater importance. Social scientists like Machlup (1962), Bell (1973), Porat (1977), Robinson (1986) and Schement (1990) have termed these nations 'information societies'. Though there was little consensus in their studies on the factors contributing to the development of an information society, the experience with a long phase of industrialisation was unanimously treated as a necessary condition for the adoption and diffusion of information technology. Information technology networks were taken as a form of physical capital, an attribute of an advanced industrial society. This assumption was also influenced by the earlier historical trend that information technology had been mainly used to support advanced industrial production structures; the existence of such a trend added credibility to the need for the presence of a long industrial phase to stimulate applications of information technology.

² An information society refers to a society where information has a high economic and social value, and information technological network systems develop rapidly (through adoption and diffusion process) for efficient transmission, processing and storage of information.

However, the case of the NICs like Singapore and Hong Kong, and developing countries like Egypt, suggest that industrialisation is only one of the factors affecting the adoption and diffusion of information technology (Katz 1989, APO 1990, Gilder 1995). The other key factors identified by Katz (1989) are the role of the government in stimulating an information society and in using the government sector to lead the adoption of information technology. Further evidence against this earlier perceived necessary link between industrialisation and information technology applications was the successful implementation of government policies in some of the newly industrialised countries to achieve adoption and diffusion of the technology.

ii) Theories on adoption and diffusion. While there are now some studies on the diffusion of information technology in developed countries, the body of knowledge in this area is still relatively limited. This makes inferences for the technologically backward former socialist countries like the People's Republic of China difficult. In addition, the growing body of literature on specific and generic types of technology diffusion undertaken in the industrialised nations (like Great Britain, USA, developed European countries) fails to provide a satisfactory theoretical grounding on the factors affecting capabilities of these nations in technology adoption and diffusion. The theoretical aspect has involved a long debate (Ausubel 1991, Nakicenovic and Grubler 1991), and has even been considered by researchers from diverse disciplines. Empirical data findings and analyses have not supported credible readings of regularities and predictabilities in the diffusion processes for a consistent theoretical grounding of the variables. Some economists (Gold et al 1970, Rosegger 1980, Raz et al. 1983) have even regarded the generalisation attempt as extremely difficult, if not impossible, as the range and nature of the factors are too varied and contextual based. As a result, the applicability of the range of diffusion models and theories, constructed from empirical findings, to the former socialist countries is by no means clear. Similarly, the lessons for developing countries on effective information technology adoption and diffusion drawn from the more developed countries remain broad and general. Cane's point in his summary that *"OECD nations, with their well-developed technological infrastructures, national computer and telecommunications industries and substantial resources, have failed to develop universal rules for applying IT*

successfully" (Cane 1992, p. 1721, emphasis added) suggests the need to consider each situation in terms of its contextual base. This is because there are inherent variabilities in the different types of technology and situation, so that it is insufficient to rely on a single set of theories for the study of information technology diffusion in a country. Nevertheless, the works of the researchers in the diffusion field do provide insights on the possible factors that could affect information technology adoption and diffusion, which will be considered in the country chosen as a case study in this thesis, the People's Republic of China.

2.2 LITERATURE REVIEW : FACTORS INFLUENCING THE ADOPTION AND DIFFUSION PROCESS.

As mentioned in the preceding section, various disciplines have been involved in determining the underlying dynamic mechanisms that influence technology diffusion.

2.2 A) Economic, Historical, and Sociological Approaches. The economic, historical, and sociological approaches are among some of the research disciplines that have been involved in the search for a valid theoretical perspective on the diffusion process. The review conducted on the literature revealed that two approaches predominate - an economic/historical one and a sociological one. Few authors have claimed that the selected one approach used for his/her study has entirely excluded the relevance of the other. Wang (1983) used the communication based theory (sociological approach) as only one of the important explanations to technology diffusion or transfer. Herbig and Palumbo (1994) also adopted a sociological approach, but acknowledged that there are various economic factors that might influence the diffusion process in their study of the relationship between technological innovation adoption-diffusion and culture. Rosenberg (1970), an economic historian, paid tribute to the sociological approach in his analysis methodology. Monkiewicz (1989) has made known in his first chapter the need to consider the sociological aspect

to complement his economic approach to analysis of the socialist countries. Others³ accommodate a wide spectrum of approaches that help to shed light on this inconclusive area of research.

This thesis adopts mainly economic, historical, and business perspectives in exploring and determining the factors affecting information technology adoption and diffusion in the People's Republic of China's banking industry. The historical perspective is adopted to provide "*some guidance and valuable insights*" (Rosenberg 1970, p.575) into identifying the factors that affect the capabilities. The descriptive survey of the processes under this perspective provides useful insights into the dynamics of the economic and business variables. For example, the conditions in the earlier history of the People's Republic of China have had a prolonged effect on the development and application of science and technology in the country. Sociological inputs were not fully addressed in this thesis, as this would require substantial sociological research tantamount to another thesis. Nevertheless, the sociology aspect of the workplace culture will be briefly addressed in the organisation level analysis in Chapter 9.

2.2 B) Variability in Research Findings. Despite the accommodative attitude between researchers towards each other's approaches, the factors to be identified as the prime forces in influencing technology diffusion and adoption remain matters of debate within each of the individual approaches. There are certainly many open questions, especially in the area of the economic factors at work. For example, economic returns from adopting the technology and average firm size were the main factors cited by economists as influencing the speed of diffusion at the end of 1970s (Lissoni and Metcalfe 1995). However, this was not consonant with findings from other researchers in the later decades. Similarly, Schumpeter's (1952) view that a monopolistic corporate structure is a driving factor in stimulating technological change (new technology adoption) has not been fully supported by findings from other

³ Refer to contributions at the interdisciplinary conference held in June 14-16, 1989, at the International Institute for Applied Systems Analysis in Laxenburg, Austria (as per *Technological Forecasting And Social Change*, Issue 39, 1991).

researchers (Geroski 1990, Cooke and Morgan 1994) and by empirical evidence (Cohen and Levin 1989).

In another area, Antonelli (1991) and Lamberton (1994) noted that patent data suggest that there is no correlation between domestic information technology innovation capability and the domestic capability to diffuse advanced information technology. Yet, it remains an open question as to the extent to which the existence of a local information technology industry is of relevance to effective technology adoption and diffusion (Cane 1992, Ducatel and Miles 1992).

In yet another area, foreign direct investment has been regarded in some quarters as an effective conduit in technology transfer and for technological 'catch-up' (Conroy 1986, Dunning 1988, Monkiewicz 1989, Markusen and Venables 1997). Conversely, it has also been regarded as hindrance to the process by others. Findlay (1978) noted that there are policy practitioners and researchers who hold the view that foreign direct investment retards rather than accelerates a country's technological capability. Their rationale is that the foreign firm may not be at its optimal in its 'technology transfer' contribution because its interest is governed by many other factors, such as comparative cost advantage, profit and higher returns (Vernon 1966, Detragiache 1994).

When economic analysis is directed to the issue of the diffusion of information technology in the banking field, the problem of diverse results still persists. Mansfield's (1963) findings revealed that high industry concentration slows down the speed of innovation adoption. However, this is not supported in Hannan and McDowell's (1984) study. The latter found a positive association between industry concentration and the speed of adoption in their studies on banking technologies. Ironically, when Levin (1987) used Hannan and McDowell's methodology for his case study on optical scanners technology diffusion, he found that his findings support Mansfield's stand. Escuer et al. (1991), on the other hand, tried to reconcile these different conclusions by drawing explanations from the separate findings of Reinganum (1981) and Quirmbach (1986). Escuer et al. (1991) argued that a firm's market share has a positive relationship with the speed of innovation adopted by the firm. However, if there is collusion among incumbent firms resulting in a bigger slice of market share being generated by collusion, the relationship is negative. Escuer et

al.'s argument suggests the need to consider the nature of the environment in the market place.

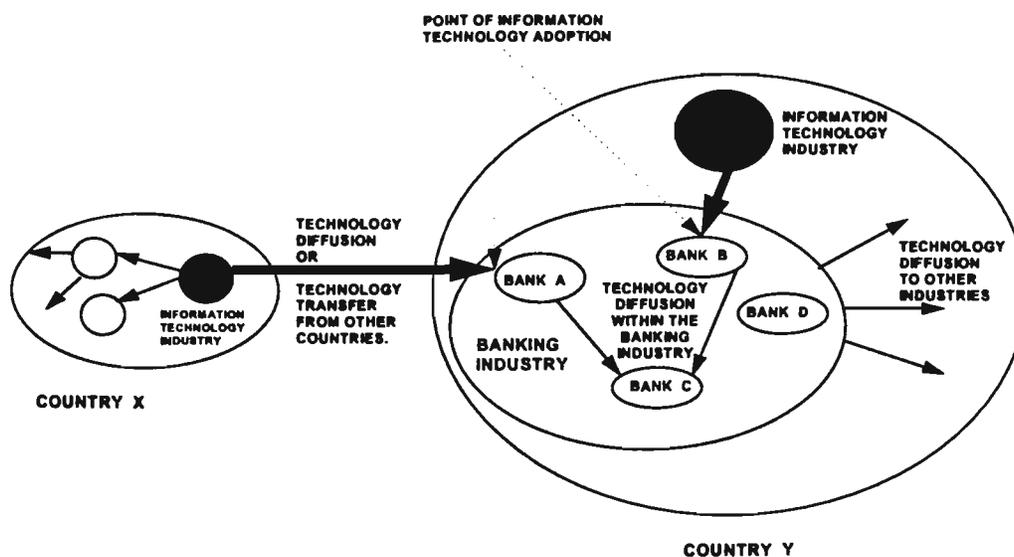
The key point, however, is that the inconsistency of the above mentioned findings does not imply that the economic approach is inappropriate. In fact, the economic approach has made a substantial contribution towards the empirical analysis of technology adoption and diffusion, since it was first initiated by Griliches (1957) and Mansfield (1961) to discover the motivation behind the speed of diffusion process (Lissoni and Metcalfe 1995). *The key point is that the variability in the findings is due to inherent country-specific differences and to differences in the adoption conditions for different technologies which are associated with different organisational and institutional set-ups. This implies that the study of technology adoption and diffusion has to be both contextually based and technology specific.*

2.2 C) Source of Information Technology Supply. One such contextually specific area that has to be taken into consideration is the supply side of the information technology adoption and diffusion process. Most theoretical and empirical studies of technology adoption and diffusion focus on the demand side of the adoption of technology (Karshenas and Stoneman 1993). The People's Republic of China has relied heavily on foreign information technology transfer and supply, as it has been weak in its local technological capability. As the world technology market is imperfect, it is necessary to take into account uncontrollable external forces that condition or restrict the amount of foreign technology entering the country. This depends on the way the technology is supplied to the country for adoption. The technological supply factors (whether they restrict or facilitate the supply of technology) will affect the adoption capability of the banking industry. The investigation of these factors has important ramifications, as high-end technology for adoption may lead to high-end technology diffusion to other sectors in the economy. There are two possible situations involving technology gaps that could arise from technology adoption through technology transfer. If a country currently employs domestically a much lower level of technology in a given industry that is available abroad, there will be a technology gap. If this country enjoys unrestrained access to

foreign technology (an extreme position for the purpose of illustrating the need to take into account of the technological supply factors), this would allow the recipient to close its technology gap through technological leapfrogging or ‘catching-up’. This country is considered to have a controllable technology gap. On the other hand, if external conditions governing technology supply prevent the closing of the technology gap. The country has an uncontrollable gap arising from the external conditions that restricts adopters to the choice of limited or perhaps, intermediate technologies for adoption. Other means will have to be sought in order to achieve optimal technological change or access to new technology for adoption. For example, it may become necessary for the domestic information technology supplying industry to build up its technological capability to achieve technological self-reliance; or it may even become imperative for the government to implement deliberate policies to encourage technology transfer in foreign direct investment. Chapter 3 provides the background to assessment of the impact of the technological supply factors on the adoption capability in the case of China.

2.2 D) Some Key Concepts: Adoption in the Banking Industry and Diffusion Both Within the Banking and to Other Sectors. This section clarifies these key concepts which are used in this thesis.

Figure 2.1 - The Adoption and Diffusion of Information Technology



The illustration above depicts a simple concept of an information technology diffusion pattern based on technology originating from two possible sources. In the illustration, the information technology that is adopted by the banks each come either from overseas or from the domestic information technology industry where it was developed. The diagram shows that the new information technology from Country X's advanced information technology industry was adopted by Bank A in Country Y. Alternatively, the new information technology invented in Country Y's domestic information technology industry was adopted by Bank B in the same country.

The first situation illustrated is common with technologically backward countries, where their indigenous information technology capabilities are weak and they have to rely on the overseas industry for the transfer of new information technology. The transfer of information technology from innovating Country X to Bank A in Country Y might be effected through one of the various technology transfer modes (example, technology embodied capital goods import, technology licensing contracts, foreign study or training, foreign direct investment, world trade participation). Subsequently, the adopted technology might be diffused to other banks within the banking industry or to other industries within the economy.

The second illustrated situation, where new information technology is supplied by the domestic industry, might occur in the technologically backward countries when technology assimilation capability had been successfully established in their domestic information technology industry. In most of the technological backward countries, they tend to rely on overseas industry for the transfer of new information technology (first situation) before technology assimilation capability is established in their domestic information technology industry (second situation). When the domestic information technology industry is capable of technological innovations, the technology adoption and diffusion process would not likely be subjected to external supply forces that are beyond the control of the applying industry or country. Chapter 3 provides the background for identifying the situation in the People's Republic of China's information technology industry. In addition, it explores whether a strong innovating domestic information technology industry is pre-requisite to the effective adoption and diffusion of information technology in the banking industry in the technologically backward countries.

2.2 E) Factors Influencing the Technology Adoption and Diffusion Process

The analysis above has highlighted the value of the economic approach to information technology adoption and diffusion, while stressing the need to take account of both country-specific and technology specific differences in these processes. The table below reflects the various salient factors identified in the economic literature review:

Table 2.1 - Factors Influencing Adoption and Diffusion of Information Technology

Factors	Reference*
Macro level :	
Infrastructure	Antonelli 1991, Meissner 1988.
Path-dependence	Rosenberg 1970, David 1985.
Indigenous Capability	Meissner 1988, Dahlman 1994.
Resources Availability	Tilton 1991, Ayres & Ezekoye 1991, Dahlman 1994, Lynn 1981.
Institutional Arrangements	Arrow 1962, Rosenberg 1970, Cane 1992.
Government Intervention	Geroski 1990, Peirce 1991
Industry level :	
Market Structure/Firm Size/Market Size	Fisher and Pry 1971, Tilton 1971, Findlay 1978, Chen 1983, Rosegger 1991, Dunning 1988, Ozawa 1980, Kelley & Brook 1991, Stobaugh 1988, Malecki & Nijkamp 1991, Karshenas & Stoneman 1993, Mansfield 1963, Davies 1979, Stoneman and Kwon 1996, Hannan & McDowell 1984 & 1986, Levin et al. 1987, Escuer et al. 1991.
Investment Climate	Vernon 1966, Stobaugh 1988, Malecki & Nijkamp 1991.
Network Externalities/Learning <ul style="list-style-type: none"> • Inter-industrial linkages/producer user interactions, • Supply and demand of technology. 	Katz and Shapiro 1985, David 1985, David and Bunn 1988, Kelley & Brook 1991, Simon 1982, Silverberg 1991, Kamann & Nijkamp 1991, Ducatel & Miles 1992, Nabseth & Ray 1974, Lundvall 1988, Von Hippel 1988, Rosenberg 1970, Mansfield 1968. Monkiewicz 1989, Stobaugh 1988. Antonelli 1991, Lamberton 1994.
Organisation level :	
Profitability	Hsia 1973, Teece 1976, Mansfield 1961, Antonelli 1991, Stoneman and Kwon 1996.
Wages	Stoneman 1983, Nabseth & Ray 1974.
Technical competence	Kelley & Brooks 1991.
Technologically aligned structure	Perrow 1970, Woodward 1965.

*Some of the authors have identified more factors than the one with which their names are associated in this table.

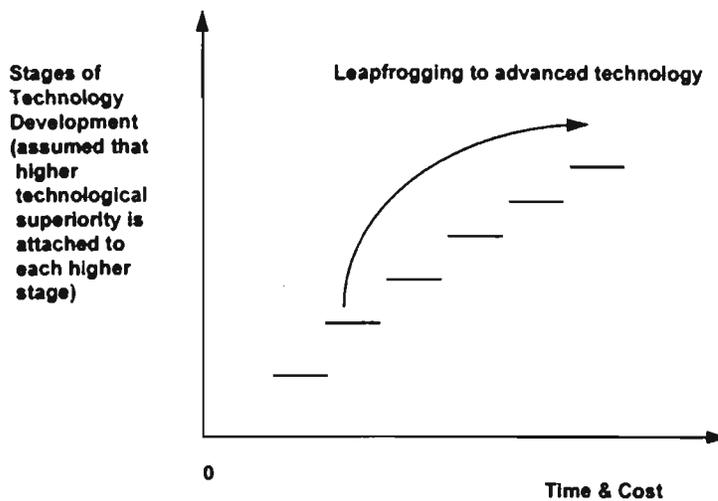
The literature review has uncovered a wide range of possible factors influencing the technology adoption and diffusion process. These factors derived from the literature review provide the base for constructing the analysis framework in Chapters 9 and 10. The analysis of the factors that influence information technology adoption is undertaken at the organisational level in Chapter 9, in which models and theories are further reviewed and developed based on the identified organisation factors in this chapter. The capability of the Chinese banking industry as an agent in information technology diffusion is analysed Chapter 10, based on the interplay of all the factors.

2.3 TECHNOLOGICAL LEAPFROGGING

Another related and even less explored area of research is the possibility of technological leapfrogging by developing countries such as China. Technological leapfrogging means adopting advanced technology immediately rather than proceeding by mastering intermediate technologies in turn. This concept suggests an interesting possibility for developing countries which are still using traditional or backward technology.

The diagram below illustrates the concept of technological leapfrogging, in which a technological backward country skips intermediate technologies and goes straight to the latest state-of-the-art technology.

Figure 2.2 - Technological Leapfrogging



Because the technologically backward country has been inactive in the adoption of each newly emerged intermediate level of technology, it has the option of adopting either intermediate technology or latest 'state-of-the-art' technology (technological leapfrogging) in its late decision to invest in technology for production. According to the World Bank and the Asian Productivity Organisation (Hana et al. 1995 and APO 1990), information technology provides developing countries with the opportunity to accelerate economic development. The advent of this technology to each higher stage level is commonly associated with greater technological capability potential. Adopting the latest 'state-of-the-art' technology would mean that this once technologically backward country is exposed to the unprecedented opportunities offer by the new technology. These unprecedented technological opportunities were not readily accessible to the advanced countries without incurring high (intermediate technology) displacement costs in these countries, due to their pervasive intermediate technology structure (Soete 1985, Antonelli 1991, Brezis et al. 1993). Thus, the late adopter in technology may be able to avoid incurring the time delays and the costs that were incurred by the advanced countries in their active adoption of each newly emerged intermediate level of technology. The possibility of achieving significant economic growth through leapfrogging to advanced information technology thus

seems exceptionally attractive to developing countries. However, views differ on the ability of these countries to take advantage of this technological leapfrogging concept.

2.3 A) Literature Review. Research studies (Mody and Sherman 1990, Antonelli 1991, Mody and Dahlman 1992, Lamberton 1994) noted that technological leapfrogging in the telecommunication and computing infrastructure is technically feasible in terms of physical facilities in the developing countries. However, what has remained elusive in this concept is the capability of the developing countries to harness fully the technological potential offered by the radical new technology for economic advantage. Research works in this area are scarce, hindered by limited availability of empirical data from the developing countries and the relatively recent emergence of advanced information technology. It has been argued that empirical case studies on the capability of developing countries in technological leapfrogging are badly needed to answer the crucial question about whether the advantages of technological leapfrogging are within the reach of these countries (Ausubel 1991). According to Sharif (1989), massive resources and a long time span will be involved in gathering reliable data from the Asian developing countries in search of the answer to this question.

The available research studies on technological leapfrogging tend to focus on industrial technology. Nevertheless, they provide some tenuous insights into the analysis of technological leapfrogging in information technology. This thesis serves as an initial effort to contribute to this relatively new field of study of technological leapfrogging in information technology.

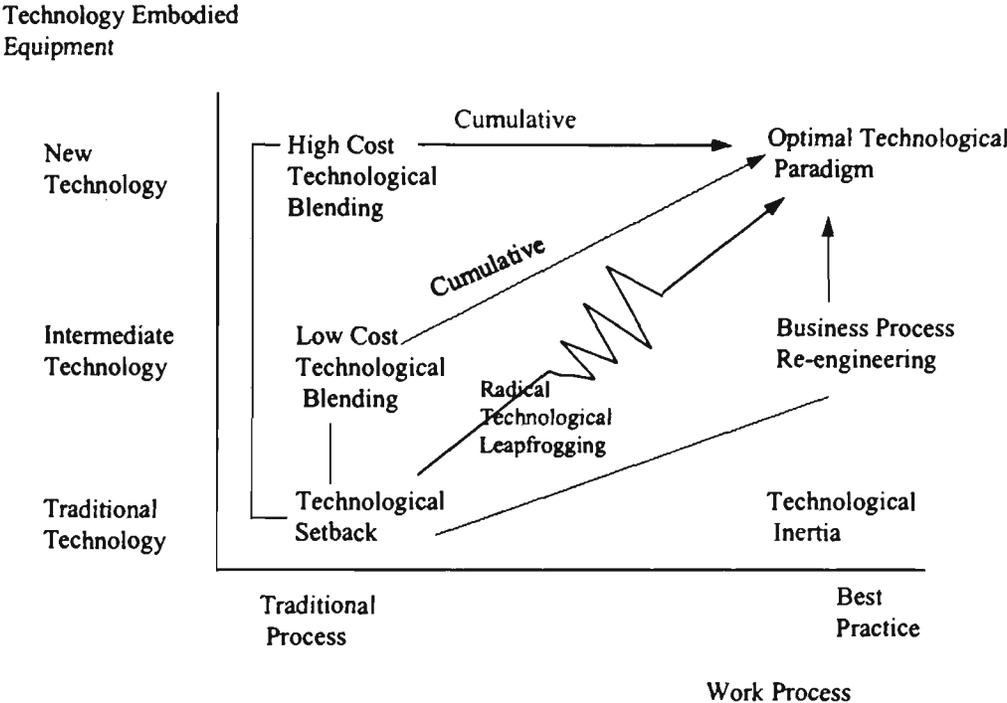
The technological leapfrogging concept was first established by Soete (1985), from his observation of the microelectronic industry which allowed rapid industrialisation within the adopting countries. The concept has received recognition of its bearing on information technology applications in the developing countries since the early 1990s (Antonelli 1992, Mody and Dahlman 1992, Lamberton 1994). However, there is limited evidence to determine the actual occurrence of technological leapfrogging in the developing countries involving this new technology.

There are particular features of the information technology developments taking place in the past decade which seem to increase the relevance of this concept to the developing countries. Firstly, the rapid decline in the prices of microelectronics has made information technology applications affordable to the developing countries. Secondly, the favourable implications of advanced information technology to an economy (as mentioned earlier), does not present intermediate technology as the appropriate choice for adoption. Why should a developing countries commit themselves to intermediate technology while the more advanced countries are pursuing a sophisticated national information infrastructure (information superhighway), even with a foresight of a global dimension (Global Information Infrastructure)? Thirdly, recent trends in information technology places less demand on knowledge and experience accumulation, emphasising ease of use. To illustrate this point, advances in information technology have involved increasing stress on 'user-friendly' applications which can be readily accessed by users with little technical skill. Therefore, considering the above points, if a developing country's information technology usage paradigm does not already involve intermediate technology, technological leapfrogging should turn out to be an ideal choice.

The relevance of the technological leapfrogging concept still remains unresolved for developing countries. There are opponents who doubt the ability of the developing countries to take advantage of information technology leapfrogging (as found by Hana et al. 1995). Those who oppose the idea of technological leapfrogging in information technology could make use of two perspectives drawn from technological leapfrogging in generic technology. One is that leapfrogging runs in contradiction to the accumulative nature of the learning process (Pavitt 1984, Hobday 1994); the other is that new technology has a strong tendency to undermine the social structure, and to dismantle the existing stock of human and physical resources (ILO 1985a & b, Wang 1991). In other words, an 'unprepared' (lack of prior knowledge and experience) economy or society would not be able to cope with the new technological paradigm nor to exploit the economic potential it offers (Jian 1995).

2.3 B) The Grid. The intent of the thesis in this area is to consider the value of technological leapfrogging from the characteristics of advanced technology and intermediate technology, and to determine the technological leapfrogging capability of the banking industry by tracing its technological path and through analysis based on using the grid below. This grid is constructed based on insights gained from literature on both the generic technology and specific information technology. To evaluate the technological leapfrogging capability of the Chinese banks in the People’s Republic of China, it is examined from the perspective of technology embodied equipment being adopted (y-axis) and the work process (x-axis) that complements or exploits the adopted equipment, as represented in the grid below.

Figure 2.3 - Technological Leapfrogging Grid



i) High Cost Technological Blending. This term is adapted from the definition of ‘technological blending’ used by the International Labour Organisation (1985a), which encouraged developing countries to integrate newly emerged production technologies with traditional modes of work process. The purpose is to achieve higher productivity with minimal social disruption. This technology strategy requires the undertaking of substantial investment costs in acquiring new technology equipment

and in transforming resources, as well as the bearing of costs related to equipment underutilisation. This might result in a 'technological white elephant' instead of higher productivity, if the advanced technology is taken on without a clear long term strategy to build the capability of personnel and institutions to harness the technological potential. This was evident in the People's Republic of China during the 1970s, when advanced production technology was imported for the sake of modernisation, but without appropriate support structures.

ii) Low Cost Technological Blending. This is a situation where the developing country adopts appropriate or intermediate technology⁴ to suit the specific internal conditions or domestic environment. This involves lower investment costs and imposes less demand on the transformation of local resources. Unless the rationale of such investment is to allow for a cumulative learning process to occur at an appropriate pace, and there is a plan to embark on a higher level of technology in the near future, the country will be destined to lag behind the technological frontier. In addition, this rationale also has to be endorsed with a strong commitment to bear the substantial replacement costs which will be involved when discarding the intermediate technology for the next newly emerged technology. Otherwise, the technologically backward country may remain in its original backward position, or find itself stuck in a specialised subordinate role to the perpetually dominating advanced nations.

iii) Technological Setback refers to the situation where internal factors and conditions are not favourable to science and technology development in the country. For example, the cultural revolution era in the history of the People's Republic of China has adversely hindered technological progress in the economy.

iv) Technological Inertia. This is an extreme situation where obsolete technology remains in use or a fully manual process remains in existence, and where improvement in the work process is non-technological based. The 'autarky' situation during the

⁴ The intermediate technology approach was popularised in the 1970s by British economist E. F. Schumacher (1973), who advocates the view that technological leapfrogging will inflict misery on the population in the developing countries.

Great Leap Forward period in China's pre-reform era relates to such situation, where the opportunity for foreign technology access is highly limited and the 'self-reliant' technological capability of the country is weak. To overcome the technology supply shortfall, the then leader Mao Zedong attempted to enhance the productivity of the other factors of production or of work activities. It was during this period that the substitutability of labour for capital and labour's capability in technology exploitation were encouraged in massive propaganda campaigns.

v) **Business Process Re-engineering** involves a combination of intermediate technology and redesigned human tasks and business processes. This tends to occur in advanced countries which they are committed to a structure of intermediate technology and do not see the economic advantage in replacing it with the latest technology. This approach involves studying the impact of the committed technology and sought to identify ways to further exploit this technology as a tool for enhancing productivity and benefits. Since 1990, developed countries, like Australia and the USA, are increasingly undertaking this approach to ensure existing information technology potential is effectively harnessed (Banaghan 1996).

vi) **Optimal Technological Paradigm** refers to the situation where the entity is well positioned in all aspects to fully exploit the potential of the latest state-of-the-art technology. The movement from 'technological setback' position to 'optimal technological paradigm' represents the paradigm of a successful attempt at technological leapfrogging.

Chapter 11 undertakes a brief examination of the technological leapfrogging capability of the banking industry in China in relation to information technology, using this grid as a structure for analysis.

2.4 ASPECTS OF RESEARCH METHODOLOGY

In pursuing the research agenda outlined above, the theoretical and empirical constraints on the task must be kept firmly in mind. Information technology is quite

new, and still developing very rapidly. There is no settled theoretical position about technology adoption and diffusion, and it is clear that the specifics of technologies, countries and firms matter a great deal. Furthermore, the situation of China is in some ways unique and reliable data is difficult to obtain. This section notes in particular the information and data sources on which the study relies.

2.4 A) Timeframe.

The timeframe for the thesis analysis is between 1949 to 1995, separated into the pre-reform period (from 1949 to 1978) and reform period (from 1979 to 1995). Information and data availability from the People's Republic of China incorporates a time lag due to the undeveloped and relatively closed information system in the country. In many cases, data pertaining to the year 1995 has only recently become available. Hence, the closing period of the time scope is 1995 (end of the Eighth Five-Year-Plan period). Nevertheless, development of events in the early Ninth Five-Year-Plan period (that is, 1996 and 1997) are quoted where possible and where relevant, to provide insights into likely future trends and to serve as a reflection on the impact of policies implemented in the earlier period.

2.4 B) Sources of Information and Data.

In the field of information technology research, the developing countries and emerging market economies constitute new and underexplored areas of study. There is a need for more research work on technology "adoption/diffusion/catchup" in developing countries like the People's Republic of China. Study of these countries would help to deepen the insight gained from existing studies, which have been largely focused on the developed countries. However, many developing countries tend to provide a common research obstacle to researchers - difficulty of deriving data due to these countries closed bureaucracy, information conservativeness or unfamiliarity with the value of research work.

The opportunity to provide fully (or extensively) quantitative documented cases on the People's Republic of China is still highly limited. It will be a long time before

researchers enjoy a level of quantitative information access or availability in China comparable to that in developed countries such as the United States, Sweden and United Kingdom. Attempts to understand the processes of information technology adoption and diffusion must be initiated despite formidable obstacles. The thesis aims to contribute to filling the gap in the literature, and the case study is constructed by employing disparate sources of information and varied research methodologies. To overcome difficulties in obtaining complete data from a direct source and to ensure fuller answers, this study uses both quantitative and qualitative methods of survey and interview, and both primary and secondary information gathering exercises. In cases where there are inconsistencies in data and reports, clarifications were sought from individuals, in both China and Australia, who are knowledgeable in the area.

Although a wide range of publications have been relied upon for information and data on the information technology movement in the Chinese economy and banking system, the majority of them are local Chinese sources. All formal sources are identified in the thesis. Some of the main sources of information and data used are as follows :

1. Published sources.

1.a) Official data sources :

- China Statistical Yearbook, compiled by the State Statistical Bureau in the People's Republic of China,
- Almanac of China's Finance and Banking, compiled by the China's Finance Association,
- China Financial Outlook, compiled by the country's central bank, the People's Bank of China,
- Reports published by the Chinese banks.

1.b) Newspapers :

- China's local daily financial newspaper, Jinrongshibao, which is co-organised and co-managed by the dominant market players in the Chinese financial system. They are also banks with government ownership - People's Bank of China, Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China, China

Construction Bank, CITIC Industrial Bank, Bank of Communications, People's Insurance Company of China. This paper reports on the development of the financial system and is considered to be the most detailed reporting source on information technology changes within the financial system during the reform period. This paper is published in Chinese.

- Other newspapers, like China Daily and Economic Daily, were also used to substantiate information and data gathered from Jinrongshibao.

1.c) Periodicals/Journals/Magazines :

- Guangdong Financial Computer,
- Computer and Credit Card,
- Financial Computer of China,
- China's Financial Computer Reporter.

The publication of these periodicals was initiated at the introduction of the Golden Card Project (that is, after 1993). They feature articles relating to the information technology movement within the state-owned banking system, written by staff from the various state-owned bank branches at different levels. These sources are especially useful for providing insights into information technology adoption and diffusion processes at the individual banking branch level and at the overall banking corporation level. The authenticity of this source is reflected in the presence of the banking authorities on the advisory and editorial boards. The above periodicals are also published in Chinese.

1.d) Others :

Other materials published in the People's Republic of China and overseas countries were also used.

2. Unpublished source (from the People's Republic of China).

Information and data secured through unpublished source were normally in the form of informal research papers, discussion papers prepared by the interviewees for the survey interview, or forthcoming publications. The relevant articles were acknowledged according to the references obtained from the respective sources.

3. Survey/Interview.

Separate surveys were conducted on the different banking units and information technology related units, to derive information for the thesis analysis.

3.a) Foreign Banks.

The structured survey was conducted on 66 foreign banks based in Beijing through telephone interview in October and November 1994, to determine their potential as agents of technology transfer to the banking industry in China. The survey was mainly conducted in Beijing because it holds the most number of foreign representative banking offices and main regional offices in charge of all outlets in China. The interviewees from this city tend to have the knowledge about the technology adoption level and plan for the overall business operation in the Chinese economy. In addition to the structured survey, some of the foreign banks (based in Beijing and Shanghai) were approached for an in depth interview to gain further understanding into this area of interest. The research showed that there was little opportunity for the domestic economy to tap foreign expertise in the area of banking technology from the fully-funded foreign enterprises operating in China.

3.b) State-owned Banks.

Structured and unstructured surveys were conducted on 25 respondents from the state-owned banks located in Beijing and Shanghai in October and November 1994, to determine the level of information technology adoption and diffusion within the Chinese banking system. In addition, factors influencing these processes were also tracked from the responses. The information gathered was further substantiated from reports of independent research study undertaken by the bank and published articles from the bank staff.

4. Miscellaneous

The path in gathering information and data from the Chinese banks and related entities, for establishing this thesis, was an arduous one. Most of the interviewees were reluctant to render information and opinions when first approached by the author. Considerable effort, patience and time have to be expended to establish a sufficient degree of trust and rapport with them before a structured interview could be

completed. Even when strong rapport is established, interviewees tend to request anonymity and were only willing to respond to the survey when confidentiality is assured.

Though specific quantification of certain situations has been obtained, the variables involved were such that the data lacked sufficient degrees of freedom and consistency for the use of statistical tests. The following materials were relied to provide a fuller base for the thesis:

- Discussions were conducted with researchers, authorities and commercial operators in the information technology field.
- Attendance at conferences and seminars presented by experts in this area.
- Surveys conducted on the banking system by other sources.

Thus, the study is based on the wide range of different sources of types of information. While the supply of data is far from optimal, it is nevertheless believed to be adequate to construct a reasonable account of the information technology adoption and diffusion process within banking industry in China.

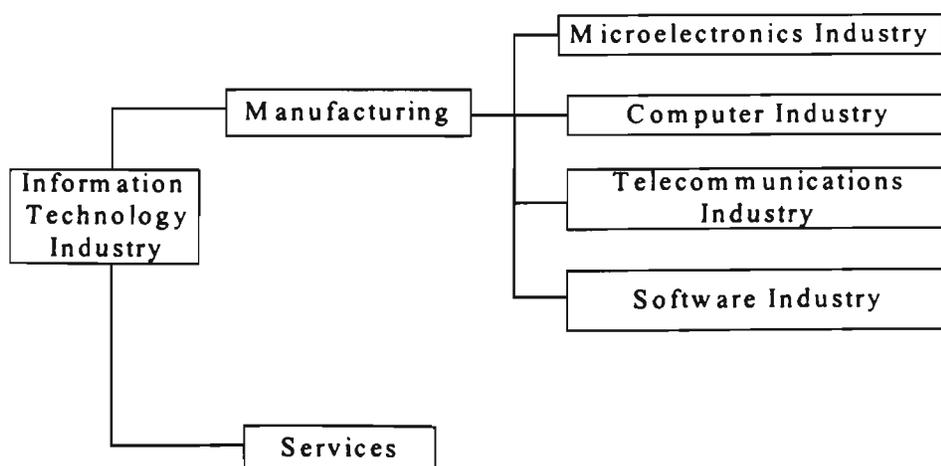
PART TWO

**THE CHINESE INFORMATION TECHNOLOGY AND
BANKING INDUSTRIES IN HISTORICAL
PERSPECTIVE**

CHAPTER 3 : CHINA'S INFORMATION TECHNOLOGY INDUSTRY.

This chapter considers the development of China's information technology industry in two separate time phases: the pre-reform period of 1950 to 1978 and the post-reform period of 1979 to 1990s. It aims to provide an interpretative background that is deemed relevant for understanding the ability of the banking industry in information technology adoption, diffusion, and leapfrogging. The development of the information technology industry is reviewed, firstly, in respect of the electronics industry development (sections 3.1 and 3.2). The electronics industry covers a wide range of products, some of which may not be used in the production of information technology equipment. For example, it covers low-end microelectronic components suitable for use in the manufacturing of household appliances. However, the electronics industry also produces components and parts that are relevant to the information technology industry. Sections 3.1 and 3.2 offer a general insight into the Chinese technological capability and the policies of the electronics industry because this industry has relevance to the foundation of information technology. The development of the information technology is further reviewed on a more specific basis in section 3.3, in respect of the development of its other manufacturing and its service segments (as per the diagram below).

Figure 3.1 - Information Technology Industry Segments



The performance of specific manufacturing segments such as the microelectronics industry, the computer industry, the telecommunications industry, and the software industry, and the status of the service segment are examined to provide further insights into the ability of the Chinese industry to support the adoption of information technology in China. Salient variables that affected the development of these segments are highlighted in this chapter.

3.1 THE TECHNOLOGICAL PATH OF THE ELECTRONICS INDUSTRY

3.1 A) Period : 1950 to 1978.

China was largely an agrarian economy when the Communist Party took over the nation and formed the People's Republic of China in 1949, after the civil war. At that time, more than 90% of its population was living in the rural areas and industrial production activity was limited within the economy (Zhou, 1982). The economy started its phase of industrialisation with the top economic priority being given to the development of the heavy industry sector (Hsueh and Woo 1986).

Like many light industrial industries, the Chinese electronics industry had to start almost from scratch on its own. The electronics industry output in 1949 was 4,950,000 yuan in value, which was 0.05% of the total nation's industrial output. The 4,106 workers employed in this industry were involved with low-end technology production. It was in 1956 that this industry was accorded national importance, as it was associated with the pursuit of military supremacy and industrial modernisation. Between these two goals, the political intent outweighed the economic pursuit and, as a result, the military sector was given high priority in resource allocation and in research work relative to the civilian sector during the pre-reform period.

During the early pre-reform period, China developed a close alliance with its Russian counterpart, on whom the Chinese relied heavily in the rebuilding of the economy. The Chinese economy was modelled after the Soviet's centrally-planned economic system, in the hope of emulating the latter's economic achievements, especially the Soviet's heavy industrial path of economic development. The period 1953-1957 (duration of the First Five-Year Plan) is considered to be the period of close

association¹ between China and Russia, during which time China imported Soviet plants and equipment and received comprehensive technology transfer and training from Russia. In 1956, a twelve-year plan was drawn up, with assistance from the Soviet Academy of Science, to guide science and technology development. China's ultimate aim in pursuing this plan was to achieve technological parity with the advanced nations. The Chinese strategy of exclusive and heavy reliance on Soviet aid and experience in the civilian sector was mainly directed towards the heavy industries. The assistance received in the electronics field was focused on the military sector. Although the development of civilian technological capability for light industry was encouraged in the Great Leap Forward (1958 to 1960) period, when Mao Zedong implemented his overtly ambitious vision to achieve dramatic increases in industry output through mass mobilisation of labour, this was not realised. The Great Leap Forward movement² has been criticised as an inappropriate strategic approach to economic development (Prybyla 1978; Breth 1988), one that was implemented with a weak fundamental knowledge base and also aggravated by untimely weather conditions.

The relationship between the two Sino-Soviet communist allies broke down in the early 1960s, due to many factors³, and this resulted in the withdrawal of aid and assistance by the Soviet Union. The Soviet-Sino rift had considerable impact on the technological progress in the Chinese electronics industry and also left the Chinese with a low level of trust towards foreign support in technology development. During the period of retrenchment (1960-1965), China decided to be self-reliant in its scientific and technological capabilities after their experience with the heavy reliance on Soviet support. Although the Chinese attempted to develop a strong domestic manufacturing capability in electronics, through the assimilation of advanced technology imported from the non-Communist countries (Japan and Western Europe),

¹ This close association was the result of several factors: leader Mao Zedong's strong belief that the Soviet structure represented the universal model (Schwartz 1973); there seem to be an urgent need to short-cut the path of economic rehabilitation to growth (Hughes and Luard 1962); and the then aloof international environment surrounding China, at that time, forced it to adopt such strategy (Ness and Raichur, 1989).

² It was a costly and fruitless attempt, with monetary damage amounting to a loss of \$32 billion (Hamrin 1990).

³ One of the major issues in tussle was related to the applicability of the Soviet model for the Chinese economy (Hughes and Luard 1962, Donnithorne 1972, Hamrin 1990).

they were not successful. This attempt was impaired by many factors, among which import restrictions by international organisations such as the Coordinating Committee for Multilateral Export Control (COCOM) were very important. Other factors were an acute lack of foreign exchange, lack of financial assistance from other countries, and lack of an appropriate fundamental structure for proper technological capability development (Heyman 1975, Orleans 1982, Hsu 1983, Conroy 1986 and Ikegami 1986).

During the Cultural Revolution (1966 to 1976), when almost all industries were disrupted, the electronics manufacturing industry continued to be given high priority due to its important role as a supplier to military production. Comparatively, it suffered less disruption than other civilian industries in the economy (Reichers 1972). Despite these, the electronics manufacturing industry still lagged behind the world standard during the 1950 to 1978 period. Within the industry itself, there was unequal progress in electronic innovations and production in the military and civilian sectors. Though relatively significant technological progress was achieved within the military sector (Jinrongshibao 8/10/1991), the benefits did not diffuse to the civilian sector due to the absence of value chain linkage relationships between the sectors.

The impact of the Cultural Revolution largely stifled the establishment of a technological development path as well as overall economic performance. Its effect on the technological capability of the electronics industry was similar to that on the general process of knowledge creation and accumulation within the country. This historical event is considered by many researchers (Esposito 1972, Berberet 1972, Barnett 1977, Zhou and Zhang 1982, Conroy 1981) to have set the clock backward for Chinese technological development. The basic precepts underlying the movement weakened the indigenous capability and infrastructural development of the economy, factors that were fundamental to the country's economic and technological progress. This event caused a long period of discontinuity in the supply of trained talent and skilled personnel to sustain future economic progress. Radical ideologies were given national priority (Edwards and Sun 1988; Minami 1994) over research/scientific and intellectual activities which were classified as "counter-revolutionary". The xenophobic stance adopted by the country during the height of the revolution (1966-1968) cut the economy off from many foreign activities and associations.

Technological development in the civilian sector, during this traumatic period, almost came to a standstill in the “autarky” economy (Robinson 1987). These factors accounted in good part for the economy’s lagged performance as compared to the neighbouring East Asia economies (Fukasaku 1994).

Although the Cultural Revolution era came to an end in 1976, the internal political tensions within the Chinese bureaucratic system continued to disrupt the technological path of development in 1977 and 1978.

Summary:

During the pre-reform period, the general technological capability within Chinese industry was low, despite intermittent signs of reasonable scientific progress in times of relative stability (Oksenberg 1973, Simon and Goldman 1989). The progress of the electronics industry occurred mainly in the military sector rather than in the civilian sector. Although there was technological progress in the military sector (Berberet 1972), it did not benefit the civilian sector because there was little diffusion of military technology to the civilian sector. On the whole, the history of Chinese technology development prior to 1978 reflects an uneven process of knowledge accumulation and restricted learning opportunities. This was mainly due to the political movements and the economic systems prevailing at that period. The political factor was the most powerful disruptive element that affected the economic inputs into and within the economy, and also bred the sociological attitude of ethnocentrism against learning from foreign sources (during the Cultural Revolution era). The political precepts underlying this period not only disrupted but, in certain times, isolated China from the mainstream of scientific and technological knowledge in many areas. These affected the development of the indigenous technology capability in this period. A further hindrance to the domestic technological development was the low level of research and development support within the civilian production enterprises for innovation generation and development. This also prevented these enterprises from establishing an adequate knowledge base to move to a level of technology advancement in electronics. Technological capability in the electronics industry was generally backward (State Science Commission and Beijing Science Research Centre 1988). The labour force in the civilian electronics sector lacked a

strong capability to assimilate new technology and was unable to integrate the imported technology into existing facilities, nor to innovate in relation to the imported technology.

3.1 B) Period : 1979 to 1995.

Although the modernisation strategy was formally implemented in 1976 by Hua Guofeng, the actual phase of modernisation in China only began from the year 1979 after Deng Xiaoping gained total power (Wang 1984). When the Deng leadership came into effect in late 1978, poverty, technological backwardness and economic inefficiency were issues of concern. Linked to these problems was the fact that the economic system was still plagued with residual inflexibilities from the past policies and events (Lieberthal 1991; Zita 1991). Rapid technology absorption was made difficult within the civilian economy by the old cultural and political attitudes, the skilled manpower shortage, institutional rigidities and the shortcomings of planning and managerial systems in the country.

Deng and his colleagues began to experiment and to introduce reforms to build a national structure that reduced the economic distortion and inefficiency associated with the old command model system. Some of the prominent economic events were the introduction of decentralised economic planning in 1979, for the purpose of achieving greater regional performance, and the decision in 1984 to move towards a socialist market economy that aligns production of goods and commodities with market forces. Despite immobility experienced in certain areas of reform, it has been claimed that the Deng leadership has brought the economy out of its economic and cultural 'strait-jacket' as demonstrated by the profound achievements in its overall economic performance. Deng's approach seemed to be driven more by factors related to economic development than political criteria, which was a great contrast to the emphasis in the pre-reform period. The reforms led by Deng enjoyed wide popular support as the economy grew at an increasing rate. Impressive results were registered in the many areas, for example in food production and exports, and foreign investment totalled to US\$24 billion during 1983 to 1987 (White 1993).

In the reform period, Deng's strong emphasis on the role of science and technology capability in economic development was reflected in many major speeches and policies. At a speech given at a science conference on 18th March 1978, Deng emphasised that science and technology constitute the linchpin of success of the "Four Modernisations" program. He reaffirmed his stand in his subsequent speeches on 7th March 1985, 18th October 1986, in early September and in 1992 (Economic Daily 23/10/1995). Even when the country was experiencing foreign exchange problems in 1986 and 1987, his stand for science and technology capability development prevailed (Simon 1989). In May 1995, the Central Committee and State Council, under the leadership of Deng, gave the highest profile to science and technology as the first production force for economic and societal development, and called for the acceleration of science and technology (Jinrongshibao 22/5/1995).

3.2 POLICIES IN TECHNOLOGICAL CAPABILITY DEVELOPMENT IN THE REFORM PERIOD

Policies in developing the electronic industry were also established in line with the national strategy as evident by the following events:

- In 1978, the electronics industry was among the priority industries scheduled for reform. A considerable length of time (1978 to 1984) was taken by the central government in planning reform for the electronics industry, to determine its industrial scope and path of transformation into an active market-oriented sector (Original Ministry of Electronics 1988).
- During the early 1980s, an attempt was made to break the unproductive barrier between the military and civilian sectors for efficient diffusion of electronics manufacturing capability. The military sector was directed to assist the development of the civilian electronics sector, the specific electronics segment involved in receiving such assistance being the consumer electronics sector (Simon 1989).
- In October 1984, the Third Plenum of the Twelfth Congress of the Chinese Communist Party decided that two main streams of reform should take place in the electronics industry: decentralisation of the state-owned electronics enterprises, and

transformation of electronics enterprises from state-control management structures to market-oriented business management structures. This was to transform production based state-owned enterprises to a market driven structure.

- In 1986, the Ministry of Electronics Industry (MEI) started to implement their own Chinese ‘Silicon Valley’ in the well-developed coastal areas, in the form of High Technology Development Zones (Simon 1990).

- In October 1987, the Thirteenth Congress of the Chinese Communist Party planned for the consolidation of the different segments within the electronics industry. The segments that were identified for indepth reform included the high-tech electronics industry, which was considered by the Party as a potential contributor to overall economic growth.

- The high-tech technological pursuit was further consolidated and reflected in the 1987 High-Tech Research and Development Program (or also known as the ‘863 Program’) and subsequently in the 1988 ‘Torch Program’. The features of those prominent programs were as follows:

i) **‘863 Program’**: The program was initiated in 1987 and aimed to promote science and technology research in the medium and long term, focusing on seven key high-tech fields (deliberately selected due to finance and manpower constraints), information technology being one of the selected areas. Its ultimate objective was to close the technological gap between China and the advanced nations in high-end technologies, and eventually to excel in the relevant fields (Jinrongshibao 22/5/1995).

ii) **The ‘Torch Program’** commenced in 1988 and was created in an attempt to implement commercialisation of research achievements. The intention behind this program was to enable China to catch up with the international level of technological capability. The award of funding to different projects, which was to be based on their market relevance, was an attempt on the part of the government to eliminate the then prevailing unproductive segregation between research and production activities. In addition, the intention behind adopting the market orientation approach was to create a self-generating trajectory that would lead to independent innovation capability in the long run, and enable the country to be competitive in the international market. The

type of technologies that were selected for focus under the program were to be of advanced level and widely sought by the market, and the electronics industry was one of the selected areas (China Daily 4/3/1996).

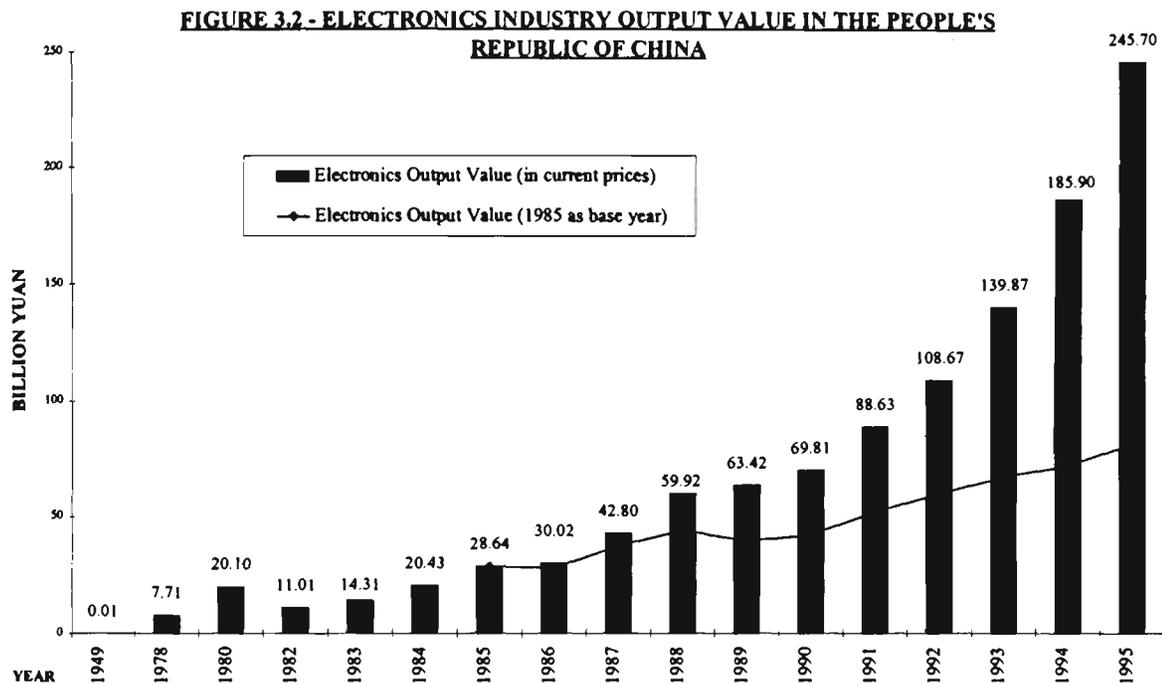
iii) High Technology Development Zones (HTDZ). The establishment of these zones was motivated by the geographic cluster concept occurring in the USA, where Silicon Valley and “Route 128” are technology diffusion beachheads. China wanted to emulate this model and, thus, the concept of HTDZ was conceived at the end of 1980. The first high-tech park was actually established in Shenzhen, then followed by Beijing and subsequently Shanghai, Tianjin, Guangzhou, Wuhan, Nanjing, Shenyang, Xiann, and Chengdu, et cetera, where expertise and skilled personnel were available. Such parks proliferated from 26 in 1991 (Jinrongshibao 11/9/1991) to 52 zones in 1995 (China Daily 4/3/1996), with range of preferential policies and programs encouraging high-tech activities. These high-tech development zones were seen as instrumental to the implementation of the Torch Plan (China Daily 4/3/1996). Deng Xiaoping and Jiang Zeming accorded strong support to the establishment of such high-tech parks and development zones to attract foreign direct investment, which was seen as a conduit for knowhow transfer (Economic Daily 1/1/1996). Incentives and tax holidays were introduced in these areas to encourage equity joint ventures, contractual joint ventures, wholly foreign-owned firms and joint developments in resource exploration.

iv) Technology Transformation Project. To improve and nurture the technological capability of the electronic industry, specific projects were undertaken to reform the electronics production enterprises. More than 1,700 technology transfer projects were undertaken during the Seventh Five-Year-Plan period, to reform structures in half of the state-owned enterprises in the integrated circuit, computer, telecommunication, broadcasting and television manufacturing segments. This was supposed to improve the technological capability of the electronic industry, and to narrow its technological gap with world standard.

3.3 DEVELOPMENT OF OTHER ASPECTS OF THE INFORMATION TECHNOLOGY INDUSTRY

3.3 A) The Electronics Manufacturing Industry.

The graph below reflects a strong increase in the real output value of the China's electronic industry from the mid 1980s. Estimated real output almost trebled between 1985 and 1995, increasing by about 12% per annum.



Source : Almanac of China Economy (1981 to 1988, 1990, 1991 and 1993)

China Statistical Yearbook 1997

Gao 1994, Yu 1994, Jinrongshibao 18/1/1995, China Daily 1/2/1995, China Daily 1/2/1996.

Despite this increase, continued China's reliance on foreign technology is obvious by the following facts. In the 1988, China's research work on electronics still lagged behind the international standard by a decade in timespan and the local electronics industry's production standard lagged behind the international standard by 15 to 20 years (Zhou 1988). In the Eighth Five-Year-Plan period, although the Chinese government commended the remarkable progress⁴ achieved by the electronics industry, it was still a small player in the high-tech arena (Jinrongshibao 6/7/1997). The Chinese government has been implementing planning and reform efforts, and

⁴ In view of its US\$1 billion export performance that exceeded imports for the first time in 1995 (Jinrongshibao 7/2/1996) and the impressive improvement in the value of output of the computer and telecommunication equipment production sector (China Daily 1/2/1995).

policies to narrow the electronic industry's technological gap with the world through these efforts. The speech made by the Ministry of Electronic Industry's vice-minister, delivered at the national conference in Shanghai, spelt out the vision of the government in narrowing the technological gap in production to 10 years (China Daily 1/2/1996). Although the industry is still limited in its ability to support economic growth, the government is trying to groom this strategic industry into a high economic contributor.

3.3 B) Specific Manufacturing Segments of the Information Technology Industry

i) The Microelectronics Industry

This industry has been accorded with priority since 1956, in the twelve-year science and technology development plan. Chip production has been one of the highly targeted outputs from this industry, because of its core foundation for information technology equipment. China has been trying to achieve advanced integrated circuit production on large-scale basis and of acceptable quality. There is still a technological gap between production in China and in the world as a whole (Lim 1985, Almanac of China's Economy 1991 and Renminribao 29/1/1996). According to Hui and McKown (1993), the Chinese established enterprises were not able to produce 1-3 microns chip (for 286 and 386 basic computer model) in the early 1990s. These enterprises faced strong competition from foreign direct investment manufacturers (Yu 1994). Despite this, the Chinese enterprises' strategy was to focus on supplying their input for domestic production of less sophisticated consumer goods, so that they could move upwards along the learning curve and eventually build their capability to become a sophisticated component manufacturer in the long run.

ii) The Computers Industry

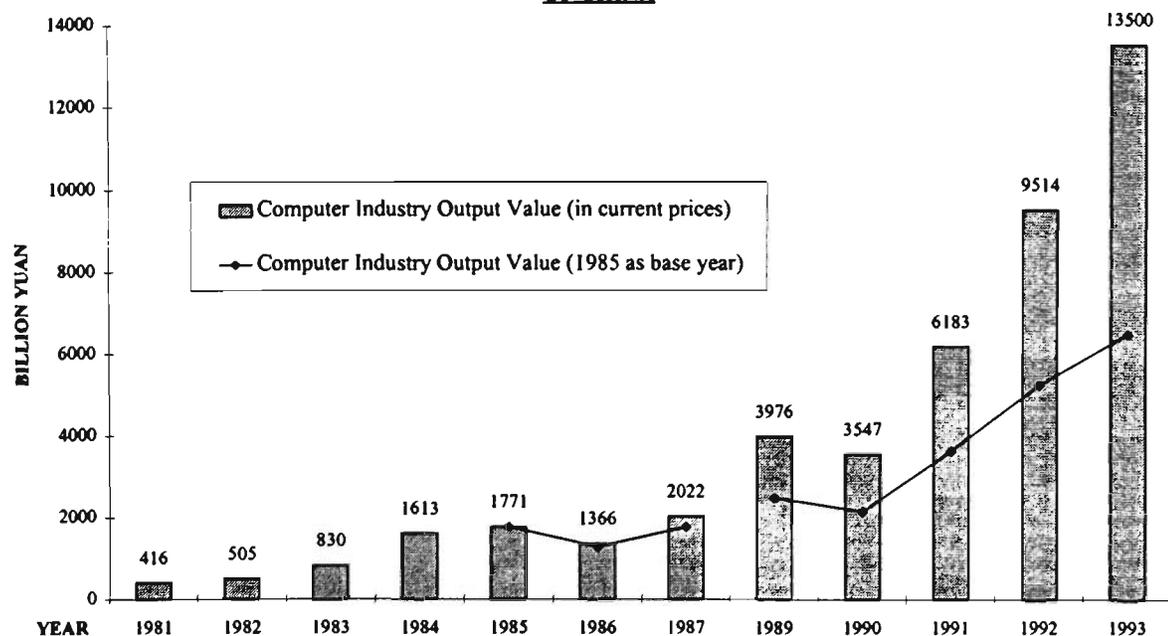
Efforts to establish the computer industry have been evident throughout the reform period. This is exemplified by the strategies and policies implemented during the reform period. During the sixth Five-Year-Plan period, China attempted to develop

its indigenous computer production capability through foreign investment and technology assimilation. In line with the strategy to 'import, digest, develop and innovate', the Government provided about 300 million yuan as a basic capital investment fund and allocated 160 million yuan as a subsidy fund to support industry development (Almanac of China's Economy 1986). In an effort to eliminate the problem of obsolete production technology in the industry, 17 major enterprises were also chosen to undergo production restructuring and technology change.

In the Seventh Five-Year-Plan, the 'Microcomputer, Workstation, Software and Peripherals' (MWSP) policy was implemented, focusing on the production of these mentioned products at the level of low-tech systems (Almanac of China's Economy 1988). On the applications front, 1,500 projects were initiated to promote information technology adoption in transportation, communication, energy, finance, trade, agriculture, medicine, defence, research and education. These sectors were encouraged to adopt production technology like CAD/CAM and office automation technology to support their internal operations. In a concerted effort by the Chinese Government to strengthen this industry, 27 hi-tech industry and central districts were set up by the Chinese government in 1991 for this purpose. In addition, 50 chip producers, 87 computer manufacturers, 19 software specialists and 68 computerised switching equipment producers (four important areas identified in the Eighth Five-Year-Plan) located in these localities were awarded special tax concessions, and research and development subsidies (Wang 1993).

The following chart shows the value of production output of the computer industry in China. The trend in production output, both in real and in current values, has increased significantly since the early 1990s. It was reported that the current value of computer industry output in 1993 was over three times that in 1989, and the value in 1995 was ten times higher than in 1991 (Economic Daily 16/10/1995).

FIGURE 3.3 - COMPUTER INDUSTRY OUTPUT VALUE IN THE PEOPLE'S REPUBLIC OF CHINA



Source: Almanac of China Economy (1981-1988, 1990, 1991 & 1993).

Production was mainly focused on low-tech product manufacturing, with high-tech equipment (mainframes and minicomputers) procured through imports (Hui and McKown 1993).

The government tried to use home demand to build the technological capability and economic strength of the computer industry in the 1990s. Personal computer manufacturing was given the primary focus and was deliberately directed by the government to target at domestic major users for applications, like the government, banks and other financial institutions (Jinrongshibao 19/6/1994).

Although achievements over the years were sporadic, they were notable overall. The innovations which enjoyed international coverage included the billion instructions per second computer, 'Milkway II' developed by the National Defence Science and Technology University; the 'Shugang I' parallel processing computer developed by the Computer Research Institute (a research institute of the Chinese Science Academy); the Beida Fanzheng Colour Chinese Character Laser Editing/Printing System jointly developed by the Beijing University and the Chinese Science Academy (Wu 1994). In the domestic Chinese segment of the computer manufacturing industry, considerable prominence has been given to the performance of locally established players like Legend, Great Wall, and 'Liang Chao', and especially to the

achievement of Great Wall Computer Company (Economic Daily 16/1/1996). This company was considered successful in its business establishment, with average annual growth rate of 20% achieved during 1985 to 1994 and with a presence in the international marketplace. However, when the whole marketplace is taken into consideration, the major dominant market players in the domestic Chinese market are still the foreign manufacturers with reliable products and reputations internationally, led by AST, Compaq and IBM in order of market share in 1995 (Economic Daily 16/1/1996).

iii) The Software Industry

Software market development began to receive attention at the national level in 1993. Research on computer science is still a nascent field in China, constrained by financial and human resources shortage. In fact, the level of computer science research in China was noted to be lower than that of India (Kejiribao 18/12/1993). Nevertheless, the industry experienced tremendous growth in the number of software houses in the Eighth Five-Year-Plan period, as indicated in the table below.

Table 3.1 - Types of Enterprise in the Computer Industry

Types of enterprise in the computer industry	1990	1995
Hardware	about 200 units	1,000 units
Software	not significant	1,000 units
Sales, service, maintenance & repairs	not significant	13,000 units

Source : Economic Daily 16/10/1995

The software houses were established mainly to pursue business interest in the industrial and government sectors, especially in relation to the 'Golden Projects'⁵ in which 40% of the funding for these projects is destined for software investment (Jinrongshibao 16/9/1995). In China, software developed with foreign technology has

⁵ The Golden Card, Golden Bridge and Golden Custom projects are the prominent projects that involve the establishment of electronic linkage with the banking industry which is a core information source.

been highly preferred over software developed by domestic skill and local companies (Jinrongshibao 12/5/1997).

Demand for software by Chinese households remain unsophisticated. According to a survey conducted in the mid-1990s, 40% of the home computers were used for the purpose of typing, 38% for leisure activities (for example, computer games) and the remaining 22% for education and learning (Jinrongshibao 17/3/1996). On average, 90% of the functional capability of home computers was unutilised. The low software demand impetus generated by the household and enterprise user segments is further reflected in the market value comparison. The value of the national software market is only 10% of national hardware sales (Jinrongshibao 12/5/1997).

It was reported that the adoption of computers during the 1980s was hampered by the lack of system software for the use of Chinese characters. Progress has been made in the development of software for Chinese characters during the 1990s, but the available computer software in the China market is considered expensive⁶. In addition, there has been a high incidence of software violation in the country, where pirated copies are widely used (Jinrongshibao 17/1/1996). This has prevented the realisation of scale economies in software production by the software development companies and, thus, has reduced the potential for the achievement of lower selling prices through scale economies.

iv) The Telecommunications Industry :

Since 1979, the development of the telecommunications infrastructure in the People's Republic of China has attracted national, and indeed international, focus. The level of investment allocated to develop this infrastructure in each five-year-plan period has been increasingly higher than the previous period, as presented in the table below. In current prices, it is estimated that investment in the public telecommunications infrastructure was ten times higher in 1991-1995 than in the previous five years.

⁶ 'UCDOC' cost 980 yuan while 'Chinese-wordstar' cost 1280 yuan in the market in early 1996 (Jinrongshibao 17/1/1996).

Table 3.2 - China's Investment in Public Telecommunication Infrastructure

Period	1949 to 1980	1981 to 1985	1986 to 1990	1991 to 1995 Estimated
Public telecommunications network fixed asset investment (million yuan)	6,000	5,800	20,196	213,500

Source : Lai (1995a)

This heavy investment spending on telecommunications products to construct a modern infrastructure has in turn generated vast market demand for the domestic telecommunication manufacturing industry. There has also been a continuing dependence on imports and on foreign technology, as shown in the table below. For the Eighth Five-Year-Plan period as a whole (1991-1995) imports amounted to about 10% of total output of this industry and exports to 3.6%.

Table 3.3 - Domestic Output, Import and Export Values of the Telecommunications Industry in China

Telecommunications Industry	1991	1992	1993	1994	1995 Forecast	8th Five-Year-Plan Period Total	9th Five-Year-Plan Period
Domestic Industry Output (in billion yuan)	8.4	14.0	22.7	37.9	51.1	134.1	150.0
Total Import Value (US\$ mil)	551	1,894	3,109	3,823	4,200	13,577	
Total Export Value (US\$ mil)	142	666	732	1,461	1,800	4,801	

Source : Lai (1995a), Chen (1995d)

It has been acknowledged by Lai (1995b) and Chen (1995d) that the problem of financial and skill shortages, and a rudimentary institutional framework, constrained the development of the telecommunication manufacturing industry. The problems identified by these authors are detailed below.

State funding for research and development in independent research institutes has been too limited. At the same time, local established enterprises were unable to support inhouse research and development from a low sales base. As a result, the

telecommunications industry lacks innovativeness and this created a mutually reinforcing linkage between inadequate research and development effort and low sales revenue. In terms of skilled talents, the local established enterprises faced difficulty in recruiting the stable pool of talent that is necessary for stable cumulative development of its technological capability in the industry. The shortage of qualified labour in the market has resulted in a high labour mobility and a high turnover rate within these enterprises, and has also resulted in poor quality and unreliable output being produced by some firms within the Chinese telecommunications manufacturing industry. The shortages of qualified personnel has also affected foreign technology transfer, as technology could not be effectively exploited due to weak assimilation capability. In addition, the institutional design was regarded by Lai (1995b) and Chen (1995d) to be unlikely to encourage competition within the telecommunications industry.

Despite these shortcomings, which the Government is determined to overcome, Chinese firms are noted for their capability in certain high-tech segments, for example, satellite construction, launch and operations. This is an area where foreign advanced countries seek the service of Chinese firms and where great pride is taken in not having to rely upon foreign expertise. This capability was one of the past achievements in the military sector, when the national priority focus was on gaining military supremacy. This has great cost-saving implications for China's objective to construct a modern national telecommunication infrastructure, based substantially on satellite communications technology.

3.3 C) Technological Capability of Service Sector

Although information and data on the information technology service sector for assessment of its capability remains scarce, the material below provides brief insight into this sector.

The number of workers in computer applications services sector experienced a steady state of increase between 1993 to 1995. It was reported that there were 32,000 workers in computer applications services in 1993, 36,000 in 1994, and 55,000 in 1995 (Statistical Yearbook of China 1996, and Economic Daily 16/10/1995). The numbers between 1993 to 1995, reflected a small service market in support of

computer adoption. The China market is facing an acute lack of talents in software analysis and applications analysis. In addition, there is also a shortage of service support in terms of sales, service, maintenance and repairs areas. The table below implies a relatively low level of service support available in the Chinese market, on the basis of 13,000 service enterprises to 7.5 million industrial enterprises⁷ (China Statistical Yearbook 1996). In reality, there has been evidence of complaint of uneven distribution of such support in terms of the geographical market (Economic Daily 16/10/1995).

Table 3.4 - Types of Service Enterprise in 1990 and 1995

Types of enterprises	1990	as at Oct. 1995
Sales, service, maintenance and repairs enterprises	Not significant	13,000 enterprises

Source: Statistical Yearbook of China (1994 & 1995), Economic Daily 16/10/1995.

The progress of this segment is heavily dependent on the capability of the national science and technology system in fostering a larger pool of talents skilled in information technology. The Government has been making effort to cultivate a necessary pool of such talents for this industry.

3.4 RESULTS OF THE TECHNOLOGICAL CAPABILITY DEVELOPMENT PROGRAMS

The technological capability of the information technology industry may be in part inferred from the results achieved from the technological capability development programs:

i) '863 Program'. Though successes had been noted in some of the projects, they were limited. For example, the program was credited with narrowing the high-tech telecommunication technological gap between China and the international standard by 3 to 5 years (Jinrongshibao 11/4/1996), however the technological gap persists. In

⁷ This figure did not take into account of other types of enterprise which are potential adopters of information technology.

addition, impressive research successes were also noted under the '863' program in the recent years. For example, the accomplishment of an ATM (Asynchronous Transfer Mode) switching prototype with breakthrough in port speed of 155Mb/s with 8x8 single node capacity. Another was the '04 Machine', a large scale programmed switching machine which gained world recognition. However, such innovations were few.

There exist some pertinent problems that have been perpetuated from the past system (Segal 1993). Commercialisation of research results was sparse, due to the segregated relationship between the research institutions and enterprises, as well as inexperience in establishing the necessary mechanisms to foster such process.

ii) **The 'Torch Program'**. In 1996, the State Science and Technology Commission claimed that the 'Torch Plan' had its successes in applying high-tech research findings to production. It revealed that a 181 billion yuan increase in industrial output was earned as a result of the Torch Plan implementation during the Eighth Five-Year-Plan, with 37.3 billion yuan achieved in profits and taxes, and US\$3.35 billion export goods (China Daily 4/3/1996). In term of innovation, there were sporadic achievements in information technology research, one being the Beijing University's 'Super' desktop-publishing system, which was a much celebrated and rewarded outcome of this program (Hui and McKown 1993). In addition, it was reported that the Torch Plan had an impact on the restructuring of traditional industries, high-tech talent development and the narrowing of China's technological gap with the world standard (Jinrongshibao 12/4/1996).

However, this program also encountered difficulties at its outset, in terms of the objective of linking research and production efforts. Technology transfer from the military sector to the civilian sector was still inhibited by a shortage of financial resources and skills, despite the decision to eliminate the technology diffusion barrier (Segal 1993). Market forces, as an incentive to stimulate commercialisation or generate market-oriented behaviour, were still weak. The funding constraint was one of the major hindering problems that persisted into 1995, and affected project implementation under the Torch program. For example, only 15% of about 20,000

projects were converted into application in production due to this problem (China Daily 4/3/1996).

iii) High Technology Development Zones (HTDZ). The Zhongguancun district in Beijing was acclaimed with operating success since it was established. The number of technology enterprises here grew from 11 in 1983 to 148 in 1987, and to 900 in 1989. The number of workers and total trade increased from 4,400 and about 900 million yuan in 1987 to 26,000 and 1.68 billion yuan respectively in 1989. With encouragement from the government, some of the research and development institutes began to establish enterprises to commercialise their products and scientists started their own business ventures in 1985. One of the success stories was that of Stone Computer Corporation which was initially established by a group of Chinese scientists working in government institutes. However, despite these effort and policies, and the favourable view expressed that the high-tech development zones in the country had nurtured a pool of one million scientists and technicians and achieved impressive capita productivity and annual growth rate (Jinrongshibao 4/3/1996), the lament made by a researcher from the State Science Commission summed up the overall result of the high-tech strategy (Economic Daily 17/10/1995). The nation is still weak in its high-tech export capability, and its 1990s high-tech output performance paled in comparison with that of Europe, USA and Japan during the period between 1971 to 1986. In 1993, the People's Republic of China's high-tech product export was only US\$4,680 million, which constituted as 5% of the country's overall export (Economic Daily 17/10/1995). In addition, the performance in the high-tech zones was found to lack innovativeness (Jinrongshibao 1/9/1995).

The programs above are still at a relatively early stage of implementation. The Chinese Government has envisaged that these programs will allow the information technology industry to develop a stronger technological capability in the long run. The Government has also recognised that the achievement of the objectives of these programs is also being influenced by the forces in the technological development path of the information technology industry, in which attempts are being made by the

Government to reform these forces to foster a strong technological capability in this industry.

3.5 FACTORS AFFECTING THE DEVELOPMENT PATH OF THE INFORMATION TECHNOLOGY INDUSTRY:

This section highlights the forces that have an impact on the information technology industry:

3.5 A) Structure of the Electronics Industry

The problem of limited development of technological capability was linked to the long embedded inflexibilities of the traditional electronics industry system, which continued to affect the industry's ability to adapt to rapid changes and to demand (Original Ministry of Electronic Industry 1988, Hua 1992, Jinrongshibao 21/9/1995, 5/10/1995 and 7/2/1996). Firstly, many of the state-owned enterprises still based their production operations on the military sector, oblivious to the fact that consumer electronic products were fast becoming the electronics item in dominant demand within the economy. Secondly, the past economic system continued to impede the development of high-tech capability in the 1980s, despite the implementation of a series of reforms. The industry was characterised by a highly fragmented electronics market structure and dispersed electronics production base among the electronic enterprises. The 3,000 electronics enterprises operating in the industry at that time were mainly of small and medium size, had a weak technological base, were plagued by inefficient resource coordination systems and operated in seclusion from one another. The absence of efficient interplay among enterprises and segments within the Chinese electronics industry led to a weak domestic electronics technological capability. Aggravating this situation was also the problem of a limited research and development system in the electronics field. These were common problems faced by other industries, and were reflective of the general residual problems impeding the overall national technological capability development in the science and technology system. Thirdly, electronics enterprises were traditionally situated at inconvenient

locations or city outskirts where access to resources (like transportation, industrial amenities, energy, education, et cetera.) was difficult to obtain for building up or advancing technological capability. The development of Chinese 'Silicon Villages' and high-tech parks in resource-rich areas were attempts to resolve such problems, but were still at an early stage of implementation. Lastly, production equipment in the state-owned electronic enterprises was generally outdated by international standards. This affected the quality of the products and, without doubt, the competitive standing of these products against imports.

3.5 B) Policy Institutions

An unstable institutional setting has also affected the technological capability development of the electronics industry. Though the Ministry of Electronic Industry (MEI) has been accorded responsibility by the State Council for governing the electronics manufacturing sector, the intricacies associated with institutional development made it difficult to see a clear and well-defined line of demarcation control and among ministries, in relation to each segment of the electronics industry. As a result of decentralisation policy and political power plays, there have been various sources of power at different levels within the vertical and horizontal lines of command.

Such factors led to the eventful fate of the MEI and the related institutional structure in the industry during the late 1980s and early 1990s, when the restructuring of the institutional design took place. In 1988, the MEI was merged into the Ministry of Machine-Building and Electronics Industry (MMEI) in an attempt to develop the electronics industry. The State Council's attempt in 1990 to establish the China Electronics Industry General Corp. (Chinatron), for the purpose of reinforcing the industry's development, was however short-lived. The organisation was dissolved about two years later in another attempt for further reform. The MEI was revived as an independent ministry to replace the MMEI in 1993. Prior to 1993, the institutional framework of the electronics industry was unsettled and this affected the technological capability development path of the industry.

Despite remaining intricacies in the chain of command and inefficiencies in the implementation of directives from the central government, MEI has played an important role in strengthening the domestic capability of the electronics industry.

MEI's initial strategy for computer industry development during the Eighth Five-Year-Plan was to focus on low-end personal computers and peripherals manufacturing, to satisfy demand from the domestic and export markets. Aware that the indigenous information technology manufacturing capability was still weak, the Ministry encouraged the entry of higher-end systems and foreign investors with technology production expertise to help build up the computer industry's capability. Almost all the international big players like AT&T, Nokia, Ericsson, Alcatel, Philips, HP, Motorola, IBM, Compaq are present in the China market in different forms of business establishment.

MEI also aimed to separate commercial operations from its regulatory role, as mentioned in preceding sections. This has led to MEI releasing its control over state-owned factories like China Great Wall Computer Group, Lang Chao Electronic Information Industry Group, and Changjiang Computer Group. The companies were also encouraged to be independent and competitive, behaving like enterprises in the free market economy.

3.5 C) Legislature Framework

Under the Deng leadership, foreign direct investment was seen as a conduit for knowhow transfer (especially high-tech knowhow) and was encouraged through the Chinese deliberate strategy and policy. High-tech parks and development zones were being established since the 1979 "Open-Door Policy" to tap this potential, with incentives and tax holidays introduced to attract technologically advanced foreign corporations. Despite the controversies surrounding these privileged investment localities, the special economic zones have been regarded as beneficial to the economy (Crane 1990) with strong support from Deng Xiaoping and Jiang Zeming (Naughton 1993 and Economic Daily 1/1/1996). A continuing problem for foreign investors in China's investment environment, however, has been the issue of inadequate intellectual property protection, especially in the areas of pharmaceuticals

and computer software. Pressure imposed by powerful international bodies like GATT and the US has led to much, though still insufficient, progress in the institutionalisation of copyright law, and in the adoption of business ethics for trade secret and patent protection within the economy. Such a legislature framework is necessary for a more predictable trading and investment climate for the foreign investors, as well as for sustainable economic growth.

During the 1980s, China promulgated an unprecedented number of statutes in the interests of economic and trade development. 'Regulations of the People's Republic of China on the Administration of Technology Import Contracts' was the first relevant law in technology transfer in 14th May 1985 (Wolff 1989). It provides general guidelines for technology transfer with the objective of ensuring that appropriate technology is imported by the local entities.

Generally, the 'Regulations of the People's Republic of China on the Administration of Technology Import Contracts' still lacks clarity on bureaucracy and equitable judicial procedures (Seid 1993). The nebulous areas in the Regulations caused concerns within the foreign business community. One of these is the difficulty of determining which bureaucratic party is responsible for approving different aspects of the transaction. Another is related to foreign transferors' concern with the inadequate respect for technological information confidentiality from individuals and domestic enterprises. The overall Chinese legislative framework is still rudimentary, and needs further development to provide comprehensive protection to foreign products and intellectual property. It had become a normal practice that the unprotected 'gaps' are filled up in contractual agreement (Liu and Wei 1989).

The pace of legislative development has been slow. For instance, a patent law was announced in April 1985 to inject confidence into the foreign business investment system, by protecting the integrity of the technology and know-how of the foreign transferors. At that time, computer software was not covered by the patent law because computer software was considered '*rules and methods for mental activities*' and was specified in *Article 25* to be beyond the scope of the patent law (Legislative Affairs Commission 1987, p. 66). The relevant pieces of legislation to protect computer software, known as the 'Copyright Law and the Implementing Rules' and 'Computer Software Protection Rules', were only enacted in 1991 after

considerable lobbying from the foreign business community, especially American businesses through their home authorities, and pressure from the international organisations such as GATT.

The Ministry of Foreign Trade and Economic Cooperation has claimed that '*China has strictly observed relevant international conventions and bilateral agreements on Intellectual Property Rights.*' (China Daily 7/3/1996). Such an observation is still widely regarded as inaccurate. Asian Intelligence (27/9/1995, Issue no. 445) has rated China as having the highest intellectual property rights risk, and most inadequate legal system to protect intellectual property rights, among East Asian countries. At this stage, much improvement on the legislation is still needed to protect foreign works. However, there are growing signs that China is making further effort to enact or amend relevant legislation to encourage and reassure foreign investors in relation to advanced technology transfers (China and North Asia Monitor 1995) and to qualify itself for membership in the WTO (World Trade Organisation).

3.5 D) Ninth Five-Year-Plan.

The MEI's Ninth Five-Year-Plan (1996 to 2000) strategic direction for the Chinese electronic industry is to develop it into a major contributor to economic growth by the year 2010. The Ministry planned to achieve an annual growth rate of 20% in this industry over the Ninth Five-Year-Plan period, and to attain an output value of 700 billion yuan in 2000.

The strategies laid out in the Plan reflected the strong desire of the ministry to strengthen and consolidate the technological capability development path within the electronics industry. In addition, the strategic direction of the Ninth Five-Year-Plan also targeted at eliminating many of the specific problems deep-seated in the system (Economic Daily 30/10/1995). The Plan has identified integrated circuits, new types of components and devices, computer hardware and software, and telecommunications equipment as the products for core focus during the period (Renminribao 2/2/1996). Furthermore, it was desired that the coastal regions' technological paradigm be shifted from low-tech production to high-tech production.

These regions, with their relatively higher level of factor endowment, were regarded as potential technological forefronters.

The initial three 'Golden Projects' launched in 1993 have not only provided a relatively large degree of impetus to the development of these product segments in the later Eighth Five-Year-Plan period, but also imposed market-oriented behaviour in the electronics industry (example, bidding for projects based on market tender). It is expected that the momentum will continue with these three Projects and even intensify with the addition of further five 'Golden Projects' in the Ninth Five-Year-Plan period.

The Ninth Five-Year-Plan, however, does not generally adopt a fully free-market philosophy, as it has set out to pick winners and to 'groom' them into substantial players in the market. These winners will be the locally established Chinese enterprises, among which priority will be given to 100% locally established Chinese companies over Sino-foreign joint venture (Economic Daily 13/11/1995). The Chinese government has long sought to emulate the success of the Japanese electronics industry where the Ministry of International Trade and Industry played a profound role in 'picking the winners' and nurturing them to strength. The thirty chosen key Chinese enterprises are expected to be each a revenue earner of more than 10 billion yuan and, together, to account for more than 60% of the domestic share of electronics output (Jinrongshibao 7/2/1996). Out of these privileged companies, 10 are targeted to make the list of the top 500 enterprises in the world (China Daily 1/2/1996). On the other hand, it has also been acknowledged that foreign cooperation and technology transfer in the electronics industry will continue to play a key role in developing the technological capability of this industry in the Ninth Five-Year-Plan period (China Daily 4/3/1996).

3.5 E) External Influences

i) GATT (General Agreement on Tariff and Trade) or WTO (World Trade Organisation).

The GATT organisation was based on a multilateral treaty that aimed to enforce a secure and predictable international trading environment, through its general rules for

international trading that were accepted by over 120 states. The People's Republic of China had no dealings with GATT during the 1950 to 1971 stage of the pre-reform period. China only began to realise the importance of GATT in its policy of economic reforms in June 1986, when it indicated its desire to regain its status as a contracting party (Cooper 1989). To China, membership in GATT meant that the country would enjoy longer term favourable access to the world market under the Most Favoured Nation (MFN) status, instead of procuring such access through bilateral treaties with countries on an individual basis. The eagerness of China to join GATT had seen the country take steps to carry out some necessary changes. One of these changes was that China has enacted the Copyright Law and the Regulations for the Protection of Computer Software, and amended the Patent Law as noted above. These changes to legislation were important, as they will facilitate technology transfer as a means for technological capability development, through predictable trading relationships between China and foreign entities. China's desire to rejoin the GATT meant that it subjected itself to heavy demands from the US, especially under the Section 301 actions. Though the extent of the impact of this demand on technology transfer is unknown (except with the call for tighter laws, regulations and policies on trade) it does restrict China's latitude in technology acquisition and technological capability development⁸.

It is believed that the World Trade Organisation (WTO), created in 1995 to succeed GATT, would make countries like China less vulnerable to such conditions imposed by influential parties (Islam 1994). By the same token, the new establishment would also provide more efficient protection coverage and enforcement of intellectual property rights to the exporters of technology imported by China. However, the decentralised economic planning structure in China poses the greatest impediment to the implementation of a consistent and comprehensive Chinese legal system to deal with the problem. The lessening grip of control of the central authorities in Beijing over the provinces has led to the enforcement of the central directives (in line with WTO's policy and philosophy) on an inconsistent basis in different provinces. This

⁸ For example, to avoid the impending high cost of US\$3.9 billion duties under Section 301 action by the US, China had to cease its import-substitution policy, and eradicate the need for import licence to transfer technology among other demands (Kaye and Awanohara 1992).

has been cited as a major blockage in the Chinese attempt to join the WTO (Islam 1995).

Despite China's failure to achieve entry into the WTO on 1st January 1995 and in several subsequent attempts between then and early 1998, it is expected that China would go further in adjusting its internal system in order to qualify for a membership in the organisation.

ii) COCOM: Coordinating Committee for Multilateral Export Controls.

This was an informal group initiated by the US in relation to the Cold War. Its purpose was to prevent Soviet Union, China and the Eastern Communist Bloc countries from procuring leading-edge technology, like computer hardware, computer software, telecommunications switching equipment and related technology for a military buildup. COCOM's export restriction lists for these countries were established on a multilateral basis, but there was no stable mechanism that secured continuous cooperative behaviour among the members nor support from non-members. The existence of COCOM was initially (during the 1950s and 1960s) based on the leadership of the US, whose influence was derived mainly from its technological dominance, reinforced by the common interests in national security among the member countries. However, with the development of the technological capability of other countries in the mid-1970s and the failure to implement a consistent control policy for the different communist countries, the US leadership gradually lost its effectiveness and the US was also accused of misusing its influence. Due to China's role in the Korean War during the 1950s, the country's imports were subjected to tighter control than its other communist counterparts. In 1952, the US led the formation of a China committee (known as Chincom) under COCOM, specially formed to monitor and exercise tighter export control to China. This committee was established with great reluctance on the part of the other allies, as they found the restrictions to be excessive and to disadvantage their economic position. This severe restriction of technology and products to China continued to be enforced in 1954, even when COCOM relaxed its control over exports to the Soviet Union and Eastern Europe. Nevertheless, restricted items found their ways into China from the technologically advanced Western nations via the Soviet Union and Eastern Europe in

1955. Moreover, China's close relationship with the Soviet Union in technology transfer rendered the tighter control policies for China ineffective. However, China experienced the same constricted flow of sophisticated technologies for modern telecommunication and computing as the Soviet Union and East European countries. With growing discontent towards the differential China policy, the US was forced to revise the exports control list and, consequently, Chincom went out of existence in late 1957. Despite liberalisation of export control, computers and electronics remained the critical technologies on the COCOM control list during 1958 to 1969. The US leadership was successful in maintaining comprehensive controls on exports of these technologies to China and its communist counterparts. This was because these technologies had the potential for military applications and the COCOM's members were concerned about their national security. Hence, the resistance from the COCOM's members towards this category of restriction was low despite some discontent. In addition, the US held the dominant technological position in these technologies and thus had stronger influence in implementing export restriction on them (Mastanduno 1992).

Political instability rather than the COCOM's policies during the Cultural Revolution era (1966-1976) was the main impediment to technology imports in China at that time. In the late 1970s, China began to procure more sophisticated US technology with the normalisation of the Sino-American relations. The 1980s situation for China saw a reverse technology transfer scenario from that of the 1950s. According to Yuan (1995), less constrained technology transfers to China were deliberately permitted by US on political grounds: as a strategic move to coerce cooperation from Soviet in arms negotiation. During this period, the Chinese economy experienced a more liberalised import situation, in certain areas of information technology, than the Soviet Union and Eastern Europe. For instance, the satellite technology procured from the US in 1981 was more sophisticated than provided to other communist countries. Export approvals for computers above the multilaterally agreed restriction level of 155 megabits per second were known to have been granted by the US through the COCOM exceptions mechanism. Highly sophisticated information technologies applications, like CAD/CAM and networking equipment, were however still subject to tight restriction.

Overall, information technology products were popular items in export licence application for shipment to China. The Chinese demand for such products grew at a rapid rate. By 1985, 95% of the total number of US computer shipment licence applications were destined for China. Between 1981 to 1986, telecommunication and computer exports from the US to China had increased by 300% and by 1,200% respectively (Yuan 1995). However, China's ability to procure foreign information technology on a large scale basis remained hampered by financial constraint.

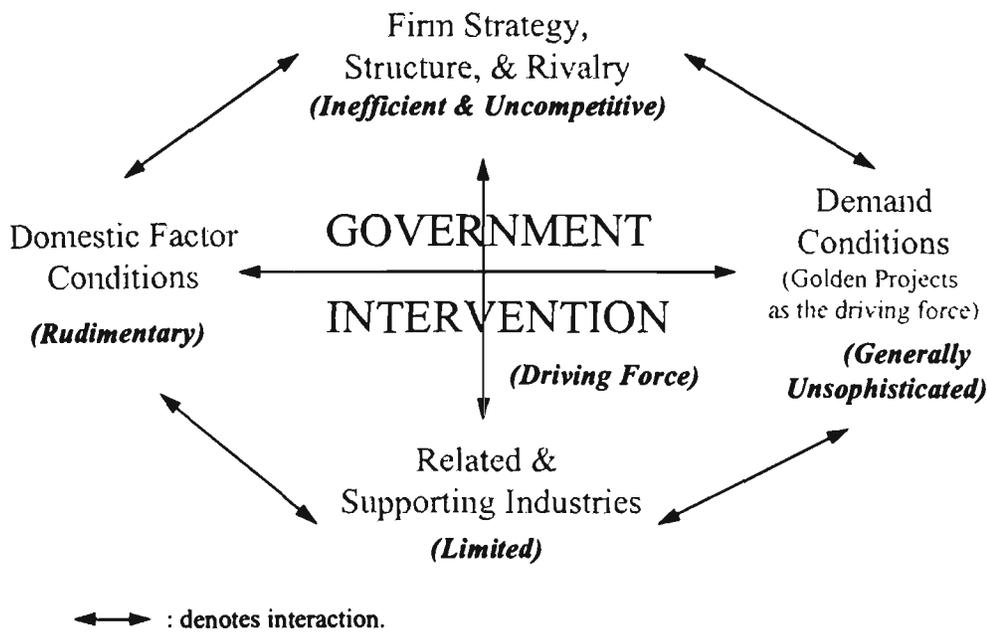
The export restriction imposed by COCOM on China gradually became liberalised in the face of its relative diminished military threat to the world and, on the other hand, the weakening of the American leadership in the face of discontent among the US's allies in COCOM towards the American's inconsistent exercise of restrictions control. In 1994, the Clinton administration and Congress revised the US export control system so that almost any level of information technology was allowed for export to China and other ex-communist countries. COCOM was eventually disbanded in October 1995.

Despite the later period of ineffectiveness, COCOM, or effectively the US, had been responsible for restricting the flow of high-end technologies into China during the 1958-1968 and late 1970s to 1985 periods. Since the mid-1980s, the influence of COCOM on restricting the flow of high-end technologies gradually became less important.

3.6 CONCLUSION

In the conclusion to this chapter, Porter's (1990) 'diamond' model of national advantage can be used to summarise my assessment of China's information technology industry. From the perspective of this model of national advantage, the determinants of China's national advantage in the information technology industry still reveal an overall weak competitive position in the international market. The diagram below shows an assessment of the relative strength of the technological capability determinants in the People's Republic of China in this international context.

Figure 3.4 - The Determinants of the Technological Capability of the Information Technology Industry in China



Domestic Factor Conditions. Factor demand conditions in China are characterised by a low level of skilled human resources, backward production capital, an immature research and development-innovation-commercialisation system and few interlinkages among the economic input units. The 1990s factor conditions continue to suggest a strong affinity with low-end technology manufacturing. Porter's (1990) model has suggested that the creation and upgrading of factors could be rapidly driven by a national focus or by government support given to the specific industry. The Chinese government has emulated models of successful undertakings by overseas countries (refer to section 3.2) in an attempt to improve the technological capability of the factor conditions. However, the overall domestic institutional framework of the information technology industry has been inadequate in engendering strong segment interplay within the industry, and has not enticed significant foreign investment effects on factors' quality and efficiency. The creation of abundant information technology literate or skilled work-force through government support will involve a long process. This is due to the time length involved in an individual's education path and the financial demands of this developing country. In the short and medium run, it is expected that the information technology manufacturing and service sectors will be

required to stimulate their own training and learning process for factor creation and improvement in their information technology production and in their service support role. Simultaneously, based on the model, it is envisaged that the information technology applications sector will be affected by the rudimentary domestic factor conditions in the information technology industry, from the standpoint of the latter's inability in quality hardware and software production and inadequate service support for the information technology adoption and diffusion processes in the applications sector.

Related and Supporting Industries. There is limited efficient interplay among different segments of the information technology industry. The immature research and development-innovation-commercialisation system, and the limited technology transfer linkage between the military sector and the civilian sector, illustrate this limitation. From the Porter (1990) model, it is suggested that such inefficiency will have repercussions on the information technology applications sector.

Demand Conditions. The overall demand conditions in the Chinese information technology industry are at immature stage and constitute an inadequate home base for developing this industry. It has been illustrated in the previous sections that the information technology industry is incapable of meeting the demand of some active information technology adoption and diffusion agents. The 'Golden Projects' are considered the most influential catalyst in the economy in generating market demand. The core applications sectors, like banking, transportation et cetera, are identified by the 'Golden Projects' to be the active demand entities in the domestic information technology industry. The issue relating to the impact of the capability of the Chinese information technology industry on the applications sector rests on the question whether the former is of relevance to the latter. In this thesis, the examination of the factors influencing information technology adoption and diffusion processes in the Chinese banking system will determine the relevance of the information technology industry in these processes.

Firm Strategy, Structure, and Rivalry. The established Chinese enterprises, in the information technology industry, lack competitive efficiency. The foreign established enterprises have been stronger and more competent competitors than these Chinese established enterprises (refer to section 3.3). The entrenched Chinese state-owned

information technology enterprises are plagued with structural inefficiencies that affect their opportunity to reap economies of scale and their competitive position in the domestic market (refer to section 3.4). The government has attempted to ameliorate this rivalry imbalance and to accelerate indigenous capability development through broadbased reform, technology transformation projects and the encouragement of joint-venture business formation and cooperation between the local Chinese and foreign investors for technology transfer (refer to section 3.5). In these areas, considerable efforts are still required to develop an efficient market structure.

Government. The insufficient conditions of the determinants in the information technology industry suggest a long interval of low-technology domestic capability in the information technology industry and a continuing lag behind international technology standards. Although this lag has been narrowed over the years, it has remained a persistent problem from the pre-reform period into the reform period.

The development of events in the 1990s, however, suggests a possible direction towards closing the technological gap in the long run. For example, the changes in external influences on technology export to China, and the actions undertaken by the Chinese government to build its indigenous technological capability, all imply that the Chinese information technology manufacturing and applications industries face higher and better opportunities in fostering learning and assimilating advanced foreign technology than in previous times. The Chinese government's participatory support is increasingly engendering a conducive environment for all conditions to take shape, to cultivate a strong technological capability within the information technology industry. The Ninth Five-Year-Plan advocacy of a strong government participation in this industry may result in the gradual narrowing of the technology gap in the future. If this materialises in the long run, the impact of this capability on the applications industries will depend on the relevance of the Chinese information technology industry to the adoption and diffusion agents which, in this thesis, are the banks in China. Chapters 6 to 10 will examine the relevance of the information technology industry in the information technology adoption and diffusion processes in the Chinese banking system in the period under study.

CHAPTER 4 : THE HISTORICAL DEVELOPMENT OF CHINA'S FINANCIAL SYSTEM.

This chapter outlines briefly the historical development of the People's Republic of China's financial system in the century prior to the establishment of the Communist Government (1840 to 1948) and in the 1949 to 1978 pre-reform period of that Government, the emphasis being placed on the profile of the financial agents during these periods. The central focus of the thesis is on the reform period, and the material on the pre-1949 financial experience and the pre-period pre-reform (post-1949) are presented to facilitate an understanding of the events that follow after 1978.

4.1 THE PRE-1949 EXPERIENCE

China's consecutive defeats in the opium war (1839 to 1842), the Sino-French war (1884), and the Sino-Japanese war (between 1894 to 1895) resulted in its ports being progressively opened to foreign presence and trade, by means of inequitable treaties imposed by the foreign aggressors. With the opening of the treaty ports, there was a rapid increase in trade and in the foreign financial institutions into the country. As a result, the financial system became more complex and developed than before. The following provides a brief insight into the historical development of China's financial industry from 1840 to 1949, based on the profile of the financial agents during that period.

4.1 A) Money Houses

An early local form of financial unit in China was the money house (Qianzhuang) which existed since the Ming dynasty (1368 to 1644). The money houses were usually owned by rich individuals with substantial power and strong connections with government

court officials. They arose out of the need to facilitate the ease of travellers and businessmen in transporting the heavy copper, brass and silver currency for payment of goods and services. At the end of the Ming dynasty, the main business of the money houses was generally confined to copper coin and silver currency exchange, to honouring customers' issued payment orders, and to lending activities. The business scope of these money houses was widened during the early period of the Manchu or Daqing reign (1644 to 1911). The nature of the financial business of these financial agents was extended to include deposit taking, fund transfer or remittance, buying and selling of coins, printing of currency and minting of coins (People's Bank of China Education Editorial Committee 1985 and Wang et al. 1990). Their presence in the country grew considerably from trade brought about by the influence of foreign powers in the country and the influx of foreign financial institutions into the coastal regions after the early 1840s. Despite the opening of the treaty ports to foreign commerce, the money houses played an important role in supporting domestic trade but only a minor role in foreign trade (Lee 1982). The profile of these local financial agents in the increasing foreign trade was confined only to supporting customers who were local Chinese merchants in small import and export businesses. The foreign banks and the large national Chinese banks, on the other hand, were the active direct financial agents in the country's growing trade relationship with foreign countries.

Nevertheless, the money houses were widely prevalent in cities and towns, and in areas untouched by the bigger financial players. In smaller towns, they served as vital financial agents for the localities. In the larger towns and cities, the money houses provided financial services to small business merchants. The relationship between the foreign financial institutions and the money houses at this time was of a complementary nature rather than a competitive one. Because the money houses were normally small in size and limited in their financial capability, they relied heavily on the foreign financial institutions for business support¹. In reciprocity, the money houses provided support to the foreign financial institutions in terms of payment clearing services that were undertaken for transaction settlement between its local small merchant clientele and the

¹For example, foreign financial institutions extended loans to the money houses for their lending activities.

foreign funded exporter, who was based in China and was the customer of the foreign financial institutions (People's Bank of China Education Editorial Committee 1985).

In modern financial terms, the money houses are considered to have been informal credit institutions because, in contrast to the foreign and Chinese banks, they did not register their business with the government authorities prior to their operation. Nevertheless, they were important financial units in the economy, because of their supporting role to small domestic business activities. The basic functions of the money houses were more similar to banks than to other forms of financial institution. They constituted the only source of external finance that was within the reach of the small businesses. However, the money houses did differ from the domestic Western style banks in the ease of credit availability and in the manner of their operations (People's Bank of China Education Editorial Committee 1985). Small businesses could seek loans from the money houses easily, without incurring high financing costs or undergoing tedious formalities that were normally imposed by the Western style banks. In addition, the money houses operated their businesses mainly based on trust and reputation. No security or collateral was required from their customers to pledge against a loan undertaking. Credit extension was based on goodwill or the guarantee of payment from another merchant. Loans provided by the money houses were of a short-term nature, usually on a quarterly basis, because the money houses had had difficulty in attracting long-term deposits. The money houses operated longer hours and for more days than the banks. They did not deal in foreign exchange business, which was a primary function of the foreign banks and the Chinese national banks. The business structure of the money house was either sole proprietorship or small partnership with unlimited liability. Hence, their business size closely corresponded to the generally limited geographical business scope in their financial dealing. Even though they provided economies of scale for several small merchants in the latter's remittance or transfer of funds, their activities were largely restricted to their immediate geographical locality. Another feature of these money houses was that they also functioned as financial intermediaries to the Manchu government.

This traditional financial unit, the money house, started to disappear from the financial scene after the internal revolution in 1911-1912². Because the money houses had close link with the Manchu government court officials, the internal revolution against their ruling power had an eroding impact on this financial unit. In addition, the limited financial capability and high business risk of the money houses also forced them out of existence, as they suffered from the effects of unstable silver prices and the loss of support from the foreign banks during political instability. However, in place of the money houses, the establishment of the Western style modern bank gradually became the common financial institutions in the domestic industry (Wang et al. 1990).

4.1 B) Local Chinese Banks

China's first Western style modern bank, China Commercial Bank (Zhong Kuo Tong Shang), was established by the Manchu or Daqing government on 27th May 1897. It conducted savings deposit and lending services, and issued paper currency on behalf of the government. Shortly after the Shanghai financial industry shakeup in 1897, as a result of interest rate speculation, and with the burning down of all the financial institutions in both Beijing and Tianjin during the war in 1900, there was a growth of commercial banks throughout the country. Shanghai was the most popular commercial banking area and the most active financial market, brought about by its busy port. The growth of local Western style banks in the country became even more rapid after the Manchu government decided, in 14th March 1904, that such banks are essential to facilitate fund flow or transfer. The government's support to the development of Western style banks was apparent in the promulgation of banking regulations in 1904 and 1907. The Xingcheng Commercial Savings Bank was the first local private bank established in 1906. The Bank of Communications was established in 1907, the Daqing Bank in 1908 and some other regional banks were also set up by the national government or court officials (People's Bank of China Education Editorial Committee 1985). All these banks dealt in activities that covered savings deposits, loans, foreign exchange, bill of exchange discount and issuance, buying and selling of gold and silver,

² This was the Chinese democratic revolution led by Dr Sun Yat-Sen to overthrow the Manchurian or Daqing government.

safe depository, insurance and currency issuance. The Xingcheng Commercial Savings Bank, however, did not survive the Chinese democratic revolution in 1911, because it was owned by a government court official. In fact, during this time, many of the money shops and banks which had similar ownership or connections were forced to close down during the revolution.

The most significant local banks in the financial industry from 1911 to 1949 were the Central Bank of China, the Bank of China (which was established on the foundation of the Daqing Bank³), the Bank of Communications and the Agricultural Bank of China. Prior to the establishment of the Central Bank of China to perform the central banking role, this role was undertaken by the Bank of China and the Bank of Communications. The Central Bank of China was established by the Kuomintang (KMT) government in the 1920s in an attempt to control and correct the monetary situation in the country. The country was experiencing a chaotic situation, as a result of a shortage of funds in the country after the revolution, where various types of currency were issued for circulation by the local governments, and by private and foreign banks in all the provinces. It was difficult to attain a clear basis for the exchange conversion among these heterogeneous currencies, as the actual amount in circulation remained unknown and difficult to ascertain. In October 1927, the KMT government promulgated a regulation to establish the country's central bank in Shanghai. The Central Bank of China commenced operation in November 1928 and was appointed as the national bank with the exclusive right to issue national currency, issue foreign exchange certificates, manage the treasury, and raise and manage bonds in both the domestic and overseas markets. However, this method of casting a tight rein on currency issuance remained effective only for a short period of time.

During the mid-1930s, the local financial industry was restructured and the smaller local banks became the branches or subsidiaries of the above mentioned four banks. This built up the oligopoly position of the four local banks in the financial industry. To consolidate the local financial industry, the KMT government instructed the four local banks to join forces to establish a task force in August 1937. The task force was charged with the responsibility of strengthening the local financial structure and operations related to financial planning, training and staffing, monetary control, deposit

³ A government bank previously founded by the Manchurian government.

savings monitoring, and auditing activities in the financial industry, and with assisting the Ministry of Finance with war related financing activities. To ensure a wide coverage of economic activities by the local Chinese banking sector, the provision of banking services by the four banks were demarcated in 1942, along the line of specialised economic sectors. The Central Bank of China was to handle government institutions' banking transactions, the Bank of China was to handle trading transactions that took place in either domestic or external markets, the Bank of Communications was to deal with banking transactions in the communication, transportation and mining sectors, and the Agricultural Bank of China was to handle the agricultural sector's banking activities.

Between 1937 to 1945, the War of Resistance broke out. The ruling KMT government party joined forces with its rival party, the Chinese Communist Party (CCP), to defend the country against the Japanese invasion. As part of the defence strategy, the local Chinese financial institutions extended their presence to the rural areas, mainly to support the resistance movement against the Japanese army.

After winning the war over the Japanese, rivalry was renewed between the CCP and KMT party, and the former triumphed by seizing power from the latter in 1949. When China was established as a socialist country under the CCP, the financial industry was subjected to major restructuring. The CCP's objective was to eradicate the country of capitalist features, so that financial units were either closed down, nationalised or restructured as socialist financial institutions. The Bank of China and Bank of Communications were restructured as Chinese socialist banks. The People's Bank of China was established in 1948 to absorb the other banks in the country, inclusive of the Central Bank of China and the Agricultural Bank of China. There was also a complete shift of power and influence from the foreign financial sector to the government after the restructuring. By 1952, the ruling communist party had nationalised all local private financial units and began to adopt the socialist financial system of the Soviet Union (Wang 1990).

4.1 C) Foreign Financial Institutions

Foreign financial institutions were first located at treaty ports and in Beijing after the opium war. These foreign financial institutions constituted a powerful influence on the direction of the Chinese financial industry development prior to 1949. This was especially so during the reign of the Manchu government. For much of the period, the operation of the Chinese financial industry was in the control of the foreign financial institutions, which even had the power to overturn rules issued by the Chinese authorities (People's Bank of China Education Editorial Committee 1985). This extensive foreign power largely stemmed from the fact that the weak Chinese government allowed the operation of foreign financial institutions to be governed by the laws of their respective home country rather than by those of the host country. The vulnerability of the government was also reflected in the operations of joint venture banks in which the government had a capital share, for example the Russo-Asiatic Bank, Banque Industrielle de Chine, Chinese American Bank of Commerce, et cetera. The internal organisation of these joint venture banks was completely in the hands of the foreign shareholder, irrespective of the shareholding configuration. The public accorded lesser confidence to these banks than to the independent and fully funded foreign banks in their financial activities (Lee 1982). In effect, the fully funded foreign banking sector had a monopoly role in the economy's trade with foreign countries.

Prior to 1949, the foreign banks continued to remain powerful financial agents even despite the turbulent political events in the country. For example, after the Sino-Japanese war in 1894 to 1895 when many of the foreign banks withdrew their businesses from the country, the remaining 14 foreign banks still constituted a powerful force in the country's financial system. The power of the foreign financial banks remained strong even during the rule of the KMT government and amidst attempts to strengthen the local Chinese banking sector. This was evidenced by the share of total assets held by foreign banks within the industry and their influence in the monetary condition of the economy. In October 1947, the 13 foreign banks located in the active financial market in Shanghai had asset holdings at 26.2% of the total overall assets in the Shanghai's financial market, whereas the 147 local Chinese banks' assets only accounted for 54.2% of the total. In August 1948, when there were only 12 foreign banks left in the Shanghai's financial market, their assets were even higher than before,

at 36% of the total assets. In term of the monetary situation, official and blackmarket foreign exchange rates were always heavily influenced by the American (Citibank) and British (Hong Kong and Shanghai Banking Corporation) banks, and these banks were very important in currency issuance. At the end of April 1949, for example, the currency issued by the Hong Kong and Shanghai Banking Corporation was about 5.8 billion yuan, which constituted two-thirds of the total currency issued for circulation for China (People's Bank of China Education Editorial Committee 1985).

The foreign financial influence and power came to an end in the year of 1949, when the government came under the control of the Chinese communists led by Mao Zedong. It was also the beginning of the era when the foreign banks and financial institutions, except the Hong Kong and Shanghai Banking Corporation, the Standard and Chartered Bank, the Overseas Chinese Banking Cooperation, and the Bank of East Asia, were either nationalised or had their assets expropriated or frozen by the ruling CCP (Wang 1990).

4.1 D) Capital Market

China's first capital market was established in 1914 in Shanghai, for the trading of government issued treasury bonds. A series of similar exchanges was subsequently set up in other cities. However, the capital market was terminated during the communist era and went out of existence for a long time, as speculative activities were condemned as an undesirable trait of capitalism.

4.1 E) Conclusion

The money houses were initially established to function as a currency transportation facility during the Ming dynasty. Their business nature began to increasingly cover a wider range of financial intermediation activities during the Daqing era, and even grew considerably when the foreign occupants in China began to initiate trading with their home countries. However, the money houses became the prevalent form of financial intermediaries during the Daqing era, but were displaced by Western style banks when the new government came into power.

The financial history between 1840 to 1949 shows an active financial system that was heavily influenced by the foreign banks. It was also a system that was unable to correct chaotic financial and monetary conditions during this period. The foreign banks remained a powerful force even when the 1911 internal revolution had led to the demise of the traditional money houses with the collapse of the Manchu government. This was despite the establishment of Western style banks by the new KMT government, in an attempt to replace the money houses and strengthen its hold in the financial industry of China. These inabilities were related to weak government control, and to the many disruptive years of civil and foreign wars that occurred in the country. The sequential emergence of political turmoil, that alternated between civil and foreign wars, made it difficult for the governing authorities to exercise control over the financial system. For example, there had been attempts by the KMT government to keep financial and monetary conditions under control, but the turbulent political events during the 1940s undermined the efforts of the KMT government to reverse and correct the situation. After 1949, the government under the control of the CCP radically changed the financial structure developed during the 1840 to 1949 period. The financial system that ensued was vastly different to the previous one, but nevertheless drew heavily on existing Chinese traditions and institutions.

4.2 THE CHINESE BANKING SECTOR: PRE-REFORM PERIOD (1949 to 1978)

After the Chinese Communist Party took over China in 1949, the financial industry underwent a process of restructuring and nationalisation. There was a perceived need to set up the economy's centralised banking system to perform an ancillary role in the centrally planned economy's development. The lack of experience in instituting a banking system that was relevant to a centrally planned economic structure resulted in the direct adoption of the Russian's monobanking system⁴, in the mid-1950s. The Stalinist system acquired by the Chinese was closely tied to the central plan that

⁴The monobanking system refers to a country's banking system in which its national bank incorporates the operation of other banks, and serves as both the central bank and commercial bank (Wilczynski 1978).

determined the production output in the economy. In this system, the type and level of banking activities undertaken by the banking system were largely dictated by the two types of financial flow that were required by the planned economy.

4.2 A) Financial Flows during the Pre-reform Period

There were two distinct and separate financial flow systems, cash and credit, in the pre-reform economy (Yan 1993). The cash system primarily involved transactions between the state sector and the household sector, in which the flow of cash payments from the former to the latter included wages, agricultural product purchases from the farmers, payment of subsidies and interest payments on savings deposits. The flow of receipts, from the latter to the former, included payment for household consumption, rent, taxes, licence fees and savings deposits. The credit system mainly served the state-owned enterprises or government entities, in which case transactions involving credit received from the specialised banks and payments made to other enterprises and government entities were conducted on cashless basis via current bank accounts. The use of credit instruments such as cheque, bill of exchange, et cetera, to facilitate transactions did not occur. The payment of wages and salaries in cash to households involved transactions that occurred in the aforementioned cash system. The flows in the two separate domestic financial flow systems were based on the central plan, which determined the required physical input and output production.

4.2 B) Bank's Role in the Financial Flows

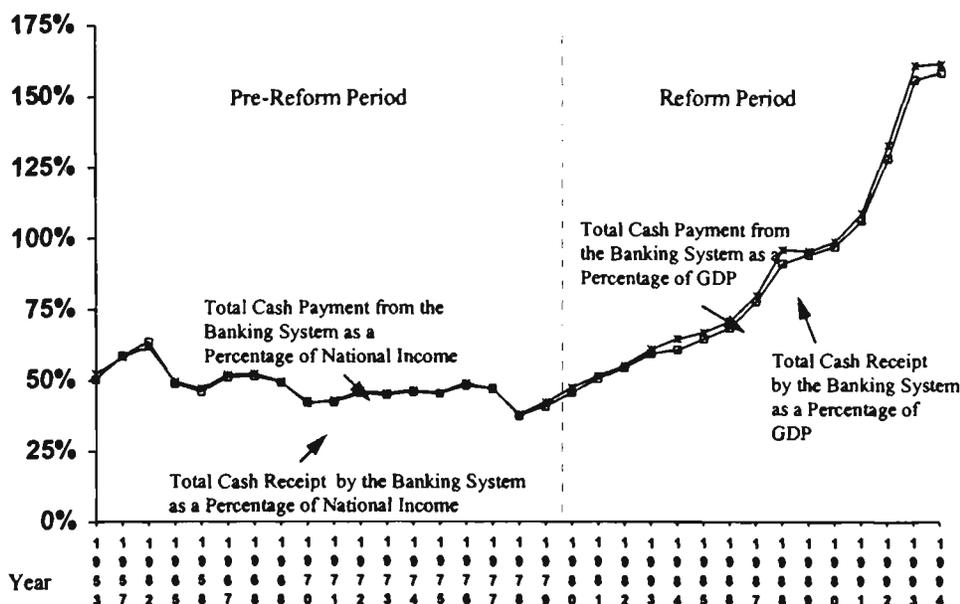
Under China's socialist system, the banks provided the amount of money required to produce the predetermined amount of output, allocated the predetermined amount of funds to the individual entities and supervised the utilisation of funds in accordance with the requirements of the central plan. Generally, banks dealt primarily with money and credit creation in their financial intermediary role. As compared to the capitalist system, the financial intermediary activity level and role of the Chinese socialist banking system was very limited. This was because money and credit were subjected to a different treatment and took on restricted meanings in the socialist country.

4.2 C) The Significance of Money in the Socialist Economy

The significance of money to the socialist system is best understood from the original socialist financial system that was first described in theory by the Russians, as well as from its actual operation in practice. In theory, it was envisaged that a pure socialist economy's activities should be based on physical magnitude (units of input and output) and on cashless settlement, and that money or cash should not have any place in the completely centralised planning system (Wilczynski 1978). However, the reality of the socialist system required that money be introduced to accommodate the 'exceptions' in the system, for transactions that could not be settled in physical terms or through cashless settlement. Thus, it was found necessary that there be a cash system in the economy. From this perspective, money was never expected to have broad functions in the socialist processes, and it was used chiefly as a token of accounting. In this way, the banking system functioned largely as a bookkeeper in the economy's financial cash system.

The money supply in the socialist economy was highly regulated. Money supply and creation were the exclusive right of the state. Any excessive money was considered detrimental to the planned financial and real flows within the economy. In the socialist context, money served as an indicator of price rather than a store of value. Because monetary policy was tied closely to the physical plan and output was determined, an unexpected excess supply of money would upset price stability and bring about inflation. In addition, open market operations had no relevance in the control of monetary conditions within the socialist economy. In this manner, there was always a constant need for the socialist government to strike a balance between the volume of currency in circulation and the volume of goods and services available for consumption in the system. Money, therefore, did not play a productive role in the socialist economy where the market forces were absent, money circulation was highly regulated and production was strictly governed by physical plan. This monetary condition is reflected by the chart below, which reveals a generally stagnant level of cash flow in the financial cash system during the pre-reform period.

Figure 4.1 - Total Cash Receipt and Total Cash Payment of the Banking System as a Percentage of National Income or GDP



Source: Zhong Guo Cai Zheng Tong Ji 1950-1985 (1987), Almanac of China's Economy 1995, A Statistical Survey of China 1994, China Statistical Yearbook 1995

As all transactions, whether cash or cashless settlement, had to be handled via the banking system, the generally stagnant level of cash flow is also attributed to the ban imposed on the banking system in relation to credit creation.

4.2 D) Banking and Creation of Money and Credit

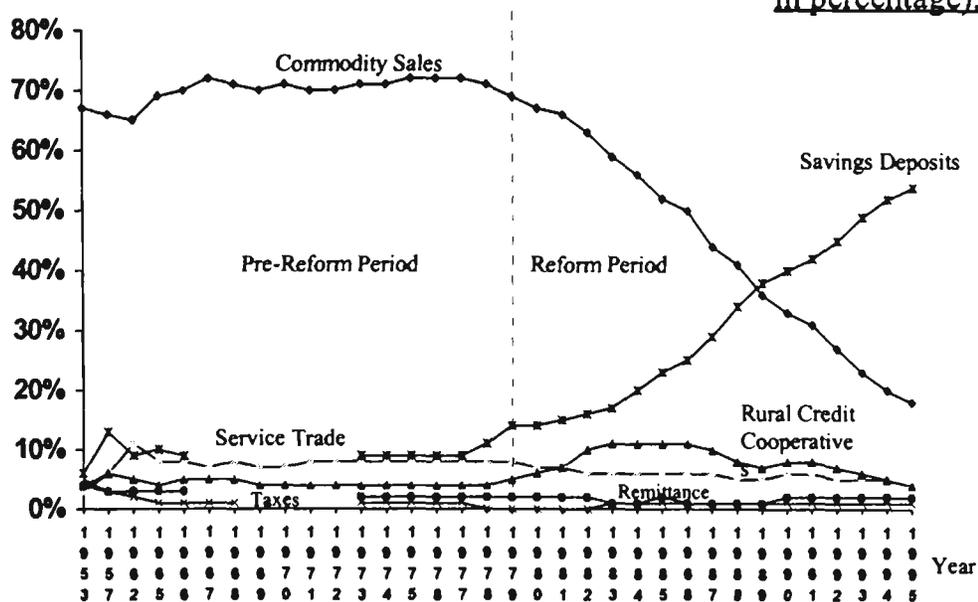
In the capitalist economy, the creation of money supply normally involves a complex and active interaction of four parties, namely the central banking authorities, banks, savers and borrowers. Both transactions between the central authorities and the bank, and increased lending by the banks to the public, can increase the supply of money. China's socialist banking system virtually had no independent role in the creation of either money or credit from the funds deposited by the households and the state-owned enterprises. The banks merely acted as financial agents of the Ministry of Finance, and the inflow and outflow of money⁵ effectively belonged to the latter. The inflow and outflow of money and credit were closely governed by the national mandatory cash and credit plan, prepared by the People's Bank of China (or effectively, the Ministry of Finance) and consistent with the national physical plan.

⁵In principle, even if they were household deposits.

i) **Financial cash system.** During the pre-reform period, the banks were the only group of financial institution allowed to accept savings deposits. There was no enterprise savings, as cash or savings holding by enterprises was prohibited. The level of household savings deposited at banks was very low. The household had little disposable income for savings since the government took care of most welfare items and wages were low. Deposit of personal savings at the banks was often encouraged for the purpose of reducing the amount of currency in circulation. The term structure of interest rate did not reflect actual market conditions within the economy (Lyons and Wang 1988). Interest rates were never used as an incentive to attract savings. The socialist system required that assets and income were the subject of common ownership, that is the property of the whole society, and therefore, no private interests were tolerated in the economy. Private individuals who hoarded a substantial amount of assets and income risked being charged with contempt by society. This socialist ideology synchronised with the fact that money or cash was to be paid to the household only for transactionary purposes rather than for precautionary and speculative purposes (the last two were considered ‘undesirable traits of capitalism’ by the government). Hence, individuals were more inclined to hoard money privately than to deposit the excess income into the transparent banking system. As a result, there were times when the government had to coerce the deposit of savings into the banking system through emotional propaganda and pressure. Overall, the financial intermediary role of the banks for savers was minor during the pre-reform period⁶. This is reflected in the charts below, which show the types of cash receipt and payment which occurred in the banking system. Cash received and paid in savings transactions constituted about 9% of the overall cash activities in the banking system between 1953 to 1978.

⁶This is also evidenced by the chart in Figure 5.9, entitled ‘Indicators of Banking Intermediary Development’ in Chapter 5, which shows that the intermediary role undertaken by the banking system was much more underdeveloped and passive during the pre-reform period than the reform period.

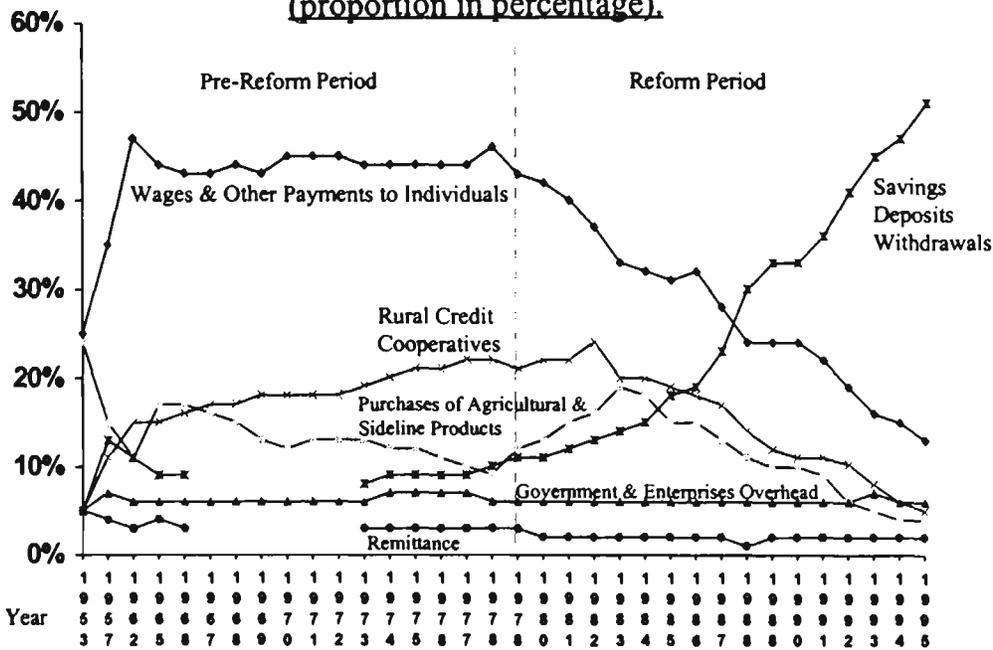
Figure 4.2 - Nature of Cash Receipts by the Banking System (proportion in percentage).



Source: Almanac of China's Finance and Banking.

The banking system mainly handled cash receipts which arose from commodity sales, which in turn largely took place in the product market (one of the 'exception' transactions in the socialist financial system). This constituted about 70% of the banking system's total cash inflow during the pre-reform period. However, the consumer market in the Chinese socialist economy was very small, as compared to that in a capitalist economy, since a substantial portion of a household consumption requirements were fulfilled through the use of ration coupons in lieu of money. For the state-owned enterprise sector, no enterprise was allowed to hold cash. The cash received by the bank belonged to the Ministry of Finance, and the bank had no autonomous power to handle cash receipts, other than as directed by the Ministry.

**Figure 4.3 - Nature of Cash Payments from the Banking System
(proportion in percentage).**



Source: Almanac of China's Finance and Banking.

The cash payments that enterprises were allowed to remit were largely wages to households for their labour services rendered in production. This was also considered one of the 'exception' transactions that could not be fulfilled through physical terms or cashless settlement. In the cash payment system, about 43% of the total cash outflow was conducted for wage payments through the banks during the pre-reform period.

ii) **Financial credit system.** During the period of the Chinese socialist economy, the banks primarily played a budgetary allocation role and a credit extension role. In the budgetary allocation role, the banks allocated a predetermined amount of funds to the predestined entities, which were all laid out in the national plan. In the second role, the banks were responsible for extending credit to state-owned enterprises and government entities to meet their additional or temporary need for working capital or additional investment capital. These activities were executed via bank accounts and, of course, were also governed by the national budget and credit plan (Wilczynski 1978). In terms of credit extension, trade credit extended among enterprises was forbidden in the centrally planned economy. The banking system constituted the only source of credit to the state-owned enterprises and government entities in the commercial and agricultural sectors. In turn, these state-owned enterprises and government entities constituted the

borrowing clientele of the banks. Bank credit was usually extended at low interest rate to these enterprises and entities, and loan repayments could be easily extended or written-off. Unlike the commercial banks in the capitalist countries, the Chinese banks in the socialist system did not have to take into consideration the risk profile of the borrowing enterprises, since they acted according to the directives issued in the credit plan. Unfortunately, this method of operation did not allow the banks to instill efficiency into the economy's production system, as the losses of the inefficient enterprises could be easily subsidised by means of government budgetary grants and further bank loans.

4.2 E) The Banking Role in International Trade

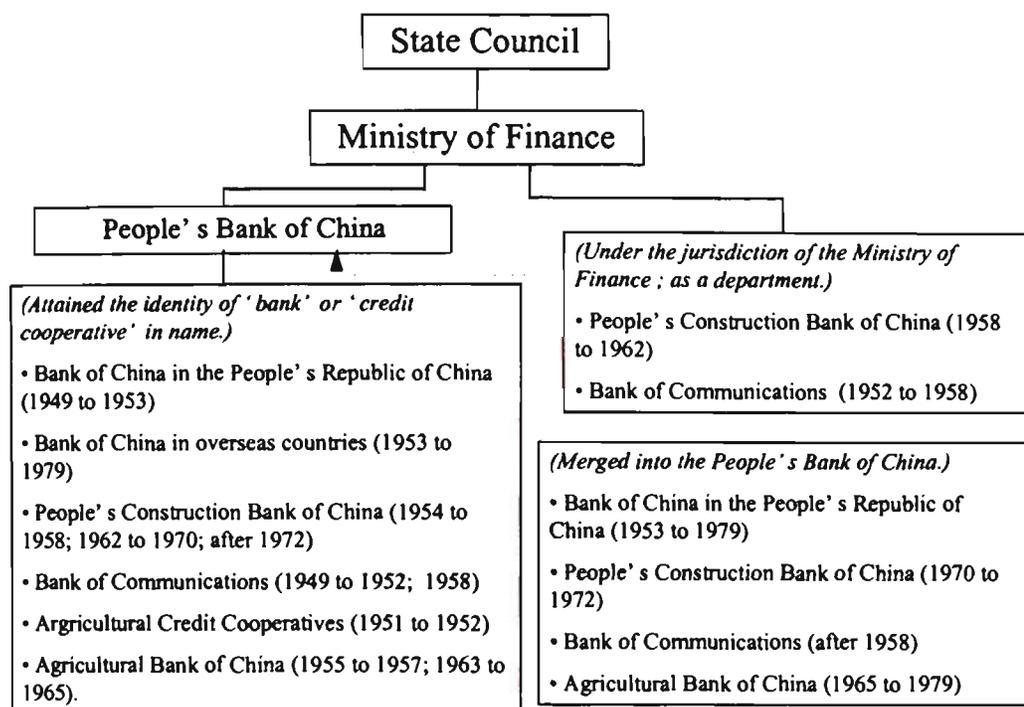
In the capitalist economy, financial institutions play an active function in their support of the economy's trade with the world. During the pre-reform period, the State played a heavy role in determining foreign exchange, external borrowing and import levels. It was through plans and administrative means of control that the State defined the economy's trade links with the international economy. The exchange rate merely acted as an accounting mechanism, to stabilise prices in the conversion between foreign and domestic prices. The Bank of China, which specialised in foreign exchange transactions, merely exercised the administrative controls set by the State.

4.2 F) The Dominant Players in the Banking System

After the country declared itself a republic in 1949, the next three years was an active phase involving the gradual nationalisation of the local private financial institutions by the CCP government. With the exception of two British banks, which were allowed to maintain representative offices in the Chinese territory, all foreign financial institutions had to terminate their business presence in China. From 1952 onwards, the specialised banks were subject to different institutional relationships at different times, as indicated in the charts below. Despite the changing structures and relationships (whether the specialised banks attained a separate 'bank' identity, were merged into the People's Bank of China, or were under the jurisdiction of the Ministry of Finance), they were all

in principle operated as a monobanking system and under the directive of the Ministry of Finance.

Figure 4.4 - The Monobanking System during the Pre-reform Period



The pre-reform banking system was dominated by the People's Bank of China, the Bank of China, the Bank of Communications, and the People's Construction Bank of China. These were subject to severe structural and functional changes during the 30-year time span - a disruptive period for the Chinese banking system in which it was plagued with creation, restructuring, abolishment and re-establishment activities as outlined below. Despite the severe changes experienced by the state-owned banks and cooperatives, they remained the core channels for the financial flows within the economy during the pre-reform period.

1. *People's Bank of China.* The bank was established in April 1948. Since its establishment, the People's Bank of China has functioned as both a central bank and a commercial bank for about 35 years⁷.

⁷The People's Bank of China became a full-fledged central bank in 1984, transferring its commercial arm to the Industrial and Commercial Bank of China.

From December 1948 onwards, the People's Bank of China was given the responsibility of issuing the country's standardised currency, the Renminbi, for circulation within the economy. This remains unchanged till today. In fact, the People's Bank of China has always retained its principal identity and had remained a core bank in times of mergers, demarcation or division within the banking industry. In the year 1952, which witnessed the consolidation of the socialist economy, the People's Bank of China became the monobank to regulate and manage the banking industry. The Bank of China's overseas business activities was incorporated into the People's Bank of China area of operations, while the Bank of Communications and People's Insurance of China were transferred to the control of the Ministry of Finance. The Agricultural Cooperative Bank, on the other hand, was dissolved. As a result, the banking structure became highly centralised and unitary, with the People's Bank of China operating as the only bank in the economy. However, the arena of the principal bank's activity was extremely limited, and was restricted to playing a subservient role to the Ministry of Finance in credit, savings and settlement activities. Lending activities were only for state-owned enterprises and in the form of working capital of a temporary and seasonal nature.

2. *The Bank of China* was built on the foundation of the Daqing bank in 1912. It operated as the international bank prior to its nationalisation by the government in 1949. In 1953, the Bank was appointed by the government to undertake and control all foreign exchange activities within the country, thus making it the economy's only specialised foreign exchange centre. The bank operated under the jurisdiction of the People's Bank of China and was referred to as the foreign exchange bureau of the People's Bank of China. However, it continued to retain a separate identity as the 'Bank of China' in overseas countries, where it has affiliated branches and assets, for the purpose of avoiding confusion. In both the domestic and overseas area of operations, it has played a passive role in the banking activities.

3. *The People's Construction Bank of China* was established in 1954 to take over the capital construction segment of banking activities from the Bank of Communications. It handled capital construction fund allocation and credit extension in accordance with

the state budget and relevant policies, especially in relation to the 156 economy development projects approved in the first Five-Year Plan (1953-57). In 1958, during the Great Leap Forward period, the central government placed the bank under the jurisdiction of the Ministry of Finance as its Capital Construction Financial Division and closed all its bank branches. It took on a name identity as a bank again in 1962 but was merged into the People's Bank of China in 1970 during the Cultural Revolution era. In 1972, it successfully regained its name identity as a bank yet again. Despite the separate identity in name as a bank, the bank operated in the capacity of a department for the Ministry of Finance. Its participation in capital accumulation for economic development was confined to the role of a fiscal agent for the Ministry of Finance.

4. *The Bank of Communications* has the longest history, being established in 1907. The government took over the bank in 1949 and thereafter shifted the headquarters to Beijing. Prior to 1952, the Bank of Communications came under the jurisdiction of the People's Bank of China. It was assigned with the responsibility for handling capital construction fund allocation and credit extension activities, and dealing in financial matters related to private and public joint-venture businesses and government bonds⁸. The bank was transferred to the bureaucratic structure of the Ministry of Finance in April 1952. In 1954, its role in the capital construction sector was taken over by the People's Construction Bank of China, but it continued to deal with financial matters of the different types of business. In 1958, when the Bank of Communications was merged with the People's Bank of China, its activities were reorganised to handle financial activities between the mainland and Hong Kong. This was necessary to manage the flurry of business transactions and reorganisation between these two countries, as a result of the restructuring of the financial and economic sectors under the control of the Communist government. The responsibility of the Bank of Communications in local activities was undertaken by the People's Bank of China and Construction Bank of China. Shortly after, the bank was consolidated with the

⁸ Private and public joint-venture business formation was the initial step in the Communist government's strategy to nationalise private businesses after 1949. There was a capital market for government bonds between 1949 to early 1950s in Shanghai, Tianjin and Beijing, but were all closed down after the Chinese internal movement in 1952.

People's Bank of China and ceased to exist within the same year of 1958. However, it was revived in 1986.

5. *Specialised bank for the agricultural sector.* During the pre-reform timeframe, several attempts had been made to establish a specialised bank to handle the financial matters of the economy's agricultural sector. Credit cooperatives were the initial common financial institutions established since 1951 to support the agricultural sector. However, they were all closed off as part of the major banking industry restructuring exercise in 1952, during the Chinese internal movement against 'the three evils' - corruption, waste and bureaucracy. These credit cooperatives were re-established in March 1955 to be known as the Agricultural Bank of China, but their service to the agricultural sector was lacking in strength and effectiveness. At that time, the branches of Agricultural Bank of China were absent at the 'grass-roots' level⁹, and they were situated in popular towns and cities, above the county level. In remote agricultural areas where the Agricultural Bank of China did not have a branch, the People's Bank of China branches played a substitute role in these areas. In 1957, the Agricultural Bank of China was shut down for its role in generating inflation. The bank was re-established again in November 1963, however the revival lasted for two years before it was then merged into the People Bank of China in 1965 (Yan 1993). It was revived in 1979 as a specialised bank to cater for financial activities in the agricultural sector.

4.2 G) Conclusion

After the communist party took over China in 1949, all local private-owned financial units were nationalised and absorbed into government ownership. The financial system of the country was restructured and modelled according to the system in the Soviet Union. The emphasis for the financial system in China throughout the preform period (1949 to 1978) was a monobanking system. Although few foreign banks were allowed to remain in the country for political reasons, they were entirely passive and their presence was confined to representative office status.

⁹In geographical localities that are below county level.

The financial flows in the Chinese central planning economy were largely governed by the predetermined physical plan. Financial flows were largely credit based, in which cash money had a low profile in economic activities. The financial system in the pre-reform period comprised state-owned banks, in which each catered to a specific sector of the economy. Although these banks experienced changes in their identity and reporting relationship during the pre-reform period, as a whole they functioned as an integrated entity and they remained accountable to the Ministry of Finance at the highest level. The banks in the central planning system were merely financial agents for the Ministry of Finance, and they performed their roles in budget allocation and credit extension according to the predetermined plan. Thus, their roles in the pre-reform financial system were simple and passive.

Overall, the financial activities of the monobanking system were restricted and limited, because there was no requirement for an active banking system in the central planning economy. Although the political instability and internal upheaval during the Great Leap Forward (1958 to 1959) and the Cultural Revolution (1966 to 1976) heavily disrupted the economy's financial activity, the financial structure of the central planning economy remained a monobanking system. This monobanking system continued into the reform period until 1984, when the Chinese government began to implement a two-tier banking system that is in line with the country's market economy transformation. The general characteristics of the financial system in the centrally planned economy of China constitute great contrast to the general characteristics of the financial system in the market economy, as outlined in the following Appendix I.

Appendix I

China has experienced many changes in its financial system structure between the pre-1949 period, the pre-reform, and in the reform period. The history of the financial system traced a development path that swung from an open and active financial industry (pre-1949 period) to a closed and passive monobanking system (1949 to 1983), and gradually towards a two-tier banking system that is in line with the country's market economy transformation (since 1984).

The central planning economy and the market economy harbour very different institutional structures and economic processes. Similarly, the market structure of the financial system in a market economy, which the government aims to realise in the reform period, is vastly different from the one in the communist era. At the time of writing this thesis, China is still at a transitional stage in achieving its targeted market economy's financial system. Thus, the pure market economy financial model¹⁰ is used to contrast the general characteristics of the financial system in a market economy with those in a central planning economy. Such comparison reflects the relevance of information technology applications in the two different financial systems, as expounded in the later chapters.

The very general and distinctive difference between financial system in the centrally planned economy of China and market economy are summarised as follows:

¹⁰This is a pure theoretical concept as there is no financial system in the world which is totally free of government intervention. This is because official intervention is sometime necessary to ensure the stability of the financial system.

Table 4.1 - Comparison of the Financial System in the Centrally Planned Economy and Market Economy

	General Characteristics of the Financial System in the Centrally Planned Economy of China :	General Characteristics of the Financial System in the Market Economy :
Types of financial market	Money market (banks and cooperatives)	Money and capital markets
Ease of entry into the financial market	Highly restricted	No barrier of entry
Profile of the financial institutions in the industry	Few large government-owned banks and cooperatives. Their operations are not governed by commercial criteria for profit.	A number of competing banks and non-bank financial institutions with different ownership structure. Each financial commercial unit is responsible for profit and economic consequences of their management.
Intermediary role	Limited	Active
Borrowing clientele	State-owned enterprises and government entities	Private individuals, private enterprises, state-owned enterprises, government entities, etc.
Type of banking system	Monobanking system	Two-tier banking system
Basis of bank function and behaviour	Budget allocation and credit extension roles in accordance to the central plan	Operates autonomously to market forces
Central bank role	Central banking and commercial banking functions	Central banking function
Monetary policy actions	Tied closely with the physical output plan	Direct and indirect mechanism
Instruments used in the Payment System	Cash and current bank account	Wide variety
Stock Market	Not in existence	An efficient stock market should have the following features : high market capitalisation level, high stock turnover, liquid market, low market concentration, and low price volatility.

The financial system during the pre-reform period was deliberately simplified and passive. During this timeframe, there was no interest in an active banking system, despite the banks constituting the primary financial unit in the monobank system. In the pure market economy, on the other hand, the participants are not confined to the banks and the state-owned enterprises as clients. Financial intermediaries in such an economy include commercial banks, savings and loan associations and cooperatives, investment companies, and pension funds organisation. The market participation for these financial

units is also wider in scope, encompassing both the money and capital markets. The operation of these independent mercantile units are largely based on commercial criteria with an interest in profit making, from a broad clientele base, and not subjected to government directives. The socialist banks, however, played a contrast role, in which it merely acted in the capacity of a financial agent to the Ministry of Finance. In the central planning economy, the Ministry of Finance functions as a major source of investment funds and subsidies. And through the state budget mechanism, the banks serves as the Ministry of Finance's main channel for the budget and loan allocation. The budget allocation role and credit extension role were all governed by the plan, and there was no interest in a sophisticated intermediary role for the banking system. Thus, the efficient allocation of budget and the extension of credit according to the predetermined plan became the very core focus or performance concern of the socialist banking system. The intermediary function of the banks was entirely passive and quite different from that of the commercial banks in the non-socialist countries. Deposit savings were secured through government directives which required that enterprises surplus fund and household savings to be transferred or deposited into the banking system. There was no motivation for the banking system to be active in attracting deposits nor any need to be competitive in making loans. The capital market was not in existence. In addition, there was no inter-bank lending taking place in the socialist economy, and prudent foreign exchange activities were not of importance in the closed economy. Effectively, the banks' role was to manage the financial flow according to the pre-determined plan.

The basic intermediary function of a financial unit in the modern market economy, on the other hand, is to mobilise savings from savers (known as the 'surplus economic units' in economic terms) and channel them as loans to the ultimate borrowers (known as the 'deficit economic units' in economic terms). The effect of financial intermediation is to facilitate the flow of funds between the lenders or savers and ultimate borrowers, which should ultimately channel savings optimally into appropriate investment uses through the working of the market mechanism. From an economic point of view, this financial intermediary role has significant impact on the economy through its facilitation of decisions to save and invest. In turn, these decisions

ultimately affect the level of employment, production, and income within the market economy.

In their intermediary role, the financial institutions perform at least one of the following economic functions (Fabozzi et al. 1994):

- 1) The institutions balance the different liquidity preference between savers and borrowers, and thus encourage both savings and productive investment. This constitutes an active market role of the banks in the market economy.
- 2) The financial intermediaries offer a wide variety of financial products that enable investors to diversify their risk on a cost-effective basis. In contrast, the monobank in the central planning economy dealt with only cash and credit through the bank accounts.
- 3) In addition, the financial intermediary units are equipped with expertise and resources and benefit from scale economies, to conduct themselves as safe depositories and market-oriented financial units.
- 4) Central to the market-oriented financial intermediation structure, the payment mechanism facilitates the transfer of resources from surplus to deficit economic units, which are evidenced in its facilitation of domestic and international transactions. The financial intermediary units play an active role in enabling an efficient payment system to support economic activities, in terms of their support and adoption of advanced payment mechanism. Examples of advanced payment mechanism that are provided by financial intermediary units are cheques, credit cards, debit cards, and electronic transfer of fund. With the appropriate infrastructural support, this aspect of the financial system could contribute to the overall financial and economic stability of the economy.

In the pre-reform period, the financial system was dominated by a single bank (monobank system) which performed both the central banking role and the commercial banking functions within the economy. It lacked independence in its operation and is subservient to the authority of the Ministry of Finance. Conversely, the banking system in the market economy is a two-tier system in which the central bank is responsible for regulating the monetary condition in the economy and supervising the commercial banks or financial units that are responsible for deposit and loan transactions with

households and enterprises. The role of the central bank in the developed countries has the following characteristics:

1) It monitors the financial conditions and protects the stability of the financial system in the economy. By this role, the central bank is responsible in setting standards and implementing monetary policies to be followed by financial intermediary units, in which such central bank's course of actions have implication on the growth rate of monetary aggregate.

2) It advises and assists the government to implement stabilisation policy.

3) It acts as the lender of last resort to both the government and the banks.

4) It reports to the highest government authority (example, the Parliament or State Council) on its operations and the causes of major monetary events. Although the central bank ultimately reports to the highest government authority in the political system, the central bank must have considerable independence of action in the technical implementation of policy, and in communicating policy to financial institutions. This independence is necessary to enhance the credibility of monetary policy, which in turn, has a significant impact in sustaining the stability of the financial system with minimum real costs.

The profile of the specialised banks during the pre-reform period was, therefore, vitally different from a real commercial bank in nonsocialist economy, even though they had adopted the identity of a bank in their name in certain times during the pre-reform period. Their importance to the socialist economy could also be inferred from the fact that they were never the priority sector to be allocated with the best quality staff or personnel, as compared to other sectors. The next chapter outlines the changes in the Chinese financial system in the reform period and the system's transition to a two-tier banking system.

CHAPTER 5 : CHINA'S FINANCIAL SYSTEM IN THE REFORM PERIOD.

This chapter outlines the changes in the financial system during the reform period. In addition, it assesses the strength of the different financial units during the 1979 to 1995 period, with the aim of identifying the core financial units in the financial system.

5.1 THE CHINESE BANKING SYSTEM: REFORM PERIOD (1979 to 1995)

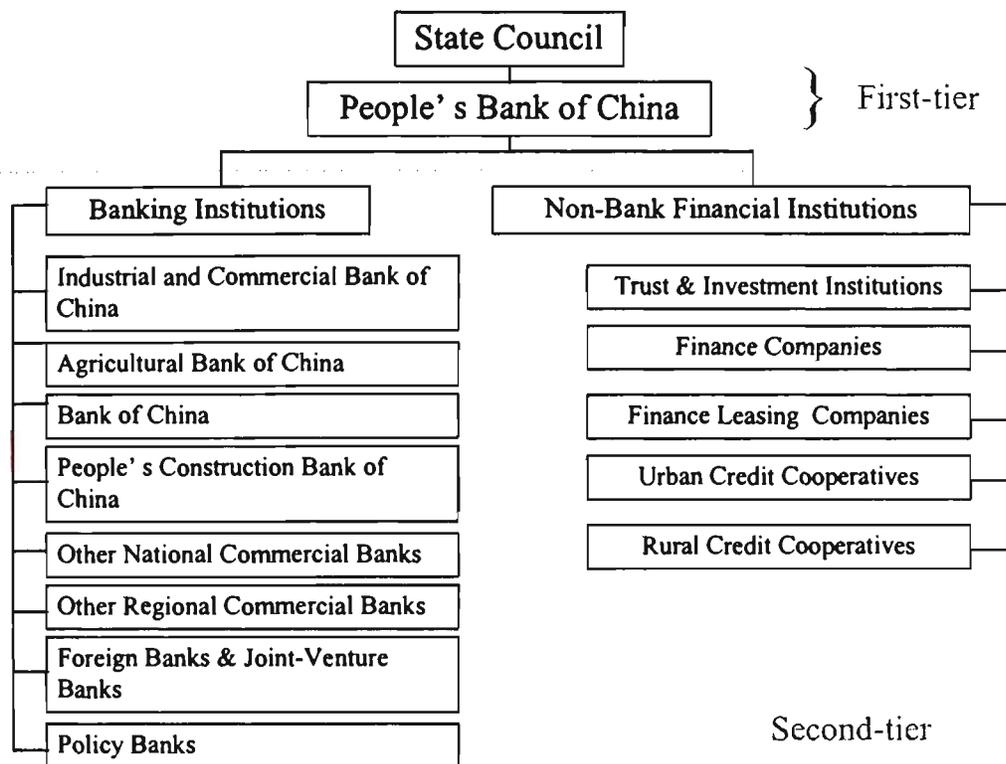
The decision made by the Eleventh Central Committee of the Chinese Communist Party in 1978 to transform the socialist country to a market economy also required the financial system in the economy to be reformed concurrently. This is because the support of a well developed and active financial industry is one of the requisite conditions for the full operation of a market economy. The development of the Chinese banking system during this process of reform is reviewed below.

5.1 A) New Roles Intended for the Domestic Banking System

During the reform period, several changes in the financial industries were targeted, reflecting the desire that the financial industry play an active and pivotal role in economy's development. Effectively, the banking sector has been the central focus of financial reform because of its relatively established standing as the active financial intermediary in the economy. In 1983, the State Council directed that the People's Bank of China function as the central bank and assume regulatory responsibility over the financial industry. This signified the breaking up of the monobank system in favour of a two-tier banking system, as the former was not considered to be conducive to economic growth in a market economy. In the two-tier banking system, the central banking and commercial financial roles and functions are

segregated and demarcated. In China, the central banking role and function is undertaken by the People's Bank of China. The commercial financial roles and functions, on the other hand, are handled by the newly transformed specialised commercial banks, newly established policy banks and commercial financial units, which all operate under their separate identity and independent jurisdiction. The two-tier financial structure in China in 1993 was as follows:

Figure 5.1 - The Two-Tier Banking System in China



Source: People's Bank of China (1994)

As indicated in the chart above, the People's Bank of China has been restructured to be responsible directly to the State Council, and no longer to the Ministry of Finance. This two-tier structure of the financial industry setup also redefined the extent of power and influence in financial matters that the Ministry of Finance and the banking system could exercise within the economy. The Ministry of Finance was to reduce its control over banking activities, giving greater independence to the central bank in its regulatory and supervisory roles, and to the banks in their intermediary functions.

Several developments in the relationship between the banking system and the economic system also highlight the increasing importance of the financial role destined for the banking system relative to that of the Ministry of Finance. Since 1983, the state-owned enterprises have been required to turn to the banking system, instead of the Ministry of Finance, as the major source of funds for working capital¹. From 1985 onwards, funding of basic capital investment was no longer a responsibility of the Ministry of Finance. Instead, state-owned enterprises have to secure bank loans or other sources of funds to finance such investment. Simultaneously, the nature of the functions and market positioning of banks had to change. The specialised banks were to be transformed into commercial banks to provide essential credit to the economic sectors. The system of bank lending with interest payments and principal repayment was introduced in 1985, to replace the traditional allocation of funds from the state budget. To support the functioning of an open market economy, the system of linking lending activities to deposits received in the banking system was implemented, which effectively allows decentralised decision making at the level of local bank branches (grass-roots banks)². The line of market demarcation across the different specialised banks, in which each bank exclusively handles certain economic sectors, was abolished to allow market competition across sectors in 1986. In addition, banks were allowed to extend credit to industries in the tertiary sector (like the hospitality and tourism industries). This was a contrast to the banks' previous restricted lending activities, during the pre-reform period, when they were normally confined to industries in the production sector. Overall, banks in the reform period were encouraged to compete with one another across the industry and without regard for market segmentation, and to assume responsibility for their profits and losses as state-owned commercial banks. In other words, the state-owned banks were expected to undertake a more market-oriented and active commercial role, and to be prudent in the management of their assets and liabilities.

In conjunction with this newly assigned role, the banking system was also allowed to take on new facets of market activities. The establishment of an inter-bank market

¹ Since 1983, more than 80% of the increase in working capital has been loans from the banking system (Jinrongshibao 29/3/1991 and 9/7/1996).

² In other words, bank branches are able to exercise their discretion in deposit taking according to the demand for loans in their respective localities.

was approved by the central bank in 1984. The inter-bank market was established for the purpose of facilitating the flow of funds in the banking system and of enhancing the intermediary role of the banks. An agency role in public fees collection and in wage payment was also gradually undertaken by the state-owned banks, based on a service fee charged to their principals. With the flourishing of new market activities, payment instruments like personal cheques, credit and debit cards, which were nonexistent during the pre-reform period, began to be introduced into the country. The government also identified increased payment system efficiency as a prerequisite for achieving a fully operational market-oriented banking system. The Eighth Five-Year-Plan was the first time that information technology was emphasised at the national level, for adoption to upgrade the national payment system. The banks were expected to play an extensive role in realising this objective.

The activities of the local banks also started to expand to overseas markets as well at this time. For example, banks began to issue bonds in both the domestic and overseas markets in 1985.

Entry restrictions in the domestic banking industry also began to fall, on a gradual basis, to different types of financial business formation. This is evidenced by the increasing number of foreign financial establishments in the country over the period since 1979 (see section 5.2), the emergence of a network of non-bank financial institutions during the mid-1980s and the admission of the first private commercial bank, Minsheng Bank, in 1995. In term of business scope, the government opened the domestic market in the Pudong region (Shanghai's new financial district) to foreign bank direct participation in 1997, as the first experimental district to allow foreign banks to deal in local currency business.

At the central bank level, efforts were made to adapt monetary control instruments to the changing structure of the banking industry. The credit or budgetary allocation system is gradually being replaced by various direct controls exercised by the central bank, such as central bank refinancing quotas and bank-specific ceilings supplemented by reserve requirements and special deposits with the central bank. The status of the central bank was reinforced during the 1990s, in the form of legislative empowerment of the People's Bank of China to exercise a more dynamic role as a central bank in ensuring a safe and effective financial system.

In fact, continuing efforts to introduce a greater degree of market behaviour into the financial system and to eliminate illegitimate activities are evident in changes in the legislative and regulatory framework, especially after 1994.

5.1 B) The Dominant Players in the Market

The section below summarises the changes faced by the dominant market players since the initiation of the reform:

1. People's Bank of China .

Several changes occurred in the role of this bank from 1979 onwards, transforming the bank into a vital economic unit in the economy's development path. The People's Bank of China attained its independence, separate from the Ministry of Finance in 1983. It was also given wider discretion and independence in its lending activities. In January 1984, the People's Bank of China severed its direct involvement in commercial credit and deposit operations, and assumed the official status of a central bank. The Industrial and Commercial Bank of China was specially created to take over the severed commercial arm of this bank. Gradually, the People's Bank of China adopted the functions typical of central bank in industrialised countries.

2. The Industrial and Commercial Bank of China. Though this bank was established in 1984, its significant share of market activities at that time was derived from the lateral transfer of established business activities from the traditional key player, the People's Central Bank of China. The transferred commercial portfolio consists of urban banking business which specialised in savings deposit and lending to commercial enterprises. In 1996, it still held the top position as the highest savings deposits bank, holding two-thirds of the nation's savings deposit.

3. The Bank of China. In 1979, the Bank of China was appointed by the government to play a crucial role in the country's import and export policies. The bank underwent a restructuring exercise in order to fulfil this important assignment. In addition, it

took on a new role as the clearinghouse for domestic transactions denominated in foreign currencies. Its activity in foreign exchange was further increased with the semi-floating currency system, with the Chinese yuan pegged against a basket of seven major foreign currencies, instead of just the Swiss franc used in the earlier reform period. Through this activity of pegging the Chinese currency against a basket of seven major foreign currencies, the bank became a major driving force in encouraging hi-tech import for industrial modernisation and export to earn foreign exchange. It also provides financial credit to enterprises with export potential, in line with the country's trade orientation strategy. In 1992, the bank was listed as the world's eighth largest bank dealing in foreign business transactions. Among the domestic financial institutions, the Bank of China has the most extensive presence in the overseas countries especially, in Hong Kong³.

4. Agricultural Bank of China.

After the various episodes of attempt and failure in establishing a specialised bank for the agricultural sector, a specialised agricultural bank was revived in 1979 and was named as the 'Agricultural Bank of China'. This bank has been responsible for financial intermediation, mainly supporting the rural areas in its agricultural activity. The most active part of its banking business covers loans to state-owned enterprises in the rural areas and loans for rural agricultural activities such as crop advances, agricultural capital investment, and farm development. In 1980, the Rural Credit Cooperatives came under the charge of the Agricultural Bank of China.

5. People's Construction Bank of China (China Construction Bank).

In 1979, the pre-reform accountability relationship of this bank to the Ministry of Finance was realigned. The People's Construction Bank of China became a unit of the State Council and the authority of the Ministry of Finance over the bank was confined to managing it on behalf of the State Council. Even after 1983, when it was granted the status of a named bank, it was on one hand under the leadership of the Ministry of Finance for matters relating to fiscal business and, on the other hand, was accountable to the central bank for its credit policies. The People's Construction

³ In 1994, it has 24% of the market share in Hong Kong.

Bank of China manages the funds for capital construction for the Ministry of Finance, and is also involved in deposit activity and commercial lending to the construction industry. In 1996, the bank changed its English name to 'China Construction Bank'.

6. Communication Bank of China.

The bank was re-established in 1986 and subsequently stabilised in 1987 with a shareholding configuration comprised of the state, state enterprises and private individuals. Because this bank was re-established (since its dissolution in 1958) after the abolishment of market demarcation and the implementation of the two-tier banking system, the bank operates as a comprehensive bank in that it handles a wide range of banking activities (including securities and insurance). It was claimed to be the first bank in China to undertake profit and loss responsibility (Shen 1995). It has an important role in promoting both domestic and foreign investment in China, and is authorised to deal in domestic and foreign currencies.

In the 1979-1995 period, China experienced a relatively higher degree of political stability than the pre-reform period. The economy has also began to transit from an era where cash had minor relevance in economic activities (refer to Chapter 4 Section 4.2) to one where money has an active and productive role (as portrayed by the graph showing an increasing trend in cash circulation and usage in Chapter 4 Figure 4.1). In conjunction with this transition, the graph in Figure 4.2 of Chapter 4 revealed that the banks are increasingly playing an active financial intermediary role in support of economic activities.

The extent of financial intermediation undertaken by the Industrial Commercial Bank of China, the Agricultural Bank of China, the Bank of China, and the Construction Bank of China in the financial market may be determined from the proportion of national loans outstanding and deposits held by all these banks. The table below reflects the dominant position of the these four specialised banks in the financial system between 1985 and 1995, although the extent of this dominance has been declining over the years :

Table 5.1 - The Extent of the Financial Intermediary Role Played by the Four Specialised Banks in China

Share of National Total		
Year	Loan	Deposit
1985	93 %	93 %
1986	93 %	93 %
1987	90 %	86 %
1988	89 %	81 %
1989	89 %	77 %
1990	88 %	73 %
1991	87 %	88 %
1992	86 %	89 %
1993	79 %	69 %
1994	67 %	68 %
1995	63 %	63 %

Source : Almanac of China's Finance and Banking (1991, 1994 to 1996).

The abolition of market specialisation and the entry of locally established competitors have gradually eroded the dominant position held by the Industrial and Commercial Bank of China, the Bank of China, the Agricultural Bank of China, and the People's Construction Bank of China (China Construction Bank). Nevertheless, the banking industry in China between 1979 to 1995, which is the period focused on in the thesis, was an oligopolistic market structure that consisted of the state-owned banks as the dominant players, surrounded by a large number of small and medium banks. The industry structure configuration, in terms of asset holding, in 1993 was as follows :

Table 5.2 - The Asset Holding of the Different Financial Units in China in 1993

<u>Financial Institutions</u>	<u>Market Share</u>
Industrial and Commercial Bank of China	34.4 %
Agricultural Bank of China	17.2 %
Bank of China	8.3 %
People's Construction Bank of China	13.2 %
Non-bank Financial Institutions	22.8 %
Other Commercial Banks	4.1 %

Source : People's Bank of China (1994)

In the earlier part of the reform period, the above four state-owned banks' dominance has been accentuated in part by the exclusive rights awarded to each respective bank to handle financial matters in particular sectors in the economy in the past and, in part, by the recognition in the national strategies that they are central economic units in overall economy reform. The clientele base of these four previously specialised state-owned banks in the reform period remained quite similar to that when the system endorsed an exclusive industry focus for their financial activities⁴. As the reform of the financial system develops, the market dominant position of these banks should be dissipated in the long run by the entry and active participation of other financial units. In the interim, the state-owned banks are expected to remain the core financial units at the transitional stage of the country's movement towards a market economy. The subsequent sections in this chapter further substantiate this expectation, by reviewing the functions of the other agents in the financial system of the Chinese economy.

5.2 THE FOREIGN BANKING SECTOR.

The revolutionary event in 1949 resulted in the withdrawal of many foreign banks from the scene or, in the case of the US banks, they were penalised heavily (through property expropriation or the freezing of assets) for their country's role in the Korean war. However, not all the foreign banks were ousted from the Chinese banking system, as the Hong Kong and Shanghai Banking Corporation, the Standard and Chartered Bank, the Overseas Chinese Banking Cooperation, and the Bank of East Asia were allowed to remain, largely for political rather than economic reasons.

Since the heavy exodus of the foreign banks, the national banking system has undergone several deliberate changes to the role of those banks which remained, mostly in accordance with the political climate. In spite of the continued involvement of the four banks noted above, the closed economy era of 1949-1979 cut off any

⁴For ease of reference, the terms 'specialised state-owned banks' continued to be used in the thesis to refer to the Industrial and Commercial Bank of China, the Bank of China, the Agricultural Bank of China, and the China Construction bank, even though the context is at the reform period in which market demarcation was abolished.

active presence of foreign banks in the industry. Through the People's Bank of China, the government took steps to revoke the privileges enjoyed by the foreign banks in China, and consolidated and transformed private financial institutions firstly into public-private joint-venture banks and then eventually nationalised them (Yan 1993).

With the open door policy in 1979 and the rapid growth experienced by the Chinese economy, the Chinese government declared the financial market opened to foreign banks in 1984. Despite this declaration, barriers to foreign entry have been high and these banks have been heavily restricted in their business location and activities. Nevertheless, the number of foreign financial institution into China has been on the increase since 1979, as shown in Table 5.3 :

Table 5.3 - Number of Foreign Financial Institutions in China

Year	Number of foreign financial institutions in China
1979	33
1987	181
1990	209
1992	304
1994	404
1995	603
1996	694

Source : Jinrongshibao 7/9/1987, 8/9/1992, 22/7/1995, and 28/6/1997, Dipchand et al. 1994 and People's Bank of China (1996)

The main purposes of the foreign banks in establishing an early presence in the huge potential Chinese market were to provide support to their clients from their home country and also to prepare for the opening up of the local currency business to them, which would spell substantial business market potential for well established foreign banks. The local currency business opening had been assessed by experts to be inevitable, in view of the external institutional pressure, for example China's desire to qualify for WTO membership (Zhang and Zheng 1993, and Dipchand et al. 1994),

and also of the evolution of a financial system that supports the development of a market economy. This assessment was in part realised in 1997, during which year nine foreign banks were permitted to deal in the domestic currency (Chinese yuan or Renminbi) business in the Pudong region (Jinrongshibao 2/4/1997).

Foreign participation in the China's banking industry took the following forms as of March 1994:

Table 5.4 - Types of Foreign Bank Participation

Types of foreign bank participation	Number
Joint Venture	10
Branches	82
Subsidiaries	10
Representative Offices	302

Source : KPMG 1994 and Research Centre of People Construction Bank of China (1994).

The market share of the foreign banks (in subsidiary and branch) is estimated to be not more than 3%. The total value of assets of foreign funded banks in China was US\$11.8 billion in December 1994, with deposit savings at US\$2.49 billion and loans US\$7.5 billion. These amounted to 2.0%, 0.7% and 1.7% of the aggregate values for the four state-owned banks respectively. These values increased by December 1995 to US\$19.14 billion, US\$3.1 billion, US\$12.75 billion respectively, with the relevant percentage being 2.1%, 0.7% and 3.0% respectively (Jinrongshibao 2/4/1997). Thus the level of participation of these foreign banking institutions remains very low, but is growing significantly.

Foreign participation has been known to be a conduit for ready access to advanced level of technologies and know-how, and also to provide a pool of financing resources (Conroy 1992). The Chinese government has been using foreign direct investment for this purpose since 1978 in large and heavy industrial sectors (Khan 1991). According to the KPMG (1994) report, the rationale for the admission of foreign banks is to attract foreign capital and banking expertise. However, the regulated industry has heavily constricted the scope of foreign activities and influence, for fear of loss of domestic market control. The extent of the opportunity for the domestic economy to tap foreign banking expertise, in the area of banking

technology and techniques, has been limited. This aspect of technology transfer by foreign banks will be further examined in Chapter 9.

Though a greater role for the foreign banks in the industry (in the areas of local currency denominated deposits and loan transaction) is intended, the scope of market opening will be on a gradual basis. The 1996 announcement that the Pudong district in Shanghai will be the first test city open to foreign entry has caused concern among the domestic banks. Foreign banks were known to have performed well despite the restriction imposed on their business scope and activity. When the foreign banks were not authorised to engage in Renminbi banking business, 90% of their income was earned from trade bills discounting for importers and exporters and fees from document processing. This remained the same for foreign funded banks which were not granted access to the Renminbi market (Jinrongshibao 28/6/1997). The Bank of China in Shanghai has expressed the view that foreign banks will pose a serious challenge to its foreign trade settlement business, and have the potential to cut its business by 50% (China Daily 18/3/1996). This view is representative of the attitude of Chinese local banks on foreign bank entry (Dipchand et al. 1994). The local banks feel threatened by the foreign participants, especially in the international business area, and regard them as competitors with much higher levels of competitive advantage in capital resources, skills, services, and technology.

The strength of the foreign banks in this business area was illustrated by the case of Dalian, where state-owned banks started to provide foreign exchange deposit services in 1988. After about seven years in foreign exchange business, the total foreign exchange deposit achieved by the four dominant state-owned players (Industrial and Commercial Bank of China, Bank of China, China Construction Bank, and Bank of Communications) in Dalian's financial market in 1995 totalled to US\$400 million. The six foreign banks, which were only allowed to deal in foreign exchange business about two years ago, had achieved three-quarters of the state-owned banks foreign exchange business in 1995 (Jinrongshibao 22/7/1995). This has greatly alarmed the state-owned banks.

On the one hand, heavy protection has been accorded by the government authorities to the Chinese commercial banks, so that the protection of the interests of the Chinese banks was a priority in any new changes to be made. On the other hand, the

Chinese government found foreign banking participation indispensable in its newly emerged market economy, as China's local commercial banks are experiencing severe capital and credit shortages in attempting to meet all the needs of growing business activity. The Chinese government preferred to maintain control over the finance industry, rather than to take the opportunity of rapid financial development offered by the full participation of the foreign banks. Therefore, to avert the loss of control over the banking industry, foreign banks were initially only allow to serve foreign business investors in the Chinese economy. Paradoxically, the customer scope of these foreign banks - mainly limited to foreign business enterprises, Sino-foreign joint-ventures and cooperative enterprises - has precluded their involvement with the high risk major default borrowers which are the state-owned enterprises. The relative credit standing of these enterprises may be drawn from a survey conducted by the People's Construction Bank of China, Guangdong branch, in which 92% of loan default was committed by the state-owned enterprises while the remaining 8% was by Sino-foreign ownership enterprises (interview source).

The foreign funded banks have generally performed well. In 1996, their average return on assets was 6%, and their after tax rate of return on investment was reported to have increased by 31% over 1995 (Jinrongshibao 28/6/1997). The foreign banks are keen for a more active role in the finance industry. This aspiration is reflected in their outlook on the tax concessions that they enjoy. Although foreign banks are subjected to lower tax rate (15%) and preferential taxes (15-30%) for banks located in the special economic zones and coastal region, relative to a 55% tax rate for the local Chinese banks, the foreign banks would rather forego these 'special concessions' for a wider business scope (The Banker, January 1996).

It is expected that the opening of the overall Chinese financial system will continue to be on a gradual and cautious (experimental) basis, despite the desire of the government to become a member of the World Trade Organisation, which encourages its members to open their domestic local currency banking sector to foreign banks.

5.3 THE CAPITAL MARKET

While a detailed study of the types of influence that a flourishing capital market has on economic activity is beyond the scope of this thesis, it is generally accepted that there are strong positive linkages. The capital market in the modern market economy is often characterised as a permanent source of funds for enterprises. Without the capital market, growth opportunities for private enterprises will be dependent on internal retained earnings and on institutional credit. The capital market extends the range of financial services available for the enterprises to seek access to capital.

The Chinese capital market officially commenced operation during the early 1990s, with the establishment of the Shanghai Securities Exchange in 1990 and the Shenzhen Stock Exchange in 1991. Prior to the official recognition of these two stock exchange markets, fragments of capital market activities had been present during the 1980s. Government bonds were first issued in 1981 but were not subjected to open market placement. Trading of bonds and shares were not allowed until 1986. In August 1986, a secondary market was established on an experimental basis in Shenyang for the trading of authorised securities at controlled prices. Similarly, markets for the trading of government bonds were also first established in April 1988 on an experimental basis in restricted cities and subsequently extended to other cities. Subsequently, such markets began to appear in other areas. After the two main stock exchanges in Shanghai and Shenzhen were established, share trading was eventually legalised on a nationwide basis in March 1991. Presently, there are two main stock exchange markets that handle primary and secondary transactions⁵, and twenty stock exchange centres that handles secondary transactions.

5.3 A) Capital Market Situation in China

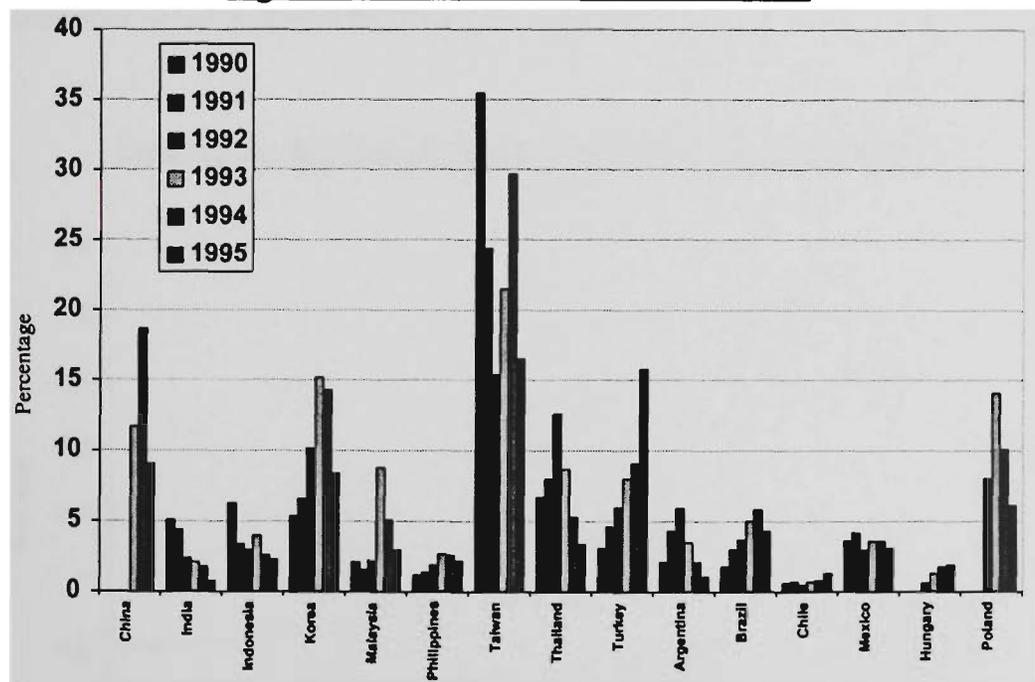
While acknowledging the shortcomings in the available empirical indicators of stock market development (International Finance Corporation 1995), turnover and market capitalisation ratios can be used to provide some insights into the development of the capital market in China. These indicators suggest that the capital market is still

⁵ Primary transactions are subscription transactions of newly issued stock, whereas secondary transactions referred to trading of already issued stock.

rudimentary in development and that the banking sector will remain the core financial sector in the country for some time.

Turnover ratio. The turnover ratio⁶ is normally used by analysts as a measure of the liquidity of the capital market. Empirical evidence suggests that a liquid capital market is favourable to economic activity (Levine 1996). High turnover ratios may indicate low transaction costs, as is the case in big and active capital markets such as those of Korea and Germany (Demirguc-Kunt and Levine 1996). Alternatively, this ratio may also be driven to a high level if active trading is due to an excess demand for shares which are restricted in availability in the market. This is the situation for the capital market in China. The graph below shows the turnover ratios for the capital markets of a number of countries. It is apparent from the graph that China has a comparatively higher turnover ratio than most of the other developing or transitional countries, other than Taiwan.

Figure 5.2 - Stock Market Turnover Ratio



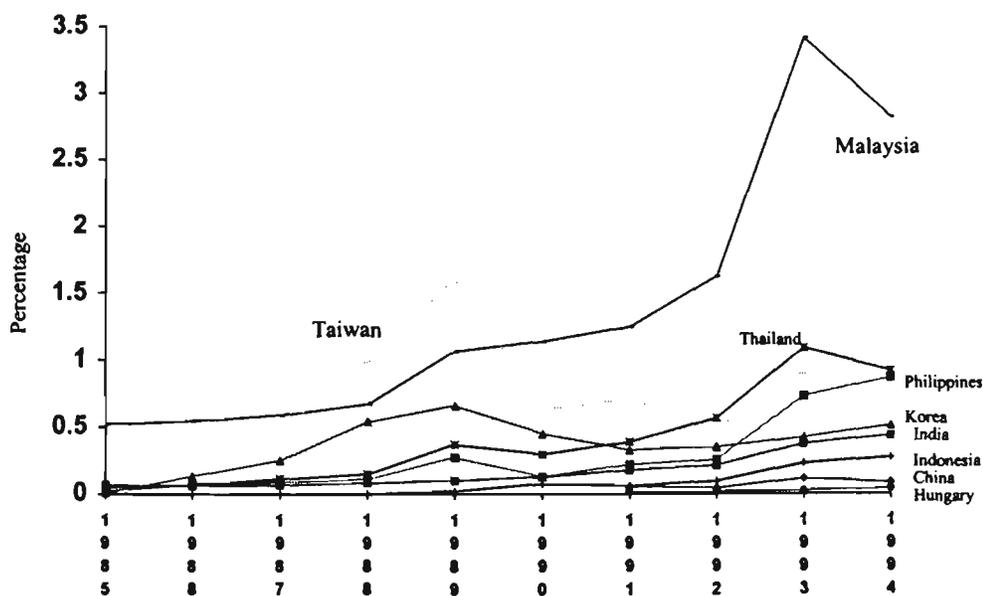
Source: International Finance Corporation, Emerging Markets database in International Monetary Fund 1996

⁶ According to the International Finance Corporation (1996, p.270), turnover ratio is the 'Total value of shares traded during the period divided by the market capitalization for the period, calculated in local currency. Average market capitalization is calculated as the average of the end-of-period values for the current period and the previous period.'

The turnover performance of the capital market in the industrialised countries like the USA (54%), UK (91%), Japan (24%) and Singapore (118%) in 1994 is much higher than that experienced in China (International Finance Corporation 1995). Thus China shares a relatively low turnover ratio with many developing countries, and to some degree its relatively high ratio within developing countries reflects rapid turnover of stocks in restricted supply rather than a deep and liquid share market.

Market capitalisation ratio. The market capitalisation ratio⁷ is often used as a measure of the relative size of a stock market to the local economy. The premise underlying the market capitalisation ratio is that market size has a positive relationship to capital mobilisation and risk diversification, so that if the market is large relative to the local economy firms will be able to raise capital and spread risk more readily. The chart below indicates that the relative size of the capital market in China to its domestic economy is much smaller than Malaysia, Taiwan, Thailand, Philippines, Korea, India, and Indonesia. This indicates that capital is less mobile (less liquid) and there is less opportunity to diversify risk (small market size) in the China's capital market, as compared to the selected developing countries.

Figure 5.3 - Market Capitalisation Ratio (as a percentage)



Source: International Finance Corporation 1995 and World Development Report 1996

⁷ The market capitalisation ratio is the market value of the outstanding shares divided by GDP in current prices.

Again, the market capitalisation ratio in the industrialised countries like the USA (76%), UK (119%), Japan (81%) and Singapore (195%) in 1994 dwarfs the level currently achieved by China (International Finance Corporation 1995).

Both the turnover and market capitalisation ratios indicate that the capital market in China is still rudimentary and underdeveloped. China fits into the description of a small but active market as outlined by the capitalisation ratio and high turnover ratios. In addition, researchers in this field, have described the market as lacking in liquidity, breadth and depth in its trading activity (Zhang 1993 and Dipchand et al. 1994).

The role of the capital market in financing economic activity in China is thus relatively small. This is reflected also in the table below that shows the annual flow value of securities⁸ issued by the listed companies and government in China's capital market to secure capital financing:

Table 5.5 - Annual Value of New Securities Issued Between 1981 to 1995

Year	Issues of Securities in China (yuan in million)	Expressed as a percentage of GDP
1981	4,866	0.10%
1982	4,383	0.08%
1983	4,158	0.07%
1984	4,253	0.06%
1985	6,561	0.08%
1986	19,251	0.20%
1987	24,787	0.22%
1988	50,344	0.36%
1989	49,321	0.31%
1990	93,936	0.53%
1991	115,324	0.57%
1992	194,520	0.80%
1993	49,545	0.16%
1994	207,677	0.46%
1995	261,192	0.46%

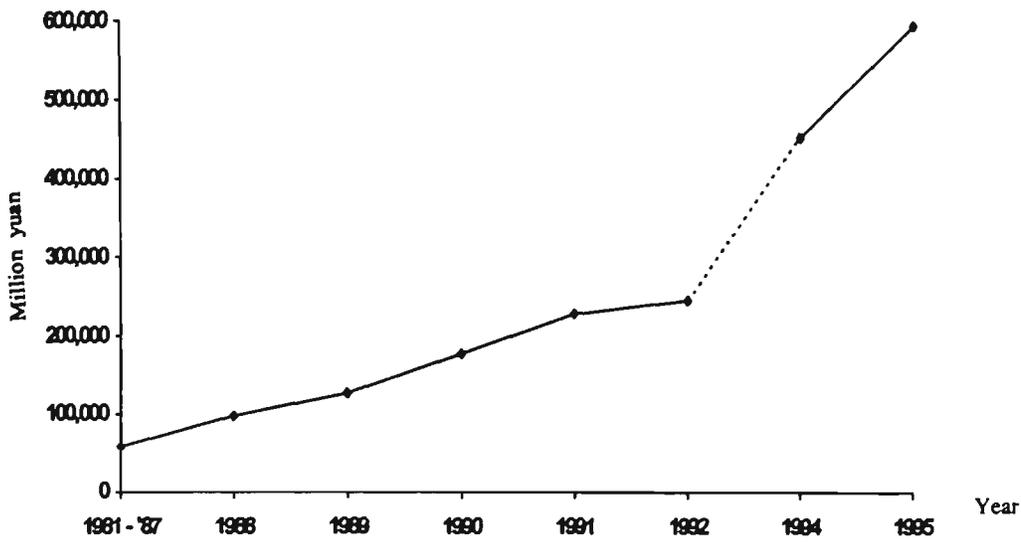
Source: Almanac of China's Finance and Banking (1994 to 1996), A Statistical Survey of China 1994 and Statistical Yearbook of China 1995 and 1996.

⁸ Securities include state bonds, financial institution bonds, enterprise bonds, certificate of deposit and company shares.

At the end of 1992, there were 2.1 million registered securities holders which constituted only 0.6% of the city dwelling population. Although the secondary market in stocks and bonds opened in 1986, about 80% of the securities issued in the stock exchange were still not traded and were being held by government and corporate bodies in 1993. Though more and more securities have been gradually made available for trading, availability is still highly restricted. This has led to an unnatural excess demand in the shallow market (Zhang 1993). For example, this was evidenced by the price-earnings ratios of domestic A shares being driven in 1993 to the exorbitant height of 90 in Shenzhen and 300 in Shanghai, and by the fact of wide variation in stock prices. Government intervention to prevent the erratic wide variation in the trading of stock prices was apparent in 1993 (International Finance Corporation 1994).

According to the International Monetary Fund (1994), the equities or shares issued in China's capital market have features distinctly different from those issued in a conventional Western capital market. Firstly, the listed companies tend to promise a maximum level of return to the securities holders, while listed companies in developed countries would normally offer nothing more than a forecast of returns. Secondly, the issued share often includes a redemption option, with a fixed maturity period and no ownership rights. These are features mostly associated with bonds or preference shares, rather than pure equities or ordinary shares commonly issued in the Western markets. Thirdly, holders of securities tend to enjoy special non-monetary benefits like priority in housing accommodation or health care, which are areas not directly related to the issuing company's line of business. Despite these factors and the fact that the shares issued by the listed companies tend to possess a hybrid of equity and bond features, the trends in the total value of the securities issued suggest that the capital market is growing rapidly, especially in 1994 to 1995 (as indicated in Figure 5.4), and is becoming increasingly geared towards entrepreneurial business development in the economy (as indicated in Figure 5.5).

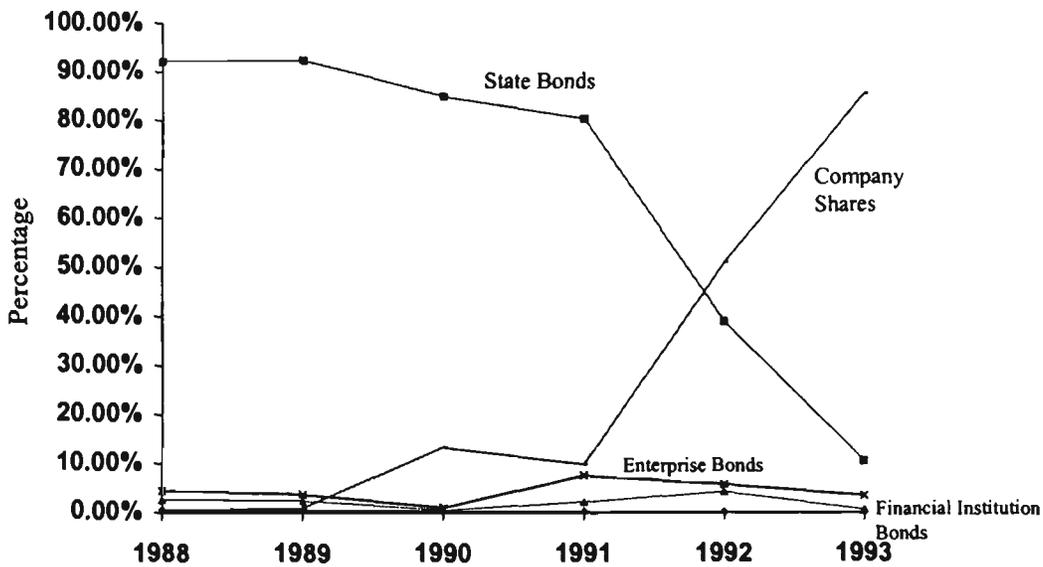
Figure 5.4 - The Value of Outstanding Securities Issued in China.



Note: 1993 data not available.
 Source: Almanac of China's Finance and Banking (1994 to 1996).

The chart below (Figure 5.5) shows that an increasing proportion of company shares or enterprise equity being traded in the capital market (in term of trading value), as compared to the decreasing proportion of state bonds.

Figure 5.5 - The Share of Different Securities in the Total Value of Trading in China's Capital Market



Note: Certificates of Deposit has been below 1%.
 Source: Almanac of China's Finance and Banking (1994).

Despite the increase in the total capitalisation of equities and in the value of company shares traded, it was reported that the capital market as an alternative source of financing for the operation of the state-owned enterprises has been inadequate (International Finance Corporation 1996). The Chinese Securities Regulatory Commission (CSRC) has been making efforts to reform the stock market into a viable source of capital financing for the listed companies. The prime concern of the regulatory authorities in this attempt has been the establishment of a transparent market trading structure (to clamp down on price manipulation and insider trading) and a less volatile market (Jinrongshibao 18/10/1996, and International Finance Corporation 1995 and 1996).

Demirguc-Kunt and Levine (1996) have indicated that the annual growth rate of the number of companies listed on the stock exchange in Indonesia, Turkey and Portugal has each exceeded more than 20%, and have used this to suggest that rapid stock market development is taking place in these countries. By this standard, China has been experiencing a very rapid stock market development, as is evident from the table below. For example, between 1993 and 1996 (except 1995) the growth in the number of firms listed on the two stockmarkets has been about 40% per annum.

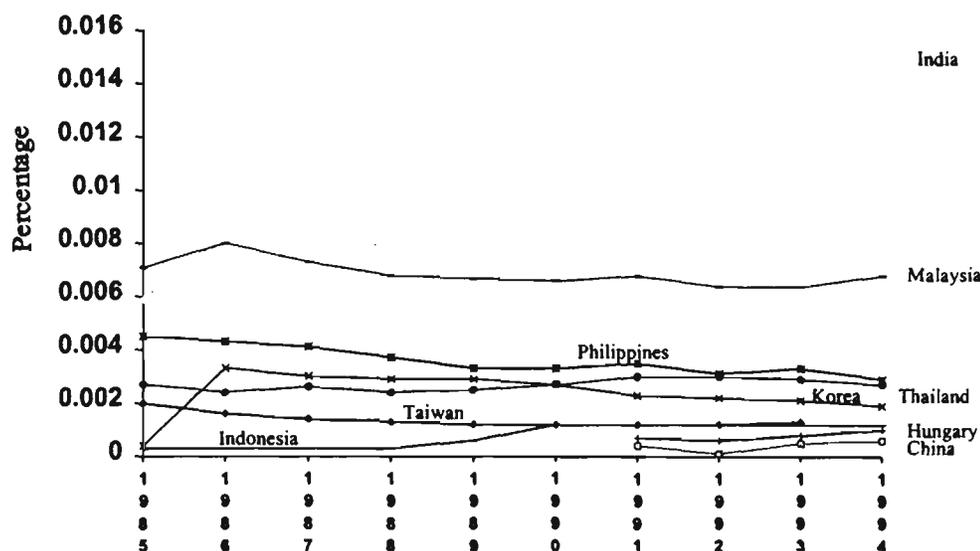
Table 5.6 - Number of Companies Listed in Shenzhen and Shanghai Stock Exchange

Year	Number of companies listed in Shenzhen and Shanghai Stock Exchange
1991	14
1992	52
1993	183
1994	291
1995	323
Sept 1996	446

Source: International Finance Corporation 1995 and 1996, and Jinrongshibao 14/10/1996.

Nevertheless, the number of firms listed is still not large. When the size of the economy is taken into consideration, the data present a picture of an undeveloped capital market by the standards of comparable countries (see Figure 5.6).

Figure 5.6 - Number of Listed Companies Per Unit of GDP (as a percentage)



Source: International Finance Corporation 1995 and World Development Report 1996

The number of companies listed on the stock exchanges, scaled in proportion to GDP, has been relatively low in China as compared to other countries. This is the result not only of the fact that the market is still relatively new, but also of the cautiousness both of companies in entering the capital market and of the authorities in approving company listings into the capital market. Generally, government restriction and control are still present in the market, which thus remains a highly regulated capital market.

The People's Bank of China (1994) has cited technology constraints, enterprise strength and macroeconomic policy as other factors that affect the rate of activity in the market. In term of institutional arrangements, management control has been carried out under a poor regulatory framework (Jinrongshibao 18/10/1996). The absence of qualified personnel and of adequate regulatory and disciplinary control⁹ has also led to the

⁹ Companies seeking listings at the initial stage were subjected to tight scrutiny, but were not subjected to strict surveillance or audit after their successful listings into the stock exchange (Jinrongshibao 18/10/1996).

occurrence of fraudulent practices, such as insider trading and unfair trade practices. In addition, there are too many government departments in the Chinese bureaucratic scene¹⁰ trying to take over the control of potentially new and lucrative markets (People's Bank of China, Ministry of Finance, State Planning Commission, State Commission for Restructuring the Economic System and State Administration for Industry and Commerce), so that the system is imbued with complexities and bureaucracy.

In terms of technology constraints, the absence of a nationwide linkage among the different domestic regional capital markets located in more than 50 cities and regions has also contributed to the low level of secondary market activities prior to the 1990s (Jinrongshibao 29/4/1988). Since the early 1990s, information technology has been gradually applied to replace the outdated methods of stock trading and settlement. The STAQS (Securities Trading Automated Quotation System) was established in 1990 to link up 17 securities companies located in six cities via satellite computer. The system provides information on prices and enables centralised clearing and settlement for securities transaction. A similar system, known as the NET (National Electronic Trading) system, was developed by the People's Bank of China and set in operation on the 26th April 1993. This nationwide system facilitates the trading of shares and bonds in the nation and links up 16 provincial cities (such as Beijing, Guangdong, Fujian, Hainan, Guangzhou, Zhanjiang and Xiamen). It has been claimed that these systems have improved the speed of processing workflow (Almanac of China's Finance and Banking 1994).

A late 1995 review (Wei 1995) of the Chinese capital market revealed that the market still lagged well behind international standards. The Chinese population is still far from having the type of purchasing power flexibility necessary to stimulate the market. Wei estimated that households have about 40 billion yuan as surplus disposable income and whether this sum will be invested in the capital market in reality is dependent upon the capital market investment climate versus that of the money market. It has been anticipated that the capital market would continue to have a low profile as a financial source to support business activities in the economy in both the short and middle terms.

¹⁰ This is a common problem in the Chinese political system.

This is also evidenced by the general capital structure of the average enterprise which tends to reflect equity representation of less than 30% (Spencer 1995). In addition, the level of activities that had taken place by end September 1996 also supported the case of an undeveloped capital market. As at end September 1996, the total 446 companies that were listed in the stock exchange have raised about 120 billion yuan in the capital market, which is 3.8% of the total bank loans¹¹ in 1995, and 4.1% of the total savings accumulated between January to August 1996 (Jinrongshibao 14/10/1996).

Though the Chinese government has considered the stock market financing an ideal way to reform and develop enterprises, the stage of the capital market development has not encouraged the emergence of such situation. The development of a mature stock market will be a long term undertaking for China and therefore requires a corresponding long term commitment to reach international standards. In the meantime, the commercial banks are regarded by the government as the most important force in expanding the primary share market and in stabilising the secondary share market¹² (Jinrongshibao 6/4/1997). This is viewed from the position of the banks as having the expertise and experience in funds investment for their customers, and the potential to consolidate funds from small investors for investment in the capital market.

Conclusion:

The preceding sections of this chapter determined the market participation of the four specialised banks (Industrial and Commercial Bank of China, Bank of China, Agricultural Bank of China and China Construction Bank) and the foreign banks. In addition, the stage of development of the capital market in China is outlined, using an assortment of indicators. The indicators suggest that the Chinese capital market is still rudimentary in the mid-1990s, and is inadequate to support economic activities within the emerging market economy. A substantial portion of the financing activities in the Chinese economy has to rely upon the financial intermediary system,

¹¹ This rate was 0.4% in 1987 and 1.5% in 1991 (International Monetary Fund 1994).

¹² Primary share market involves primary transaction where subscription transaction of newly issued stock takes place, whereas secondary share market involves trading of already issued stock (secondary transaction).

which effectively means relying on the banking system (and not the non-bank financial system). Within the banking system, the four state-owned specialised banks have been the dominant banking units in providing financial intermediation services to the domestic enterprises between 1979 to 1995. The foreign banks are restricted in their business scope and activities, and are not permitted to play a prominent financial intermediary role in the protected banking system.

The next section, Section 5.4, of this chapter considers the level of intermediary development in the Chinese financial system, and also serves to highlight the fact that the Chinese financial system under reform is still a bank-centred system.

5.4 THE MAGNITUDE OF CHINA'S MARKET-ORIENTED FINANCIAL SYSTEM

This section draws from studies done by other researchers to provide some indications of the relative stage of development of the financial system in China, on the basis of both time series and cross country comparisons, and to assess the level of intermediation the financial system.

5.4 A) A Comparison With Other Countries

Financial Intermediary Development. Demirguc-Kunt and Levine's (1996) work, comparing the size of financial intermediation across more than 40 developing and developed countries between 1986 to 1993, provides a ready framework for measuring the development of the Chinese financial system. Due to problems relating to the availability and relevance of certain information, only three of the seven indicators used by the researchers are used to explore the position of China's financial system. The first indicator used is the ratio of liquidity liabilities of the financial

intermediaries to GDP, which is $M3^{13}$ divided by GDP. This ratio is a measure of the overall size of the financial system in relation to the size of the economy. The second measurement factor used is the ratio of quasi-liquid liabilities, which indicates the level of financial intermediation involving longer-term investments. This ratio involves dividing the difference between M3 and M1 by the GDP. The difference between M3 and M1 (M3 minus M1) means subtracting narrow money from the M3 monetary aggregate, so that efficiency of financial intermediation is assessed on the basis of longer term liabilities. The next available ratio is the ratio of total claims of deposit money banks to GDP, which measures the level of the banking system development. The other four indicators that were not employed involved the computation of interest rate spreads, asset values of private nonbank financial institutions, and the level of domestic credit extended to private sector. Information was not available on the level of domestic credit extended to private sector during 1986 to 1993. For the computation of interest rate spreads, this measure would not serve as a representative indication of banking efficiency, because interest rates on borrowing and lending were largely controlled by the Chinese government and the risk involved in the dominant state-owned banks has been largely carried by the government. For the measurement factor that involves private nonbank financial institutions' assets value, such information is either limited or not available.

¹³Note: In the various series of the Almanac of China's Finance and Banking, monetary aggregates from wholly state-owned commercial banks, other commercial banks, finance companies, rural and urban credit cooperatives, and the policy banks have been classified as M0, M1 and M2 in which:

M0 = currency in circulation,

M1 = M0 + demand deposits by enterprises + rural deposits + deposits by government agencies,

M2 = M1 + time deposits by enterprises + self mobilized capital construction deposits + personal deposits + other deposits.

The Chinese monetary aggregate terms differ from the Western concept. In Australia (Baumol et al. 1988):

M0 = cash currency in circulation + chequeing deposits (or current deposits) at trading banks,

M1 = M0 + fixed interest-bearing deposits with trading banks,

M3 = M2 + savings bank deposits.

The difference is contextually based. For example, household passbook savings and time deposits in China are less liquid than demand deposits of firms and institutions because the household cannot write cheques on them. Bank transfer of the firms and institutions in China is very similar to the demand deposit in the West (Yi 1994). China's M2 is used as a proxy to M3 for the measurement indicator. Because the Chinese payment system is still unable to facilitate liquidity in the chequeing system, therefore it is considered a liquid monetary component. Nevertheless, the issue of monetary aggregate segregation has no major effect on the measurement indicators used here.

Furthermore, no private nonbank financial institutions were permitted by the Chinese government until 1995.

To provide as consistent a base as possible for comparison, China's monetary aggregates were extracted from the various issues of International Financial Statistics instead of from the China Statistical Yearbook.

Table 5.7 - Financial Intermediary Development of Different Countries

	Liquid liabilities to GDP	Rank	Quasi-liquid liabilities to GDP	Rank	Total claims of deposit banks to GDP	Rank
Hong Kong	3.91	1	3.53	1		
Japan	3.57	2	3	2	2.58	3
Switzerland	2.83	3	2.26	3	3.26	1
Jordan	2.4	4	1.41	8	1.52	16
Taiwan	2.38	5	1.49	6	2.1	6
Luxembourg	2.36	6			2.59	2
Singapore	2.26	7	1.8	4	1.87	12
Malaysia	1.89	8	1.51	5	1.61	13
Austria	1.72	9	1.44	7	2.39	4
Netherlands	1.61	10	1.16	11	1.97	10
United Kingdom	1.59	11	0.92	17	1.97	9
Greece	1.54	12	1.21	9	0.95	27
Portugal	1.47	13	0.93	16	1.49	17
Italy	1.47	14	0.75	23	1.01	24
Spain	1.44	15	0.9	18	1.89	11
France	1.36	16	0.87	20	2	8
Germany	1.34	17	0.94	15	2.16	5
United States	1.33	18	0.99	13	0.99	26
Thailand	1.31	19	1.12	12	1.23	19
Israel	1.3	20	1.19	10	2.07	7
Canada	1.27	21	0.97	14	0.93	28
Norway	1.26	22	0.61	28	1.57	15
Denmark	1.19	23	0.62	27	1.2	20
Australia	1.13	24	0.89	19	1.19	22
Finland	1.1	25	0.82	21	1.6	14
South Africa	1.06	26	0.72	24	0.78	31
New Zealand	1.03	27	0.61	29	1.1	23
Zimbabwe	0.96	28	0.7	25	0.45	40
Sweden	0.96	29			1.41	18
Korea	0.96	30	0.78	22	1	25
Belgium	0.94	31	0.55	33	1.2	21
Ireland	0.88	32	0.64	26	0.87	30
India	0.87	33	0.57	31	0.68	33
Venezuela	0.8	34	0.55	32	0.45	41
Pakistan	0.79	35	0.25	40	0.7	32
Chile	0.72	36	0.61	30	0.9	29
Indonesia	0.65	37	0.44	35	0.65	34
Philippines	0.63	38	0.48	34	0.48	38
Turkey	0.61	39	0.41	37	0.54	36
Nigeria	0.48	40	0.23	41	0.33	43
Colombia	0.47	41	0.28	39		
China	0.44	42	0.44	36	0.59	35
Mexico	0.42	43	0.29	38	0.48	39
Brazil	0.26	44	0.14	43	0.51	37
Argentina	0.23	45	0.15	42	0.37	42
Average	1.32		0.93		1.29	
No. of economies		45		43		43

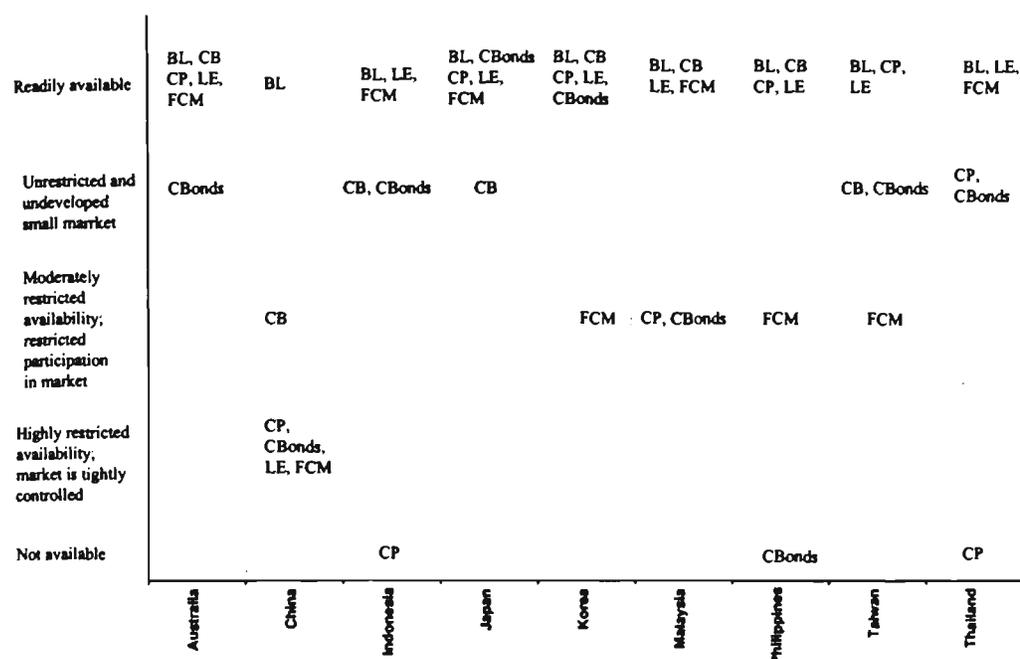
Source: Demirguc-Kunt and Levine (1996).

Source for China data: International Monetary Fund. *International Financial Statistics* April 1984, January 1987, February 1994 and October 1996.

The first two indicators in the table above suggest that China's financial system was generally less developed than most of the developing countries during the period from 1986 to 1993. China ranked as fourth last of the forty-five countries on the first indicator, in which this country's overall size of the financial system is about half the size of the economy. China was in the thirty-sixth position for its financial intermediation development level, in term of quasi-liquid liabilities to GDP. The third indicator, the ratio of the total claims of deposit money banks to GDP for China between 1986 to 1993, revealed that China is at the lowest percentile of the ranking which suggests a less developed banking system. These indicators reveal that despite the dependence on the Chinese banking system to support economic development, this system itself is still undeveloped when compared to many countries. In addition, they also revealed that substantial amount of time will be necessary before financial units become equipped with the essential behaviour and systems of a market-oriented financial intermediaries.

The Depth of Financial Products Available. The analysis done by Lynch (1996), on the financial products available, again revealed a highly restricted and regulated financial market in China. Comparatively, the underdeveloped banking system remains a vital source of capital financing to economic activities, as shown in the chart below.

Figure 5.7 - Depth of Financial Products Available in Different Countries in 1993



Source: Information extracted from Lynch (1996)

Abbreviations used in the above chart :

- BL = Bank Loans
- CB = Commercial Bills
- CP = Commercial Paper
- CBonds = Commercial Bonds
- LE = Listed Equity
- FCM = Foreign Capital Markets

The overall stage of development of the China's financial market indicates that the level of financial intermediation is at a sub-optimal level. In terms of product range, the availability in the financial system of products to support economic activities and to cater to the liquidity preference of individuals has been highly limited (as reflected in the chart above). This is also evident in the limited types of depository facility offered by the banks to attract their primary source of funds, savings deposits, for their lending activities. In banking intermediation, about 90% of the Chinese banks' sources of fund is from deposit savings, in which personal savings deposit¹⁴ constituted the majority share of total deposit savings (Liu 1995a). However, the bank saving facilities that are offered to the personal savings depositors are largely limited to fixed and current deposit accounts. Despite this, savers still prefer to

¹⁴In 1994, personal savings deposit constituted 70% of the total deposit base (Jinrongshibao 26/7/1996).

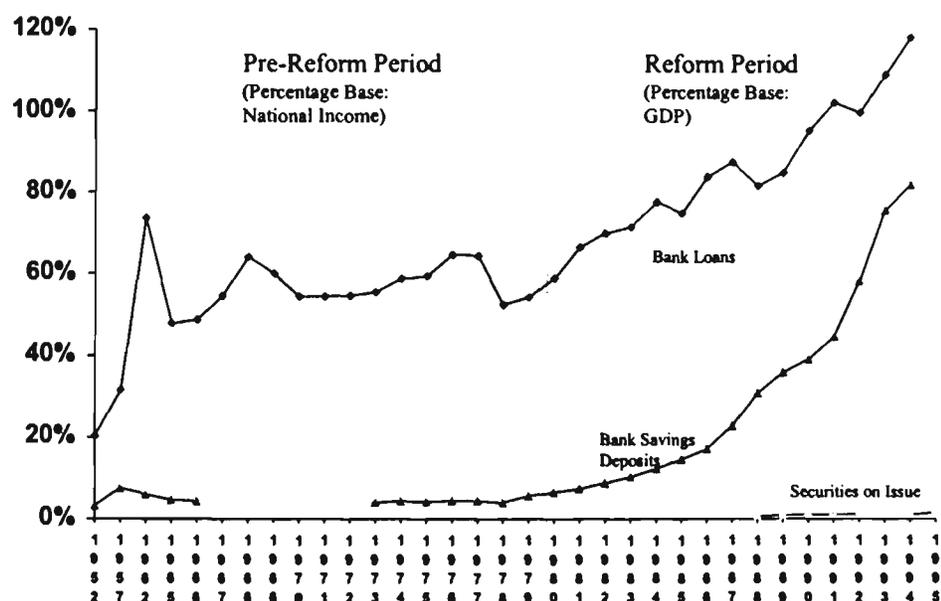
deposit their excess funds in the banking system because of lack of confidence in other means of investment opportunities, such as the capital market.

5.4 B) The Active Financial Agent.

This section serves to verify that the most active and important financial agents in China's rudimentary financial system are the banks. This is carried out by comparing the extent of intermediary role of the banks with that of the other established financial units in China's financial system across time.

The chart below reveals a comparatively minor profile of the capital market in the economy's total investment, in contrast to the banking system. This has been verified by the World Bank which reported that although US\$1 billion worth of new securities were issued in China's market in 1993, they constituted only a minor share of the total investment undertaken by enterprises.

Figure 5.8 - Bank Loans, Bank Savings Deposits, Outstanding Securities as a Percentage of National Income or GDP



Source: Zhong Guo Cai Zheng Tong Ji 1950-1985 (1987), Almanac of China's Economy 1995, A Statistical Survey of China 1994, China Statistical Yearbook 1995, Almanac of China's Finance and Banking, International Monetary Fund 1996.

The magnitude of the significance of each of these markets as a source of funds to enterprise, may be inferred from the comparison made between the size of the increase in bank loans value and the size of increase in bond and equity issuance value in 1993.

It was reported that the former was ten times the size of the latter (International Monetary Fund 1994). The dominant role of the banking system was further verified by the debt structure of the state-owned enterprises. The debt to asset ratio of enterprises increased from 22.4% in 1985 to 81% in October 1995 (Jinrongshibao 10/11/1996), of which 80% of the enterprises debt in 1995 was liable to the banks (Jinrongshibao 4/11/1996).

As compared to the non-bank financial institutions, the banks still play the major role in the economy. The non-bank financial institutions include trust and investment corporations, finance companies, leasing companies, rural and urban credit cooperatives. Their intermediary role in the economy is still relatively minor as compared to the banking system, as revealed by the table below :

Table 5.8 - Proportion of Deposits and Outstanding Loans in the Banks and Non-Bank Financial Institutions

Year	Banks with Government Ownership*		All Banks		Non-Bank Financial Institutions	
	Deposits	Loans	Deposits	Loans	Deposits	Loans
1993	74%	80%	75%	81%	25%	19%
1995	72%	78%	75%	80%	25%	20%

Source: People's Bank of China (1994 and 1996)

*Note: It was shown in Table 5.1 that the total market share of the four specialised banks (Industrialised and Commercial Bank, Bank of China, Agricultural Bank of China and Construction Bank of China) has been on the decline. It was determined in Section 5.2 and 5.3 of this chapter that the erosion of their market share was not the result of financing substitution by the capital market or the foreign banks. Table 5.8 above suggests that the cause of the market share erosion in 1993 and 1995, was due to competition from the establishment of local Chinese banks with government ownership.

Although the non-bank financial institution segment still plays a relatively minor role, it is developing rapidly (Mehran and Quintyn 1996).

Overall, the banking system has traditionally been the popular depository for attracting individual surplus funds. This is revealed again by the table below which

shows the form of personal financial assets held by individuals (percentage) in the economy :

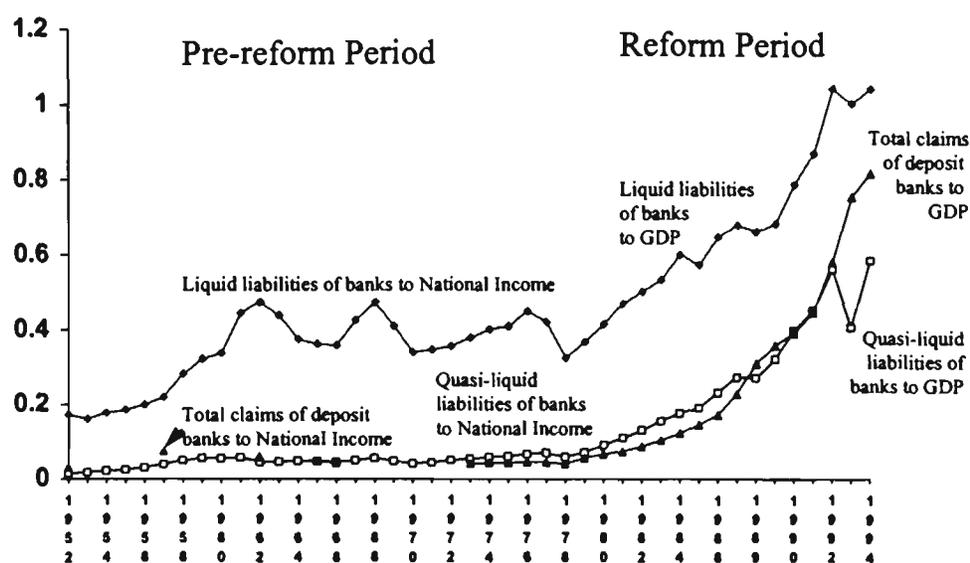
Table 5.9 - Forms of Personal Financial Asset Held By Individuals

Year	Cash in hand	Savings deposits	Securities	Insurance
1978	45.2 %	54.8 %	0 %	0 %
1980	41.7 %	58.3 %	0 %	0 %
1985	30.8 %	65.0 %	4.0 %	0.2 %
1990	20.5 %	70.0 %	8.9 %	0.6 %
1991	19.2 %	70.0 %	10.2 %	0.6 %
1992	19.1 %	69.0 %	11.3 %	0.6 %
1994	18.9 %	68.2 %	12.3 %	0.6 %

Source: Su and Yong (1995).

To assess the level of banking intermediary development in China across time, the two indicators - 'liquid liabilities to GDP' and 'quasi-liquid liabilities ratios' - which were used earlier to measure the overall financial intermediary of various countries are reapplied for this purpose. The ratios were computed for each period, between 1952 to 1994, and indicate an increasing level of banking intermediary development across time (Figure 5.9). Although the earlier computed average ratio of the total claims of deposit money banks to GDP between 1986 to 1993 for China shows a less developed banking system that is still behind many developing countries, China's banking system has actually increased in its intermediary role across time. However, there are problems in the banking system reform which have to be resolved and these problems are presented in Section 5.5.

Figure 5.9 - Indicators of Banking Intermediary Development



Source: Zhong Guo Cai Zheng Tong Ji 1950-1985 (1987), Almanac of China's Economy 1995, A Statistical Survey of China 1994, China Statistical Yearbook 1995

It has been the stated intention of the Chinese government that the financial system be the core base for the implementation of economic policy. Although the present China's financial sector has developed considerably as compared to the pre-reform financial sector, the market still has poor regulatory and disciplinary framework, a weak legislative framework and high protection for the interests of local financial institution. The banking sector, especially the specialised banks, is expected to remain the core intermediary within the financial framework for a relatively long period of time, in view of the limited development of the capital market and the high entry barriers to foreign participation.

5.5 PROBLEMS OF BANKING SYSTEM REFORM IN CHINA: A BRIEF REVIEW

5.5A) Limited Progress to a Market Based System.

As in many developing countries, a sound and efficient banking system and money market is regarded as vital to the development of the capital market in China and to the deepening of the overall Chinese financial market. The competitiveness of the international banking world and the growing importance of the country's banking

system to a newly emerged open economy have all made it necessary for China to speed up its reform progress to reach international standards.

As economic reform deepens, the banking structure has also undergone further reforms in support of economic development. However, the characteristics of the old banking system have not been entirely eradicated after 15 years of reform attempts. Some of the continuing features of the reform process are noted below.

- The central bank still has difficulty in acquiring the necessary degree of independence in executing monetary policy, which remained guided by the credit plan (China Economic Systems Reform Committee 1995, Zheng 1995 and Jinrongshibao 6/6/1996).
- The central bank still depends on credit ceilings to implement monetary policy.
- Monetary policy actions in which interest rate is a control mechanism¹⁵ are still not adopted to influence monetary conditions in the economy (Mehran and Quintyn 1996 and Jinrongshibao 8/4/1997). Interest rates are still administratively determined by the People's Bank of China.
- The specialised banks are still not operating in the full capacity of commercial banks in their intermediary role, because they are still inhibited by past policy loans (Jinrongshibao 19/8/1996) and policy-related obligations (China Daily 18/3/1996).
- In addition, the state-owned specialised banks are relatively inexperienced and new to the behaviour of a Western style commercial bank that is required to support a market economy. This was illustrated by cases on some of the banks taking their own discretion to raise interest rate to attract more depositors. Even though the central bank had conducted a drive in 1991 to reinforce conformity to interest rate set by itself (China Economic Systems Reform Yearbook 1991), the problem still exists in 1994 (China Economic Systems Reform Yearbook 1995).
- Despite the abolition of the industry demarcation for specialised banks in 1986, there continued to be industry specialisation and limited competition in the oligopolistic banking system (Boreham 1993).
- In terms of the development of new markets, like the inter-bank market and the foreign exchange swap market, they are still underdeveloped and rudimentary

¹⁵ For example, through the discount rate and open market operation of treasury notes, bonds, and bills.

(Jinrongshibao 8/4/1997). The inter-bank market has limited product variety and low trading volume, in which actual open inter-bank market activity was claimed to be less than 5% (Qi 1995). Besides the problem of an inefficient payment system, the undisciplined behaviour of the banks has also led to the chaotic development of the inter-bank market. For example, at the end of May 1993, 105 billion yuan of transaction recorded as net inter-bank loans were actually loans made to enterprises instead of to other banks. Such loans were made under the false pretext of inter-bank lending activities because of the banks' deliberate effort to circumvent credit ceiling imposed by the central bank to tighten monetary condition (China Financial Outlook 1994). The mis-use of the rediscount scheme to obtain funds is another case of concern (Jinrongshibao 8/4/1997). In addition, the imperfect inter-bank market has also resulted in different inter-bank rates in different regions (The International Bank for Reconstruction and Development 1994).

- Similarly, the foreign exchange swap market, which was established in 1986, is still vulnerable to fluctuations caused by growing demand for imports and by inflation.
- The underdeveloped national inter-bank and money markets have contributed to the continued use of direct control mechanisms for monetary policy. Though there were attempts by the government to implement market-oriented liberalisation, the resulting conditions in some cases tended to induce the reversal of action and made the government cautious in re-introducing such market-oriented measures. The government does not want to introduce sudden restructuring shocks into the economic and financial systems, which may be difficult to reverse at a later stage and may involve a high cost of reversal. For example, in the case of interest rates, there were attempts made between 1986-1988 to liberalise interest rate but this was withdrawn during inflationary period between 1988 to 1989. So far, the government still remains reluctant to liberalise interest rates because of the view that there are imperfections in the market mechanisms and that the banks are still too inexperienced for a more liberalised financial system.

From a macroeconomic perspective, the banking system has a responsibility in stabilising the economy. However, the overall banking system is still in a poor

position to function as an effective mechanism in regulating and controlling financial liquidity and solvency within the economic system.

Though China started financial reform in 1979, it still shares many of the transitional characteristics faced by the former socialist countries¹⁶ of Eastern Europe, which started reform during the 1980s. They share similar problems like the poor quality of loan portfolios, the lack of competition in the banking sector, weak capital financing capability, and unresolved past financial obligations with the inefficient state-owned enterprises. The below indicates that, in comparison with some of the transition economies like Bulgaria, Hungary, and Poland, China has high barriers of entry to private commercial banking. Government involvement in bank establishments within the domestic banking sector is significantly higher than shown in Table 5.10 if regional government-owned banks and private-government joint-ventures, instead of just the state banks, are taken into account.

Table 5.10 - Comparison of the Banking Industry in Different Emerging Market Economies

Selected transition economies	Bulgaria	Hungary	Poland	China		
Date of implementation of two-tier banking system	Mar-90	Jan-87	Jan-89	Sep-83		
Period of observation for below details	1993-1994	1993-1994	1993-1994	1993	1994	1995
Number of state banks	11	11	10	4 ^a	4 ^a	4 ^a
Number of private banks	23	31	63	0	0	1
Total assets (million US\$)	25,000	33,000	45,000	923,851		
State-owned commercial banks assets (percentage of total assets)	90%	70%	75-85% End 1991 : 30% ^a	79%		Officially 20% (The World Bank 1996)
Nonperforming loans (percentage of total loans)	End 1991 : 40% ^a 1993-1994 : 50%	15%	1993-1994 : <20%	35% (Ma 1994)		
Minimum capital requirement (million US\$ dollars)	15	>11	6	13 [@]		
M2/GDP (percentage)	69%	50%	36%	100.38%	104.26%	104.27%

Source : ^aEstimated by Calvo et al. (1993).

[@]Jinrongshibao 2/4/1997 and 9/4/1997, based on China's Merchant Bank initial capital investment.

Data on Bulgaria, Hungary and Poland is from Borish et al. (1995).

Data on China is from Almanac of China's Finance and Banking; Ma (1994); The World Bank (1996).

¹⁶ The other Eastern European countries adopted the two-tier banking system a few years later: Hungary (January 1987), Bulgaria (March 1990), Czechoslovakia (January 1990), Poland (January 1989), and Romania (December 1990).

Though the reform approach has been largely adopted based on experience and on experimental approach, the bottlenecks created and problems faced by the main participants can not be ignored and they constitute long term issues that have to be addressed. Interestingly, Xia and Xie (1994) noted that there has been a considerable body of local literature on banking reform in China but none has clearly stated the reasons for the slow progress of the fifteen year reform process (Xia and Xie 1994). There has been an indirect implication that the state government has not been making sufficient efforts to 'coerce' the necessary reform in the banking sector, to the extent that it has done so in other areas (example in relation to entrepreneurship, trade, pricing, agriculture, taxation). One of the reasons given is that these specialised banks had been the central government's main source of revenue¹⁷ during most of the reform period. Government coercion on banking reform may jeopardise the earning capacity of these banks and thus placing the flow of revenue at stake. However, the reliance on specialised banks by the central government as a source of revenue started to decrease after 1993, when it was determined that the central government will be the main recipient of tax payments within the economy.

There are other dilemmas faced by the central government in demanding speedier reform among the specialised banks, for they have been the key financiers to many important industries in the economy. For example, they have been the prime source of funding to the industries earmarked by government as strategic to economic development. Loans made out by these banks to these industries, under the government's influence, are more favourable than prevailing market terms. The commercialisation of the banks' operations would mean depriving the strategic industries of privileged borrowing opportunities for development. It is widely considered that the granting of such loans inhibits the commercialisation of the specialised banks. Policy loans as a percentage of total loans in 1993 were as follows for the specialised banks (Hui 1994): Industrial and Commercial Bank of China (20%), Agricultural Bank of China (30%), Bank of China (15%), and People's Construction Bank of China (45%). In 1994, the government decided to resolve this

¹⁷ The tax imposed on the activities undertaken by the dominant specialised banks constituted at least one-sixth of the central government revenue between 1985 to 1991 (Xia and Xie 1993).

conflict by establishing policy banks to deliberately take over the management and allocation of concessionary loans from the commercial banks, in order to enable the latter to focus on reform. It is intended that the commercial banks will operate as market-based and profit-making organisations, while the policy banks will operate under government directives to fund key development projects in line with government policies. The policy banks established by the government since 1994 are the China Import-Export Bank, the State Development Bank, and the Agricultural Development Bank. However, this has not yet fully resulted in the intended outcome as some of the commercial banks, like the People's Construction Bank of China (China Construction Bank) and Agricultural Bank of China (Xue 1995), are believed to be still handling loans of a policy nature despite the role segregation (The World Bank 1996).

5.5 B) Role of the Central Bank.

The Chinese central bank lacks a key necessary attribute, strong independence, to perform its role in macro monetary management and control fully (Xu 1995). Since its establishment as a central bank in 1984, it has had difficulty in attaining independence in performing its role as a central bank. This was not rectified by the provisional banking regulation that was passed in 1986, but was formally rectified by the law¹⁸ enacted in 1995 concerning the central bank's lines and areas of responsibility. However, the effect of the enacted law is still limited by interference from the local government. The power of the local government has interfered with the central bank's attempt to cultivate its independence (Jinrongshibao 6/6/1996). Though the 1995 central bank legislation spells out that local government and government at different levels have no power to interfere with the People's Bank of China's course of action, the problem of interference from the local government still persists, being especially strong at the branch and subbranch level (Jinrongshibao 1/9/1995). In some areas, a public dressing down of local government officials was deliberately instigated to deter noncompliance with this provision (Jinrongshibao

¹⁸ This central bank law involved a long period of discussion which began in 1988 and last till 1993, before it was eventually enacted (Wu 1995b).

29/3/1997). Local government often claims that it is hard to define the relationship between itself and the local banks that are located in its region. They do share a symbiotic relationship in many of the economic support roles for their local region, and this makes it difficult for the local government to determine the limit of its influence. On the other hand, one of the factors that allows such behaviour to persist is the inadequate legislative structure of the economy. The enforcement of legislation has been especially weak, despite relatively more laws being passed since 1994. In fact, this weak framework has been constantly blamed for continued cases of loss of asset, 'triangular debt' proliferation, corruption, and embezzlement (Jinrongshibao 14/7/1996).

The People's Bank of China has been unable to implement market-based banking relationships between banks and enterprises with persistent problems of corruption¹⁹, default loans and the prolonged operation of deficient state-owned enterprises. Its attempt to manage the financial situation is also limited by the slow development of financial markets. For example, its open market operations are restrained by the weak secondary market and the limited range of monetary instruments (Jinrongshibao 8/4/1997). In total, the imbalances in the system have precipitated a situation where the central bank finds it frustrating and difficult to implement tight monetary policy and to control money supply. This is very disconcerting as the inflation rate, commonly at double-digit figures in the large cities, has been a chronic problem which the government has been trying to arrest for a long time.

Since enactment of the 1995 law enactment that bestows greater power and independence to the central bank, there is no doubt that further efforts by the central government to enhance that independence will be necessary in the future. However, an equally strong discipline and cooperation from the other economic agents are also necessary to spur the pace of financial reform and development in the People's Republic of China.

¹⁹Chow (1994) considered such illegal activity to be a natural phenomena of a mixed economy that partly based on market forces and partly on bureaucratic administration.

5.5 C) Continued Influence of the Local Government.

Local government has been one of the factors impeding the progress of reform. It must be mentioned that each of the specialised Chinese banks delineate their branch hierarchy according to the geographic segmentation drawn up by the central government. As a result, the chain of command in the overall banking structure is arranged in the descending order of head office, provincial branches, municipal-prefecture branches and county branches. However, in reality, the power of control and influence does not run in accordance to this hierarchical order. The overall structure of a banking organisation is commonly viewed as comprising various local banks each with varying degree of power.

This power is related to the influence of the local government and is explained as follows. The traditional Chinese lifestyle is very much centred around the local government, which organises education, housing and basic welfare. Since the economic reform, the economic system has been further decentralised for the purpose of enabling regional needs to be taken into account and facilitating optimal utilisation of resources by local government. This has resulted in enhanced power of a local government over the residence and business enterprises operating in its vicinity. In fact, some of these local governments have now become powerful players over which the central government appears to have gradually lost control. This is especially so in the coastal provinces and municipalities. Some of the local banks, especially those located in the less prosperous inner region, relent to the heavy pressure and influence of the local government and allow commercial loans to be treated in the same manner as the traditional Ministry of Finance's fund (Jinrongshibao 9/7/1996).

Because of this higher degree of decentralised power given to the local governments, the local governments can evade complying with the banking reform requirement of relinquishing control over their local banking credit activities. Local government intervention in local banking activities has been common (Imai 1996 and Jinrongshibao 10/8/1996). Though the local governments do not have any direct part in the formulation of the national reform strategy, they have enormous influence over the local banks' credit operation. The banks are an avenue for funding or sustaining local development; hence, funds transfer between the local bank and its headquarters tend to be difficult and subjected to the local government's intervention. Some of the

local governments continue to behave in the pre-reformed way, treating the banks as national coffers or fiscal agents of the Ministry of Finance (Jinrongshibao 9/4/1997 and 11/8/1997). The local government's resistance towards the reform of the banking sector has been largely due to the fear of jeopardising this ready source of funding and destabilising its local economic system. This makes it difficult for the local banks to adhere to lending activities according to profit-maximisation precepts only and to insist on the independent use of commercial criteria in lending activities. The desire of local governments to prevent business failure or business bankruptcy, in order to ensure continuous employment for the locals, has contributed to the high level of bad debt in the banking system. Ma (1994) estimated that the banking system was plagued with 35% bad debt or default loan payment problem in 1993. The World Bank's World Development Report 1996 stated that the official rate of non-performing loan at that time was 20%. This was the cumulative result of these enterprises' failure to meet prior loan obligations while continuing to incur further borrowings to meet the loan obligations and to sustain inefficient operations. In certain cases where a bank tried to repossess the collateral of bad debt accounts, they were prevented from doing so by the local government (Jinrongshibao 7/8/1994). As a result, the quality of bank assets deteriorated on a progressive scale. Some bank branches were found to have more than 60% of their borrowers defaulting in loan payment, in which 50% of these borrowers were confirmed cases of bad debts to be written (Yang 1996a). This indicates that these banks have not been providing efficient intermediary services for either savers or investors.

5.5 D) The Constraints of the State-Owned Enterprises as the Customers of the Banks.

Internal organisational reform in the banking industry is further complicated by the need to take into consideration the reform process in the state-owned enterprises, which have been the oldest customers of the banking system. The modernisation and commercialisation of the state-owned enterprises has not been firmly established. Many of the state-owned enterprises still retain their past mode of operation. Proper contractual lending relationships between these enterprises and the specialised banks

are far from being fully instituted and implemented, even though the former has increasingly relied upon the latter as an important source of funding for investment. This reliance is evident from the share of the bank loan versus state budget funding as sources of investment funds in the state-owned enterprises during 1978 and 1986. Generally, the reliance on the state for funds, expressed as a percentage of fixed asset investment, diminished from 42% in 1978 to 13% in 1986; whereas the reliance on bank loan, also expressed as a percentage of fixed asset investment, increased from 20% to 32% in these years (Jinrongshibao 15/5/1987). The reliance on the banks is especially heavy for those state-owned enterprises located in the inner regions, for which more than 80% of their funding came from the specialised banks, and could be as high as 98% in the case of enterprises involved with foreign trading. This remained so in 1997 (Jinrongshibao 30/3/1997).

The weak financial position of the state-owned enterprises is a cause for concern, given that the state-owned enterprises constitute such a high portion of the clientele of the major specialised banks. The situation is extremely precarious when the financial position and the nature of the short-term debts owed by these clients are taken into account. It was estimated that two-third of the state-owned enterprises are operating with losses in 1996 (Jinrongshibao 19/8/1996). This is reflected in the clientele portfolio of the market leader, the Industrial and Commercial Bank of China, in which at least 60% of the state-owned enterprises were found to be operating with losses and half of these enterprises suffer serious losses (Wang and Yang 1996a). The poor investment management and decision making of some state-owned enterprises in the market-oriented economy had resulted in losses and capital assets underutilisation (Jinrongshibao 6/4/1997). Overall, it is estimated that in 1995, 70% of the debts incurred by state-owned enterprises are debts owed to the banks in the form of loan repayments and accrued loan interest, while 30% of the debts are owed to workers, the national tax bureau, and others (Zhang 1995b). As for the bad debt situation, there was at least one trillion yuan worth of bad debts (about 22% of the GDP) in the Chinese banking system in 1995, of which 20% of this amount was incurred by the state-owned enterprises (South China International 6/4/1996).

The banks have blamed this bad debt situation on the absence of comprehensive bankruptcy law, as well as inadequate banking law and lack of strong cooperation

from the local governments (Jinrongshibao 23/7/1996 and 7/4/1997). These were quoted as the major factors that impede their efforts to commercialise their operation. Although cases of reported enterprise bankruptcy have been on the increase over the years²⁰, some of the cases were not genuine (Jinrongshibao 9/3/1997). Some local governments and business enterprises took advantage of the weak legislative framework to evade loan repayment. In some cases, when the enterprise declares bankruptcy a new enterprise is formed (Jinrongshibao 8/3/1996), with assets and talents of the former moved to the newly established enterprise (Jinrongshibao 9/3/1997). Some enterprises, on the other hand, used bankruptcy as an excuse to obtain welfare assistance, but continued to operate as normal (Jinrongshibao 9/3/1997). Ironically, the banks will have to accept huge losses if the effect of the bankruptcy law is fully felt. It was reported that specialised banks had to write off 8 billion yuan of bad debts in cases of bankruptcy and merger (Jinrongshibao 23/5/1996). In fact, the central government has been trying to soften the impact on the banks by writing off bad debt of enterprises (7 billion yuan in 1994; 15 billion yuan in 1995; and 20 billion yuan in 1996). Unfortunately, some enterprises took advantage of the situation, to the extent that there was mass declaration of bankruptcy by enterprises in some areas (Jinrongshibao 9/3/1997). In another breach of the law, there were enterprises which deliberately tried to avoid bank monitoring of their financial status and the detection of available funds for loan repayment, by opening multiple bank accounts under falsified or real names in other branches or in different banks (Jinrongshibao 7/8/1994).

On the other hand, the lack of experience and discipline of the bank staff also contributed to the inefficiency of the system. To ensure that the banks are disciplined in their lending approach, the central bank published lending rules that came into effect from the 1st April, 1996 and were implemented on an experimental basis in 200 major Chinese cities. The rules require the state-owned enterprises to apply for licence from the central bank before being eligible to undertake any borrowing in the financial system. In applying for the licence, the state-owned enterprises have to furnish information about their financial position to the central bank, and a sound

²⁰ 428 cases in 1992, 710 in 1993, and 3,906 between January to October 1996 (Jinrongshibao 9/3/1997).

financial position will entitle the enterprise to a licence and to a bank loan. This helps to develop commercial relationships between state-owned enterprises and the banks, and curbs the indiscriminate increase of credit risk in the financial system. Nevertheless, to a certain extent this policy induced a relapse to centralised and controlled lending in the banking system. After about a year of implementation, *Jinrongshibao* (1/3/1997) reported that there were loopholes in this approach, in terms of undisciplined participation and inadequate loan management law.

On the state-owned enterprise reform front, the amount of debt created from the economy's credit adjustment during the 1980s²¹ has been a major block to their reform progress. The credit restriction imposed by the government, in the market conditions at the time when the economy was overheated, led to the increase in the level of debt owed among the Chinese state-owned enterprises. The most serious financial situation was the 'triangular debt' or multilateral debt relationship in which a company cannot pay its creditor because its debtor (a third party) could not meet its outstanding obligations. Such relationship could even proliferate to involve several agents in the economic value system within the economy. In 1989, the 'triangular debt' in the economic system amounted to 300 billion yuan (Yang 1996a) while bilateral debts amounted to 150 billion yuan. To combat the problem and pave the way for system reform, the State Council issued a mandate in March 1990 for a debt clearance exercise to be conducted on the state-owned enterprises. The exercise involves writing off 4 yuan of debt for every 1 yuan in repayment, with financial support from the central government (*Jinrongshibao* 28/12/1992). The drive was considered finalised on the 23rd December, 1992 by which time it was claimed that 219 billion yuan of debt in the state-owned enterprise system was resolved under this drive. Thereafter, the central government declared that it had cleared all inter-enterprise debts and absolved itself from future responsibility to such debt arising in the future. However, there are still outstanding debts of this nature in the system, which were not resolved and remain a pending issue. Overall, the drive did not seem

²¹ Tight monetary policy was executed after an upsurge of credit creation in 1985 due to relax government policies on import and rapid growth in investment and consumption. The tight credit institutional discipline has driven enterprises to seek trade credit. Trade credit proliferated and cumulated as the enterprises were stuck with high stock level, inefficient operation, old technology and political disruption in the late 1989.

to be effective nor to force the enterprises and the banks to be cautious in their future credit dealings. According to Yang (1996a), the inter-enterprise debt problem still persists and continues to build up in the system. It was estimated that there was 400 billion yuan of inter-enterprise debt in 1994 (International Finance Corporation 1995). Resolving this problem may either require another government drive or the stronger enforcement of the bankruptcy law, if the weak state-owned enterprises do not improve their operation. Either way, these measures will have a major impact upon the economy in terms of the resources required. This section focused on the debt position of the state-owned enterprises between 1979 to 1995, which is the period understudy in thesis. Although this area has been given much attention by the government in 1998, it is beyond the scope of the thesis to proceed further than the period understudy.

5.5 E) Limited Development of the Specialised Banks.

In comparison to the share of deposit, loans, and settlement held by dominant bank players in overseas markets, the share held by the oligopoly of the four Chinese specialised banks is substantial. The high market share of the four specialised banks is a legacy from the past monopoly position of each bank, being the exclusive banking unit to specific market segments. In addition, it is also due to the fact the specialised banks have been a relatively effective direct channel for the government in managing, controlling and regulating the economy since 1979. With the government's decision to allow the banks to take on a more active role to support enterprise reform and business activities in 1985, these specialised banks became vital units for the business sector. Their importance has been further enhanced by the rapid pace of economic growth. According to Xia and Xie (1994), the robust economic growth not only bestowed high returns on these banks but also gave unprecedented status and power to some of the higher ranked bank officials, especially officials in the lending departments of the banks. The prospect of breaking up the monopoly position of these banks, a goal of the banking reform agenda, would impact adversely on the bank's profitability position and the consequential enjoyment of benefits and privileges. The decentralised organisational structure of the banks makes it hard for

the headquarters to eliminate such attitudes. This partly accounts for the low level of cooperation given by some of the specialised banks to banking reform. This is not to say that there has been total rejection of the banking reform program by the specialised banks. In areas where the reform will place the banks in an advantageous position, support is accorded by the specialised banks. Examples are the realignment of the central bank power, abolishment of loan quota restrictions, eradication of business restrictions in the specialised banks and the higher level of bad debt allowable. Although the demarcation of exclusive market segments for the specialised banks has been officially abolished, the problem of market concentration still persists. This has resulted in the lack of a truly competitive banking system in most parts of the country, with the exception of the economically well-off coastal region.

During the 15 years of reform, there has been a contrast in the progress made in the central bank (People's Bank of China) and the four specialised banks. Comparatively speaking, the People's Bank of China has showed a greater willingness to pursue reform and has carried out the reform process in its area of operation, while the specialised banks made very slow progress, being hampered by internal resistance. Unfortunately, this lopsided reform progress has affected the effectiveness of the central bank in its reformed role. The chief of the People's Bank of China has admitted that the financial system still harbours inefficiencies and inappropriate conduct (Jinrongshibao 1/3/1997). There have been attempts by the central bank to solicit cooperation and consensus from the specialised banks through 'open dialogue' (in the form of conferences or joint reports to the State Council) to resolve difficult issues. In fact, the relationship between the central bank and the various types of financial institutions still remains satisfactory. The former still finds it hard to exercise effective control over the financial institutions (Zheng 1995 and Jinrongshibao 26/8/1996). Most of all, it has been difficult to drive the forces of reform along market lines with the collective resistance of the four specialised banks since the beginning of the 1985 reform period.

Nevertheless, there have been some valid reasons for the slow response to reform by the four specialised banks. These are related to their difficulties in upgrading the internal banking structure and limitations in skills and techniques to meet the

requirements of operating in the open market economy. The specialised banks found it hard to achieve a sound reform when they are still plagued with problems of low productivity, poor customer service, inefficient return on assets, an increasing number of bad debts and many cases of delayed loan repayment. Through the years, the specialised bank's internal organisational structure has evolved to become a large-scale and complex one, so that the fulfillment of the reform objectives requires massive restructuring of workflow processes, operating systems and human resource management, as well as a realignment of the authority relationship with the local banks. All these require substantial funds and time for adjustment. Besides the pace of reform has been delayed by the lack of a strong legislative framework to propel the commercialisation of the state-owned banks, it has also been delayed by the social employment obligation of these banks. The social responsibility of these state-owned banks in providing employment to sustain the economy's employment rate had hampered efficient organisational restructuring. Though such social responsibility was formally dispensed with by the adoption of free mobility in the job market in 1993, through the labour market reform plan approved by the Chinese Communist Party's Central Committee, the power of the local government to distort this reform remains.

It is evident from the various characteristics of the specialised banks noted above that they have not reached the status of a full-fledged commercial banks (Zheng 1995). This is particularly so for those banks located in the less prosperous inner regions than in the prosperous coastal regions (Wang 1995b).

5.5 F) The Payment System.

A major concern over the efficiency of the banking intermediary role lies in the primitive and manual payment system which results in substantial float locked within the system, which in turn has undesirable repercussions in the management of monetary policy. Mehran and Quintyn (1996) have pointed out that the antiquated payment and settlement system has been one of the reasons for the absence of an organised national money market and integrated inter-bank market in the People's Republic of China. Hence, information technology is necessary for the functioning of

an efficient payment system, and thus the adoption, diffusion and leapfrogging capabilities in relation to this system are of interest in this thesis.

It was in the 8th Five-Year-Plan²² that the Chinese government acknowledged that an efficient payment system is important to the development of a market economy and that information technology plays a leveraging role in this relationship. There had been no distinct display of national emphasis for an efficient payment system at the national level until 1988, when cash management and bank settlement regulations were instated. The national emphasis for information technology leverage in the payment system was accorded only in 1993, when the Third Plenum of the Fourteenth Central Committee of the Chinese Communist Party emphasised the need to develop a payment network supported by information technology to achieve speed, reliability and efficiency (Jinrongshibao 13/11/1994 and 26/9/1994). In conjunction with this, the use of credit instruments, especially the credit card, was widely promoted as it is complementary to the computerised system for reducing cash usage. Thus, to develop an electronic payment network system requires two processes to be in place: the automation of operations in banks and the diffusion of the technology to the economic agents that use the banking system. The efficient functioning of the payment system also relies on non-technological infrastructure and arrangements (such as behavioural and institutional aspects). Nonetheless, information technology is a necessary element in enhancing the efficiency of a payment system to support economic development.

Information technology adoption and diffusion capabilities will be examined in relation to the Chinese national payment system, which is presently a national priority, in Chapter 7. In addition, that chapter also highlights the impact of the less technologically equipped payment system on the Chinese economy.

²² Endorsed by the 3rd Plenum of the 14th Central Committee of the Chinese Communist Party (Jinrongshibao 26/9/1994 and 13/11/1994).

5.6 CONCLUSION

This chapter surveyed the evolution of the Chinese banking industry, the market positions of the major players and the stage of financial development in China. It has explored the key uncertainties facing the industry and briefly outlined the constraints, both internal and external, which are bottlenecks that have to be eradicated for achieving the desired reform outcomes. The purpose of addressing the reform bottlenecks is to provide insights into the structure of power within the banking industry. This should lend further understanding to the institutional influences on information technology adoption, diffusion and leapfrogging in the later chapters. The importance of the banking system to the Chinese economy was highlighted. The three chapters which follow in Part Three document the adoption and diffusion of information technology in the banking system over the 1979 to 1995 period.

PART THREE

ADOPTION OF INFORMATION TECHNOLOGY IN THE

CHINESE BANKING INDUSTRY

CHAPTER 6 : INFORMATION TECHNOLOGY ADOPTION IN THE CHINESE BANKING INDUSTRY - AN OVERVIEW.

Chapters 6, 7 and 8 outline the path of information technology adoption in the Chinese banking industry. These chapters are intended to provide a background for identifying the nature of the factors influencing information technology adoption in the China's banking industry. This analysis is presented in Chapters 9 and 10. Individually, Chapter 6 provides an overview of the information technology adoption path in the Chinese banking industry. Chapter 7 describes the development of the financial system infrastructure and the applications in the network. Chapter 8, on the other hand, examines the institutional basis of the information technology adoption pattern within the Chinese banking industry by looking at the foreign banks and at the individual state-owned banks.

The information for the documentation in these chapters was gathered through fieldwork research such as surveys and interviews, and from review of both published and unpublished materials. Some of the information sources are deliberately omitted, given their request for confidentiality. Though specific quantification of certain situations has been obtained, the variables involved were such that the data lacked sufficient degrees of freedom and consistency for the use of statistical tests. Nevertheless, the information gathered provides a reasonable basis for determining the factors that are important to information technology adoption in Chapter 9 and to information technology diffusion in Chapter 10, and for discussing information technology leapfrogging in Chapter 11.

This chapter provides a brief outline of the role of information technology in the Chinese banking industry, before a brief chronicle of information technology adoption in that industry.

6.1 THE ROLE OF INFORMATION TECHNOLOGY IN THE BANKING INDUSTRY

The role of information technology may be determined from the basis of its application for business purposes (information technology support for business purpose) and for integration of internal and external activities within the firm's value chain (information technology support for electronic integration). The presentation of the historical pattern of technology adoption within the banks (in section 6.2) and its analysis (in Chapter 9) are viewed from the perspective of the forms of information technology support outlined below.

6.1 A) Information Technology Support for Banking Business.

Information technology may be employed in the following different banking business areas, which are commonly undertaken by commercial banks both in the developed nations and in the newly market-oriented economies such as China.

Table 6.1 - Business Areas and Activities of a Bank in a Market Economy

<u>Banking Business Areas</u>	<u>Activities</u>
1. Core Banking	Customer Accounting, Loans/Deposits, Customer Information, Reconciliation.
2. Treasury	Foreign exchange, Options, Bonds/Securities.
3. Trade Finance	Import/Export, Letter of Credits, Bills, Collections, Guarantees, Re-imbusement.
4. General Ledger	Financial Management, Business Unit Accounting.
5. Payments	Fund Transfer and Clearing (including ATM, POS, telebanking, etc.)
6. Office Management	Reporting, document and information processing, database.

The purpose behind information technology adoption for the banking operation may be related to transactional, informational, strategic, or infrastructural purposes (Weill and Broadbent 1994). Transactional processing refers to the operational level of organisation which performs and records the daily routine transactions that are basic to the business. Another facet of information technology applications is that they could provide superior technical capability, over manual capability, in processing information for increased organisational control and coordination (informational purpose). Closely related to its informational capability is the strategic implication of

the technology on the organisation's performance in the market place. Information technology could assist higher management in timely and strategic decision making. On the other hand, the strategic profile of information technology could also be related to its capability in creating product and service innovations to achieve competitive superiority (as leader) or competitive parity (as followers). Adoption of technology for infrastructural purposes underlies the other purposes. It is associated with information technology capability that defines the technological paradigm within the organisation (for example expertise, network architecture and resources) for achieving transactional, informational or/and strategic purposes.

6.1B) Information Technology Support for Electronic Integration.

The banking business areas are very often related or linked to one another, hence there is a need to consider the multiple reciprocal linkages among these areas which may enhance their transactional, informational or/and strategic impact on organisational performance. As demonstrated by the evolutionary path of technology applications in the developed countries' banking industry (refer Chapter 1 section 1.4), information technology could be adopted to integrate these linkages into a network conducive for the attainment of corporate goals. The type of network created will vary in scope of coverage, depending on the availability or absence of the influencing factors. The organisation could adopt information technology to create a framework that supports intra-organisational linkages for an integrated organisational business system. This integrated organisational system characteristic could also be extended beyond the organisation or branch to interlinkages that involve the banking branches, sub-branches, offices and headquarters (of a single banking corporation) in different locations, thus forming an integrated electronic corporate banking system. At a higher level of applications, network technology could also engender linkages among different banking corporations enabling an electronic inter-bank interoperable system that is beneficial to each bank, the domestic banking system and the overall economy (for example, payment facilities). Furthermore, this interoperable financial system enabled by advanced information technology may transcend the intra-city and inter-

regional (domestic and international) geographic barriers that were faced by antiquated postal system, and may also help to cross industry boundaries.

6.2 INFORMATION TECHNOLOGY ADOPTION IN THE CHINESE BANKING INDUSTRY

Contrary to the active adoption pattern of information technology in the developed countries' banking industry in the mid-1970s (refer Chapter 1, section 1.4), information technology applications in the Chinese banking industry began to receive considerable attention only in the mid-1980s (Witzell and Smith 1989, Simon 1990). In addition to other sources, the work of Zhou et al (1991), Chen (1994) and Wang (1994a) on the computerisation experience in the Chinese banking industry also revealed that computer applications prior to the mid-1980s was limited and passive.

6.2A) Pre-reform Period: 1949 to 1978

After the Chinese Communist Party seized control over China in 1949, the centralised institutional setup and the economic processes that were formed under the communist command economy relegated a passive financial intermediary role to the monobank system. The core financial processing activities in the monobank system were largely concerned with the reconciliation of the actual financial transactions with the predetermined plan.

Prior to the adoption of technology within the monobank system, the processing of documentation and settlement of transactions were all carried out via fully manual processes which were both time consuming and devoid of accuracy. The processing of such transactions was undertaken at the People's Bank of China's national accounting processing centre¹ (Jinrongshibao 30/9/1989). Sometimes, an inaccurate transaction took months to be detected, clarified or settled. Despite the low level of banking consolidation activities involved, at a daily average volume of about 4,000 transactions, the 120 people in the accounting department were constantly

¹ This centre carried out the core accounting function in the monobank system.

overwhelmed by the workload. The inefficiency of transaction processing was evidenced by the unduly long delay in document processing and transaction settlement activities, for the reconciliation of inter-regional transaction accounts, within the communist monobank system. However, the centralised directive planning and management system was noted for its high level of tolerance for inefficient processing of transactions within the financial system.

The first notable sign of computer adoption within the banking system was in 1957. This was the result of the direct adoption of the Soviet's monobank model in the mid-1950s, as a result of which six units of the electro-magnetic based computers were imported from Russia to facilitate the central supervisory and consolidation role. The import was also part of the program involved in receiving technology assistance from the Soviet Union, under the national technology policy. These computers were among the earliest batch of computer technology adopted within the economy² and were used for simple tasks like book-keeping and data storage (Yu 1991). However, the adopted computers were highly inefficient, user-unfriendly, and slow in processing speed. The work process was still largely labour intensive. In conjunction with using these computers to process and consolidate accounting data, the staff had to use an abacus³ in the parallel manual work process to ensure technological processing accuracy. Instead of using computer technology to alleviate manual tasks, an increased level of labour resources were demanded by the duplicated work processes.

Despite the rapid rate of change in computer technology or information technology on the international scene, the national processing centre retained the early acquired technology and work processes for more than a decade. It was only in 1970, when the accounting processing centre was relocated to Sichuan, that those mid-1950s machines were left behind and written-off, and locally made computers were subsequently adopted (Jinrongshibao 30/9/1989).

The next known computer technology adopted by the national processing centre was in 1972. A prototype "PJ-Pujiang No. 1" (translated) was produced in Shanghai and was later put into business use (Wang 1994c). However, due to its low capacity and

² Some of the other economic sectors were the railway and meteorology sectors.

³ The Chinese traditional manual operated tool for performing counting and calculating tasks.

low processing speed, it was replaced in 1974 by the imported French 61/60 computer model which was capable of batch processing. In the same year, 3 units of the Ricoh-8 minicomputer were adopted by the foreign exchange bureau⁴ (known as the 'Bank of China' in the overseas countries - refer Chapter 4 section 4.2F) of the monobank system, for basic transactional purposes. At this stage, the adopted equipment's technological ability was found to be still limited and lagged behind overseas capabilities (Zhang 1997).

In 1975, the "National Pilot Project on Banking Account Network in Large and Medium Cities" was initiated, in which cities like Beijing, Shanghai and Xian were selected for the experiment (Chen 1994). However, this experiment did not prove to have a significant influence on the domestic rate of information technology adoption (Zhang 1997). At that time, the banking communities in overseas developed countries were actively pursuing the establishment of electronic account networks.

In the pre-reform period, information technology application in the simple value chain system was basically confined to transactional purposes (handling of paperwork) and mainly in the activity area of accounts reconciliation. The higher level of information technology applications (that is, informational and strategic purposes) were nonexistent.

6.2B) Reform Period: 1979 to 1995

i) Sixth Five-Year-Plan Period (1979 to 1985)

Area of Computerisation. Towards the end of the 1970s, 30 units of simple accounting machines and interest-dividend computing machines, known as accounting control machines, were imported to manage the accounts of the state-owned enterprises and the interest-dividend computation of private savings accounts at the front counter or "front office". The adoption of these machines by a number of banks, generally the specialised banks, were claimed to have lightened the workload and enhanced the productivity of the counter staff. The equipment was extremely expensive, such that an imported small to medium sized computer system required a

⁴ Similarly, information technology adopted by its overseas bank branches in 1973 was also applied for transactional purpose in their role as foreign exchange bureau (adoption of technology in the overseas branch was mentioned in Chapter 8 section 8.2).

minimum hardware investment cost of US\$1 million, not including the cost of software support (Sha 1994).

During the early 1980s, a small quantity of Hitachi M150 and L320 minicomputer sets were introduced to specialised banks located in Beijing, Tianjin, Nanjing, Xian and Guangzhou - these were test sites for computer adoption or applications. The Hitachi M150 minicomputers were commonly adopted for automating internal front-counter work process. The initial applications allowed basic and standardised types of transactions to be input at the terminals for direct transmission to the mainframe, which was housed within the same building, for updating and verification. The processed information of such simple transaction was then transmitted back to the terminal on an on-line basis. However, the minicomputers eventually could not handle the growth of banking activities in line with the rapid pace of economic development. As a result, the workflow system was restructured to use the small batch processing mode to increase the minicomputers' processing capacity. Unfortunately, this delayed the availability of processed data or current information (which means delaying the finalisation of the transaction). The minicomputers were then reconfigured to used on a standalone basis, solely for the entering of transaction data. At regular intervals, the data entered into the minicomputers were then downloaded onto tape, the predominant secondary storage medium at that time, and subsequently fed into the central mainframe system for processing. As the economy continued to grow rapidly, the burgeoning business banking transactions (refer Chapter 5 section 5.3) put tremendous pressure on the stretched capacity of the minicomputers in coping with customer's demands to open bank accounts and conduct account deposit and withdrawal transactions (Zhou 1991). There was no effective plan to initiate or sustain any consistent movement in the adoption of information technology within the Chinese banking industry.

Network Development. The absence of an electronic network to support banking activities during the Sixth Five-Year-Plan period, when the country was experiencing strong economic growth, had caused significant difficulties for the banks in carrying out their newly assigned commercial intermediary functions. This was especially significant in the banks' effort to attract deposit savings. Complaints from customers

about the difficulties they encountered in opening a new account, making withdrawals from an established account and depositing savings into an established account were common during the Sixth Five-Year-Plan period and the early Seventh Five-Year-Plan period. Customer transactions were confined to a specific branch where the account was held, regardless of the short walking distance between branches located within a small city. The Bank of China's Shenzhen branch was the first branch in the country in this period to establish an electronic intra-city system for its savings transactions. The pervasive absence of transaction processing and information sharing facilities among the various branches of individual banks stopped customers enjoying the convenience of opening savings accounts or making deposits and withdrawals at any city-based locality (Jinrongshibao 5/10/1987). As a result, each branch carried a separate and segregate set of customer accounts. To a large extent, this situation also made it difficult for the authorities to detect and prosecute those state-owned enterprises that established numerous bank accounts, to evade loan repayment and to deliberately hinder the specialised banks' ability to exercise prudent judgement over the enterprises' weak financial position. The establishment of connection with international network was very insignificant, with the Bank of China's Shenzhen branch as the first and only branch to establish connection with the SWIFT system. The attempt to establish intra-city electronic savings system linkages (among branches that were based in a city) was the focus in the network development plan during the late Sixth Five-Year-Plan period.

ii) Seventh Five-Year-Plan Period (1986 to 1990):

During this period, there were pockets of technology applications in the banking system, which were initiated by the government or by the banks themselves. The effort undertaken by the Chinese government to influence technology applications shifted from a general focus, that covered a cross section of several key economic units during the initial Seventh Five-Year-Plan Period, to a specific focus on the banking system at the end of the same period. In the initial Seventh Five-Year-Plan period, the banking sector was one of twelve participating sectors identified for the establishment of a national information service system. The total investment for these

sectors was RMB 20 billion (Fang 1995). There was very little specific direction given in the adoption of information technology for the banking industry in the initial period, that is prior to 1989. The national payment system, which had been a bottleneck to economic activities, was not on the national agenda for reform until the late Seventh Five-Year-Plan period. There had been a high level of float⁵ in the average daily 1.7 million settlement transactions among 130,000 financial institutions (Jinrongshibao 20/6/1988), and this became a serious obstructing force to economic reform and progress. Towards the end of the Seventh Five-Year-Plan period, the government began to take action to correct the float situation. In May 1989, the State Council approved the People's Bank of China's move to construct a satellite communication network, known as the China National Financial Network (CNFN). This was to be the infrastructure for enabling national electronic linkage among the different banks in the country (Jinrongshibao 4/9/1990 and 2/10/1991). The initial focus was targeted at supporting an electronic payment clearing system (the China National Advanced Payment System), to eliminate bottlenecks in the flow of funds within the economy. The achievement of this system required the banks to be equipped with information technology applications.

Overall, the national emphasis on banking computerisation during the Seventh Five-Year-Plan (especially prior to 1989) was less focused and aggressive than that in the Eighth Five-Year-Plan.

Areas of Computerisation. After the mid-1980s, the adoption of information technology for internal process automation became the undertaking of the individual state-owned bank, in line with the newly enforced financial reform objectives of transforming these banks into independent and largely self-funded commercial banks. The technology that was adopted by the specialised banks during this period was mainly applied to support either information systems or counter transaction processing systems in these banks. For example, the Agricultural Bank of China applied technology to integrate its fragmented organisation structure, while the Industrial and Commercial Bank of China applied it to improve counter processing efficiency in its branches. However, over time, the trend of computerisation or

⁵ About 60 billion yuan in 1988 (about 6% of M_2 - refer to Chapter 7, Figure 7.5).

computer technology applications became distinctly centred on the front-counter business system, which is part of the overall accounting system in the banks. It became a priority area for reform and computerisation in most of the state-owned specialised banks when the national reform process began to focus heavily on the accounting system and when it became clear that the bank have to assume a commercialisation role in the two-tier banking system after this new structure was established between 1986 to 1988. With the installation of computers, the transaction process at the counter became comparatively faster than the previous highly manual work process. In the other banking business areas, there were also gradual establishment of the electronic system for intra-organisation reconciliation, customer accounting relating to deposit and loan, and foreign exchange transactions. However, the popular area of automation remained the front-counter section (which is part of the accounting business area of activity) for transactional purposes. The overall aim of these banks was to achieve about one-third automation by 1990, with the perspective of establishing an electronic network for accounting operations in the future (Simon 1990). The first goal was reflected in the achievements at the end of the Seventh Five-Year-Plan Period in 1990 (China Economic Systems Reform Yearbook 1991). About 30% of the front counters in the banking system were indeed computerised. The distribution of computerised bank outlets revealed that higher priority was being given to those outlets located in the cities - 80% of bank outlets located in the cities were computerised - while a low rate of only 10% of bank outlets in the country were computerised. The overall level of computerisation in the domestic banking business areas during the Seventh Five-Year-Plan Period was considered to be low (Jinrongshibao 12/6/1991).

Networking technology. By the late 1980s, microcomputers were the more common technology adopted to meet the demands of increasing business volume. The specialised banks were able to realise inter-organisation electronic linkage to facilitate their basic intermediary activity, through the adoption of networking technology. The type of inter-organisation electronic linkage constructed by the banks was confined to electronic linkage among branches of a single banking corporation which were located within a city (intra-city linkage). This was to facilitate the processing of customer's

transactions initiated at a different branch. With the advent in microcomputers, banks began to make use of the networking capability of microcomputers to establish linked communication (Li 1994). It also became possible for the work systems to be linked up with one another to support information sharing. Pockets of local area network (LAN) and intra-city network emerged in a few of the major areas. Modems were used to transmit information between microcomputers, but it required a major effort on the part of the banks to transmit and collect information due to weak telephone line support. Subsequently, PCTELEX was used to hook up microcomputers and enabled the automated transmission and receipt of data with relative ease (Zhou 1991). Comparatively, the Industrial and Commercial Bank of China was the more active bank in establishing intra-city networks, because the majority of its branches are located in cities with well equipped infrastructure and amenities. For those banks with branches mainly located in the less developed areas, where the access to telecommunication support was highly limited, their attempt to establish an intra-city network depended on a piecemeal configuration of technology to support information transmission. There were crude electronic intra-city networks that relied intermittently on technology and manual resources. Such rudimentary networks were being established by the specialised banks and the People's Bank of China for their savings system and for their own internal purposes. For example, the China Construction Bank's Wuhan branch established a crude electronic network in 1987 using fax, machines, telephone and other simple electronic devices to enable information exchange on an intra-city and inter-cities basis. Nevertheless, the makeshift system was capable of handling fund transmittal of 4,194 million yuan (Jinrongshibao 20/8/1987). There were cases of international network linkage being established by the Bank of China in this period, but the number of such cases in the banking industry was very low.

On the whole, the information technology adoption process in the different banks and their respective branches lacked a coordinated structure. Each had its own plan and approach in information technology adoption, which resulted in the adoption of incompatible technologies that were not appropriate for network development. The weak electronic linkages between the different banks were reflected in the low utilisation of the China National Financial Network (CNFN).

In this period, construction of the banking industry infrastructure (CNFN) began with the adoption of high capability microprocessors for establishing intra-city business networks to support electronic data interchange in major cities like Shanghai, Beijing, Tianjin, Shenzhen, Changsha (Hunan), Hangzhou (Zhejiang). These networks were supposed to provide electronic inter-bank linkage among the banks, in which the payment system was the first to be provided through the CNFN. However, the overall adoption pattern of networking technology for payment transactions constituted only a few pockets of applications. By 1990, there were only 53 bank outlets located in the cities (0.03% of all outlets in the nation) that were linked to an intra-city network in support of clearing transactions (China Economic Systems Reform Yearbook 1991). Thus the usage of the electronic network was very limited. The adoption of converged computer and telecommunication technologies was still insignificant, due to the lack of competent and supportive infrastructure. Communication between organisations was still dependent on the manual postal system. Large scale networks covering a bigger geographical area, like inter-city linkage within the same province, were not evident at the national level, as the relevant organisations were preoccupied with their internal applications rather than with extensive external electronic linkages (Zhang 1994). The clearing of payment instructions was normally carried out manually and physically at clearing centres in the major areas, either once or twice a day. Thus, there was an inbuilt time-delay factor in the non-electronic system which, together with the manual mode of delivery, resulted in the high level of float within the payment system (Jinrongshibao 12/6/1991).

iii) Eighth Five-Year-Plan Period (1990 to 1995)

During the Eighth Five-Year-Plan period, the pattern of information technology adoption by the local specialised banks within the banking system, revealed that it covered the following banking business areas :

1. Core banking (mainly front counter/desk business processing),
2. Treasury (foreign exchange and securities transaction),

3. Payment (local and inter-bank business funds settlement systems and automated service systems including bill and cheque clearing, funds transfer system, ATM, POS, etc.),

4. Office management (financial management information system and office automation system).

Information on the level of information technology investment in the banks was limited and was derived from different sources. Although there is the problem of consistency with some of the sources, the data (as presented in Table 6.2) generally indicated a significant increase in the level of information technology investment within the state-owned specialised banks and in the overall national financial system during the Eighth Five-Year-Plan period. The spending on the technology adoption within the overall national financial system, as reflected in the table below, came chiefly from the state-owned banks and from the central bank.

Table 6.2 - Amount of Investment Spent on Information Technology in the Major State-Owned Specialised Banks and the National Financial System (in varying period)

Year	Bank/Financial System	Total Investment Amount (in million yuan) in the Period	Investment Amount Computed on a Per Annum Basis (in million yuan)
1985 to 1987	Industrial and Commercial Bank of China	600	200
1987	Agricultural Bank of China	50	50
1984 to 1993	Agricultural Bank of China	3,000	300*
1991 to 1995	Bank of China	8,000	1,600
1993	China Construction Bank	2,000	2,000
1993 to 1994	State-Owned Specialised Bank [@]	3,400 to 3,600	1,700 to 1,800
1986 to 1990	People's Bank of China	3,000	600
1991 to 1995	People's Bank of China	4,000	800
1993	The Overall National Financial System	5,000	5,000

*The per annum investment spending by the Agricultural Bank of China in the 1990s should be higher than this figure because this bank became more active in information technology adoption during the 1990s than the prior period.

[@]Data reflects the average investment amount spent by each state-owned specialised bank.

Source: Jinrongshibao and Financial Computer of China.

The Eighth Five-Year-Plan strategic direction produced by the government and the central bank for the financial industry in information technology adoption was particularly strong on achieving a modernised payment system. It involved the following objectives (Chen 1995c):

- o to complete the construction and testing of the main structure of the modern payment system, CNAPS (the China National Advanced Payment System),
- o to complete the construction of the main structure of CNFN (China National Financial Network)⁶. Based on the completed structure, it was targeted to establish high value and small value fund clearing systems at intra-city, intra-regional and national levels in the selected main cities,
- o to continue to encourage the construction of an automated intra-city bill clearing system and
- o to complete the development of application systems for counter business processing, credit card verification, foreign exchange business, financial management system, accounting system, management information system and so on.

The adoption of information technology in the payment system was increasingly accorded a high degree of importance. This was because of the chronic situation with severe fund float and payment delay in the widely used postal mode and non-technological system, noted above. In addition, the priority given to the payment system also stemmed from the fact that it underlies almost every aspect of banking activities - from front-counter to backoffice operation, telebanking, ATM, POS, and to central banking control and management.

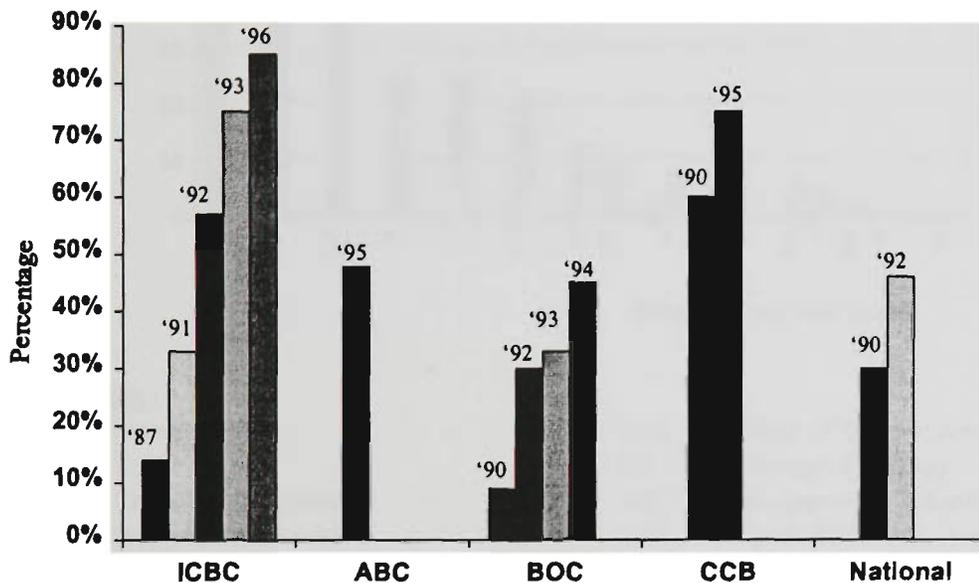
Areas of Computerisation. During this period, the proportion of outlets that adopted computer technology within the national financial system was 10% in 1990, 18% in 1992, 29% in 1993, and 46% in 1995 (from different sources). Despite this increase in information technology adoption, application of technology to the internal work processes within the national financial system was largely confined to islands of automation, on an intra-branch or intra-organisation basis. Overall, the business value chain in the organisation or branch was partially computerised. It has been identified

⁶ CNFN is an infrastructure network in which CNAPS is one of the applied systems in the network.

from different sources that the focus of computerisation still largely centred on the front-counter or front-desk in business and savings outlets. The graph below shows the extent of computerisation of front-counters achieved by the specialised banks in different years. Though the data are incomplete, the graph does indicate that this area of business activity received an increasing level of computing technology applications in the specialised banks and the national financial system as a whole.

Figure 6.1

Percentage of Computerised Front Desk Processing or Accounting System in the Business and Savings Outlets of the Major State-Owned Specialised Banks and in the National Financial System



Sources: Various.

Abbreviations:

- ICBC - Industrial Commercial Bank of China
- ABC - Agricultural Bank of China
- CCB - China Construction Bank
- BOC - Bank of China
- National - The Overall National Financial System

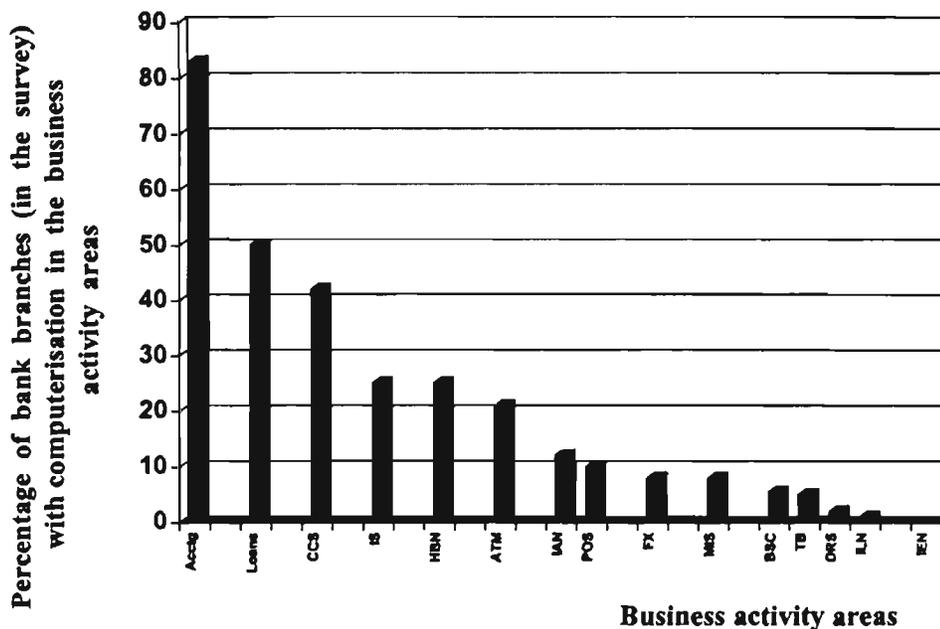
In addition, a separate survey⁷, conducted on a sample of about 360 local bank branches located in the main cities in China in 1993, indicated that the accounting area had been receiving heavy focus in technology applications over the previous

⁷This survey was carried out by an independent research company and concerned the information technology application in the banking industry of the People's Republic of China. The source is treated confidential.

years. The graph below shows the extent of computerisation in individual banking business areas in 1993, as derived from the survey.

Figure 6.2

1993 Survey: Computerisation of Business Activity Areas in the Chinese Local Banks.



Abbreviation:

- | | |
|---|-------------------------------------|
| Acctg - Accounting | POS - Point of Sales Funds Transfer |
| Loan - Loans | FX - Foreign Exchange |
| CCS - Credit Card System | MIS - Management Information System |
| IS - Information Service
(Reuters, etc.) | BSC - Bank Statement Clearing |
| HBN - Headquarter-Bank Network | TB - Telebanking |
| ATM - Automated Teller Machine | DRS - Disaster Recovery System |
| IAN - Intra-Bank Network | ILN - International Bank Network |
| | IEN - Inter-Bank Network |

The y-axis in the above graph reflects the percentage of the 360 bank branches surveyed in 1993, that have responded to the survey question that they have computerised one or several of the different areas of business activity. The computerised areas of business activity is reflected in the x-axis of the above graph. The survey revealed that the most automated business area was the accounting system. 83% of the 360 bank branches in this survey had computerised the accounting function. It was supported by interviews conducted separately by myself, that the front-counter or the front-desk in the business and savings outlets were the areas in the accounting function that were involved most heavily in computerisation.

This was due to the tendency of the branches to select the front-counter business system as the initial area for automation, to facilitate their commercial role in the two-tier banking system. The loans area and the credit card systems were the next most automated area of activities. The 1993 survey has noted that the adoption of technology for the automation of banking activities were largely confined to individual work process system on islands of automation basis. My thesis survey in 1994 confirmed the existence of this pattern.

Electronic Network Development. Although the establishment of intra-city networks was on the increase in the Eighth Five-Year-Plan period, the degree of electronic networking⁸ at more extensive geographic coverage was low, as indicated by Figure 6.3. The pace of the construction or development of electronic networks was considered slow in view of the fact that the banking industry had started to adopt technology in the mid-1980s, networking technology was readily available and the precedent had been set by the banks in the developed countries in their intense pursuit of electronic networks for competitive reasons.

In the local Chinese banking industry during the mid-1990s, none of the electronic networks established by the different banks were operating on an inter-bank basis (as indicated by 'IEN' on the graph). Even within an individual corporate banking system, comprehensive intra-provincial and inter-regional electronic networks for linkage among its affiliated branches were still rare in the Chinese national banking system. The lack of electronic networking characteristics was obvious in the area of the delivery of modernised payment services, like the ATM system and POS system which were introduced in the mid-1980s by the local Chinese specialised banks. Although there was a plan to construct the inter-bank form of linkages (for an interoperable ATM system) in Guangzhou during this period, this was the first initiative in the country. Such computerised systems largely remained non-unified on an inter-regional and inter-bank basis, even though such systems were highly automated at a sophisticated level in the developed countries. Electronic connection with the international banking communication network took the form of linkages with

⁸ For example, electronic linkage among branches within a corporate bank, and domestic and international inter-bank electronic linkages.

international SWIFT members and with affiliated banks in Hong Kong⁹. This type of electronic linkage is still relatively rare within the domestic banking industry (as indicated by ILN on the graph), although its incidence has increased considerably during the 1990s, as compared to the preceding periods. Nevertheless, there was a significant change during the Eighth Five-Year-Plan period, in information technology network development within the Chinese banking industry. Prior to 1994, the increasing trend in electronic linkages between bank branches (of a single banking corporation), located in different cities of the same province, was mainly the result of the People's Bank of China branches adopting networking technology for the purpose of forming the CNFN. From 1994 onwards, there were a higher number of dedicated inter-city and intra-provincial networks built by the state-owned specialised banks. In addition, there were also plans to link up the established intra-city networks to eventually achieve a nationwide network. It appears that the CNFN initiative has had an impact on the network development by the state-owned banks. However, the overall level of electronic connection among the different banks' network within the domestic banking industry, and with banks in the overseas banking industry, was still very low in 1995.

6.3 CONCLUSION

The experience of the socialist period suggests that central planning does generally entail less demand for banking technology applications than the market based system. Financial flows arise according to the production guidelines set by the planners, and bank staff have less freedom and incentive to alter the methods of processing financial transaction in ways which fully reflect the opportunities technology offers. In the reform period from 1979, the Chinese banking system was intended to adopt information technology progressively, since China was opening up to world trading and its banking system was being transformed to a two-tier banking system. This chapter revealed that the state-owned specialised banks have been the main adopters

⁹Interestingly, information technology adoption by the Bank of China's Hong Kong branches achieved significantly more impressive results than the domestic branches in China (Jinrongshibao 31/7/1996).

of information technology in the Chinese banking system. However, the adoption of information technology within these banks was largely for transactional and informational purposes, rather than for strategic and infrastructural purposes which were the main objectives of overseas bank in developed countries. The front counter operations have been the common business activity area for applying technology. Although technology has been diffused to other banking activity areas since the Seventh Five-Year-Plan period, the overall pattern of technology applications still constitutes islands of automation in the 1990s (Zhou 1995, Wang and Yang 1995). In the area of network establishment, the individual Chinese banks have not been able to establish extensive networks despite the availability of networking technology since the mid-1980s. The networks established by these banks were confined to a restricted geographical coverage and were not on an inter-bank basis. The adoption pace within the banking system was considered slow (Jing 1997) and unable to support the rate of economic development within the economy (Zhang 1997). This slow and shallow pattern of information technology adoption within the banking system is significantly reflected in the operation and utilisation of the CNFN (Jinrongshibao 13/11/1994) which is discussed in Chapter 7.

CHAPTER 7 : DEVELOPMENT OF FINANCIAL SYSTEM INFRASTRUCTURE.

The creation of the China National Financial Network (CNFN) was envisaged as providing fundamental support to the reform of the central bank and to the banking system as a whole, by providing fundamental financial system infrastructure. The full development of the CNFN is expected to support information technology system applications for information flow, transaction processing and a range of traditional and modern financial services on an intra-city, inter-city, inter-region and inter-bank basis in the future (Jinrongshibao 30/7/1996). It is intended that several inter-bank functional systems will be developed on the CNFN¹ to support the efficient functioning of the overall financial system. The initial construction of the CNFN has focused heavily on enabling the development of a national payment system (CNAPS), which was the priority area to facilitate the central bank in its financial and monetary management².

7.1 THE CHINA NATIONAL FINANCIAL NETWORK (CNFN)

Construction of the CNFN started in 1989, after the State Council's approval was allowed, and test operations were commenced in April 1991 in the first batch of selected sites. The CNFN is based primarily on a satellite communication network (being built by the People's Bank of China) and, secondarily, on the public digital network (leased public networks, CHINAPAC and CHINADDN from the MPT),

¹ Because the CNFN supports an electronic linkage system among banks, it is often closely associated with the term 'Electronic Inter-bank System'.

² 'The network system will, through the inter-bank funds clearing service, have a strict surveillance and control over monetary base, money supply aggregates and monetary liquidity, assets and liabilities and standby reserve accounts of commercial banks, and have the capacity of integrating itself with international settlements for the purpose of stabilising the currency and market.' (People's Bank of China 1995, p. 66).

which provide complementary support for technical connection among the geographically dispersed branches.

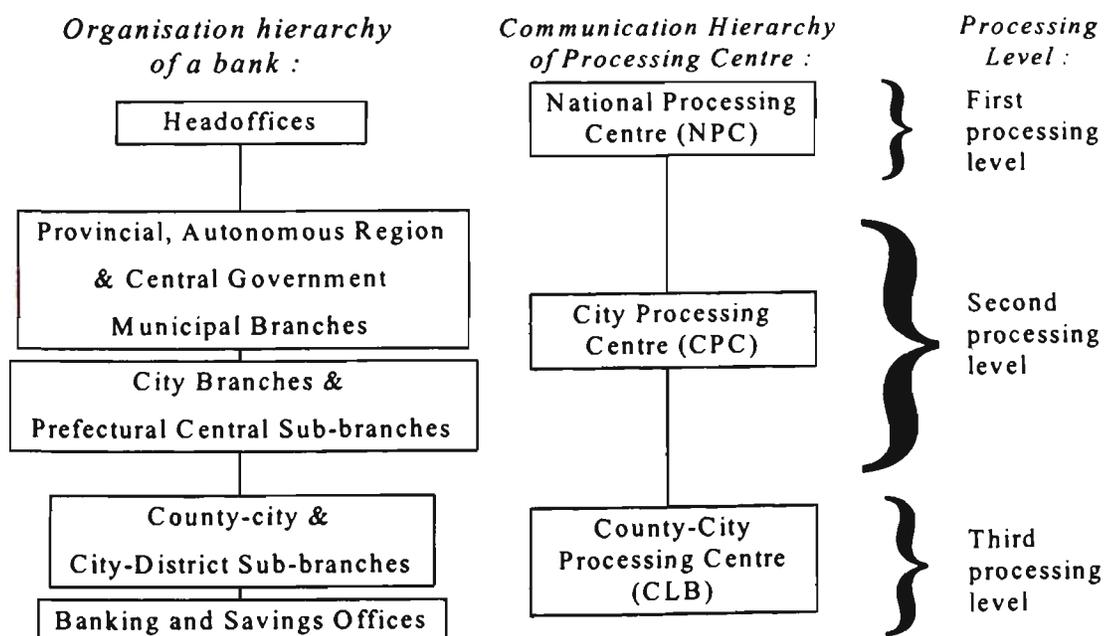
7.1A) The Structure of the China National Financial Network (CNFN)

The China National Financial Network (CNFN) structure comprises of two networks, viz. the National Network (NN) and the Regional Network (RN). The Regional Network (RN) is further subdivided into the City Network (CN) and the City-County Network (CCN). From a technical perspective, the national network serves as the backbone network or the central wide area network that links up all the regional and local sub-networks across the nation.

In the banking system, the organisational hierarchy of the banking units within an established banking corporation is segmented in accordance to geographic areas. Generally, the head office is at the apex of the organisational hierarchy, followed by provincial, autonomous region and central government municipal branches, city branches, prefectural central sub-branches, county-city and city-district sub-branches, and finally, at the bottom of the chain of command are the banking and savings offices. Correspondingly, the two networks (NN and RN) are stratified into three processing levels which correspond closely to the organisational hierarchy:

Figure 7.1

The Three Processing Levels in the CNFN



i) National Network (NN).

This network connects the City Processing Centres (CPCs) at the second processing level to the National Processing Centres (NPC) at the first processing level. The CPC includes the relevant intra-city processing sub-centres, all of which are normally located within one building and electronically interconnected via LAN. The NPC and the CPC are connected via satellite technology, with terrestrial communication lines as complementary support to enable full and secure network linkage. Technically, the satellite-based telecommunication network infrastructure that facilitates the electronic linkage between the NPC and the CPC constitutes a main functioning satellite station (first NPC), a backup satellite station to the main station (second NPC), and a number of small satellite stations (CPCs). The two main satellite stations (NPCs) are capable of alternating between the role of a main station and a backup station, which separately located in Huairu³, a suburb of Beijing, and in Mashang in the city of Wuxi, in Jiangsu province.

Initially, during the early 1990s, the People's Bank of China leased the lower-frequency C band (4 and 6 gigahertz) of the 'AsiaSat I' satellite for the purpose of constructing the CNFN to facilitate information transmission⁴ (Yin 1993). This was subsequently upgraded in the mid-1990s to operate at two main frequencies in order to enhance the safety features of the communication: the lower-frequency C band and the higher frequency, Ku band which is digital (Yin 1996). The main satellite station used two IBM 4381 mainframes initially, subsequently upgraded to ES9000/260 and IBM 9672, to provide the basic connection with the communication satellite.

The functions of the City Processing Centre (CPC) in the CNFN are undertaken by People's Bank of China branches at the city level. These small stations employ

³ Originally in Shahe but due to limited capacity and obsolete technologies, relocated to Huairu in 6/5/1996.

⁴ It has a 13 metres antenna that is capable of communication at high frequency of above 70MHz and middle frequency of below 70MHz. In addition, it is also capable of transmission speed at 57.6 kbps which is typical for facilitating linkage to international network.

VSAT technology⁵ for electronic linkage to the NPC and each has a 3 metre antenna with 1W or 0.5W transmission capability. The VSAT network directs all traffic on the network flows through the main satellite station which will then be routed to the destined receiving station. Such configuration involves the centralisation of network routing and control intelligence and technology at the central hub or main satellite station (NPC). This approach enables many small station terminals to be set-up easily and the network coverage to be expanded at low cost. The small satellite stations largely use HP486 or COMPAQ 486 microcomputers⁶ as the main control communication equipment and are also equipped with backup facilities.

ii) Regional Network (RN).

As mentioned earlier, this Regional Network (RN) consists of the City Network (CN) and the County-City Network (CCN). The City Network (CN) interconnects nodes at the second processing level, that is, the CPCs and the branches of the specialised banks located in the relevant city. The telecommunication networks in the developed economic areas like the special economic zones' local cities branches of the second processing level, are capable of data, voice and image transmission. The County-City Network (CCN), on the other hand, interconnects nodes at the third processing level, that is the CLBs (County-city processing centres located at the People's Bank of China county sub-branches) and the specialised banks' sub-branches in the relevant county. The CCN is a WAN (Wide Area Network) established by the relevant People's Bank of China sub-branch. In principle, the construction of the CNFN at this third processing level uses the X.25 public digital network provided by the MPT. However, the plan does not rule out the possibilities of employing other interim connection technologies (satellite or wireless transmission devices) to link up those branches in the remote and rural areas. The type of electronic interconnection between the processing centres and the banks in the industry depends on the extent of information technology adopted by each bank for the linkage.

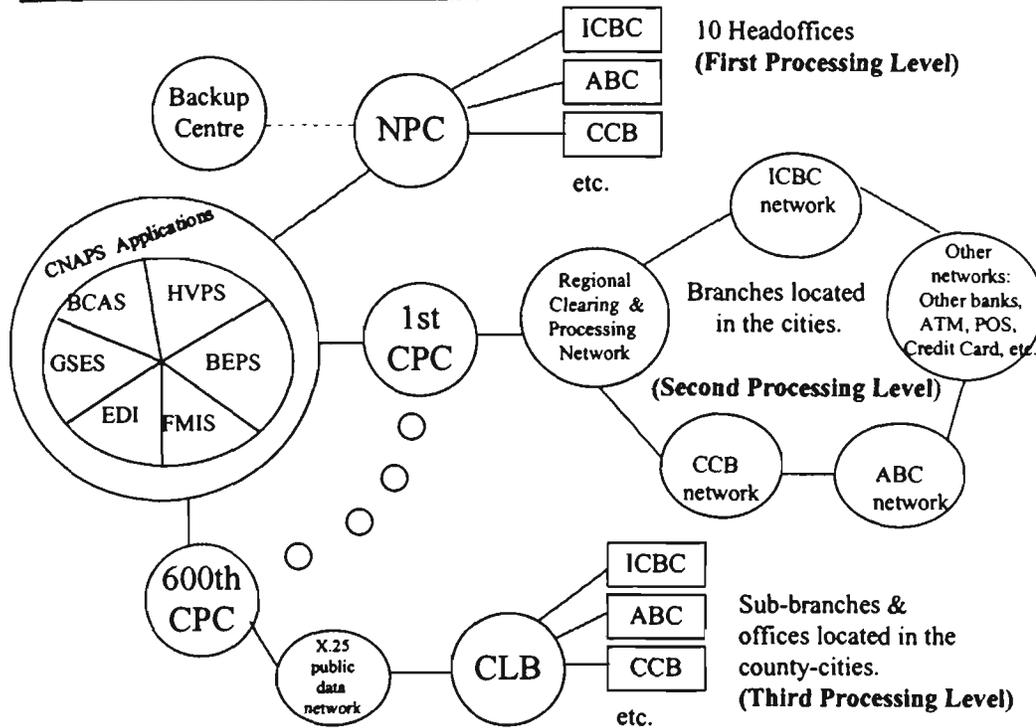
The diagram below illustrates the layout of the CNFN:

⁵The VSAT (Very Small Aperture Terminals) network uses the star topology in which all switching and routing intelligence is concentrated at the central hub station (that is, NPC).

⁶16M storage capacity and 540M harddisk.

Figure 7.2

An Illustration of CNFN & CNAPS



Adapted from Zhang Z. (1996)

Abbreviations:

- CNFN - China's National Financial Network
- CNAPS - China's National Advanced Payment System
- NPC - National Processing Centre
- CPC - City Processing Centre
- CLB - County-City Processing Centre

- ICBC - Industrial Commercial Bank of China
- ABC - Agricultural Bank of China
- CCB - China's Construction Bank

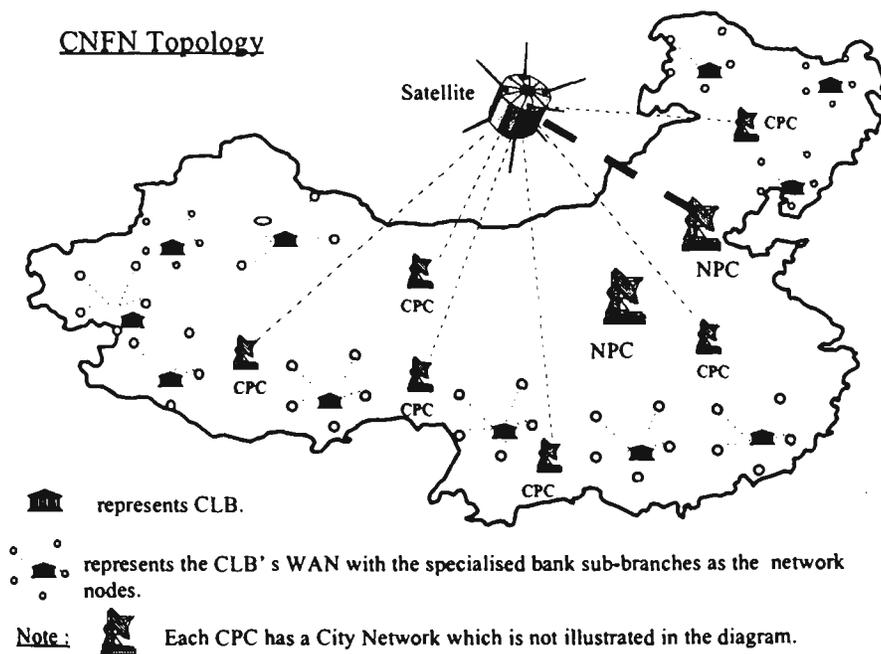
The joint function of the satellite communications technology and terrestrial wire (public data) facilities is to connect electronically the three levels of the processing centres as a network, as well as connect to the branches of the local specialised banks. The extent of electronic network coverage for the transmittal and receipt of funds flow or payment instruction is dependent on the degree of electronic linkage achieved among the parties. A payment instruction given by a specialised bank to the People's Bank of China processing centre could either be delivered via the electronic network directly, via a magnetic media of exchange, or via the postal system. Though information transmission from the specialised bank could be almost instantaneous via

the electronic network, the internal processing of the instruction within the processing centre was largely manual up to 1995. Before the processing centre transmits the information received on payment instruction to another processing centre for clearance, the accounting department in the first processing centre will initiate the instruction by generating its internal official transmittal document. Generally, the internal process will involve acknowledging, confirming and recording the information, each step being handled manually and separately by different staff. Once accuracy is confirmed, transmission of the information to the relevant processing centre is activated via the satellite communication network. At the other end, when the second processing centre receives the instruction, the staff receiving the information will type the data on the internal document which will be passed on to the accounting department for internal processing. This part of manual work process hinders the speed of the overall transaction process and is a concern which has to be addressed.

The topology of the CNFN structure on the map of the People's Republic of China is as follows:

Figure 7.3

CNFN Topology



In terms of the type of technology adopted by the processing centres for electronic connection to the CNFN (Yin 1996), the commitment given during the national

clearing system reform forum held on April 1989 (Jinrongshibao 25/4/1989), and the reinforcement laid out in the Ninth Five-Year-Plan (Li 1996), made clear that latest, tested computer network and satellite technology was to be used. Indeed, the adoption pattern within the banking industry did reflect the applications of such level of advanced technologies.

7.1B) Development Stages of the CNFN

On 1st April 1991, a recorded trial run on the CNFN was conducted in the People's Bank of China branches (the CPCs) located in seven cities (namely, QiqiHaer in Heilongjiang, Harbin in Heilongjiang, Changchun in Jilin, Shenyang in Liaoning, Dandong in Liaoning, Dalian in Liaoning and Guangzhou in Guangdong). In each of the branches in the cities the necessary communication equipment was installed for testing the financial network's operational efficiency in transmitting payment instructions. Both manual and electronic mode of processing payment instructions were executed along side to one another, in order to determine the superior mode of processing. After six months of the trial, the electronic mode was proven to be much superior in every aspect of an efficient payment clearing and settlement system (Yin 1993). The People's Bank of China found that it was much faster, more accurate, clearer, safer and more reliable than the manual processing mode. On average, more than 50% of the payment transactions were finalised within a day using the electronic system, while the rest was finalised by the next morning. In Guangzhou, it was reported that the branch achieved 100% clearance within a day during the experimentation period. These results were indeed a far cry from the previous antiquated payment system, which took between three days to more than a month to finalise a payment instruction. The Harbin branch noted that the electronic mode eliminates the 10% human error which was normally found in the manual mode of processing. The test result was acclaimed as successful and impressive, but most importantly, it accorded even greater importance to the need for a fully electronic inter-bank payment system. This experience was subsequently extended to other cities. On 4th September 1991, the second batch of 14 cities, which include Shanghai and Tianjin were equipped with facilities to form the relevant part of the CNFN and

subsequently tested. On 31st March 1992, the third batch of cities including Beijing and further cities in Guangdong followed suit in establishing linkage to the CNFN. By that time, 51 People's Bank of China branches were linked to the CNFN, most of which were from the first processing levels while the remaining minority were from the second processing levels. On 3rd of January 1993, 66 of the People's Bank of China branches (CPC) belonging to the second processing level were the fourth batch involved in establishing electronic connection to the CNFN. They included Pearl Delta in Guangdong, Daxing in Heilongjiang, and other cities in the coastal region. By the end of 1993, 138 People's Bank of China branches at the first and second processing levels had established network connection to form the CNFN, which had a coverage boundary including Haikou (located in the Southern region), Haila'er (located in the Northern region), Yanji (located in the Eastern region), Wulumuqi (located in the North-Western region), Lasa (located in the South-Western region). This network covered all the central government municipal cities, provincial capital cities, single planned cities and part of the prefectural cities (Jinrongshibao 3/8/1996). The establishment of the CNFN followed a top-down geographical hierarchy and which also followed a pattern of first covering areas that are economically better off. Payment transactions were used to test the network's processing capability. The early setup of the CNFN with 138 small satellite stations in 1993 was capable of handling the transmittal of 1,136,000 number of payment or fund transfer transaction at total value of 1,189,000 million yuan in that period. The type of payment transaction transmitted was high value payment which, on average, was about 1 million yuan per transaction (Jinrongshibao 3/8/1996).

By 1995, the number of small satellite stations in the CNFN structure had proliferated to 400 small satellite stations, capable of serving about 60,000 bank branches and offices (about 36% of the banking units in the industry). The CNFN's transmittal capability had also increased to 3,940,000 number of transactions at total value of 6,350 billion yuan (Li 1996 and Jinrongshibao 3/8/1996). In 1996, 98 small satellite stations were set up in the eighth batch of cities to further establish the CNFN. The network basically covers all the National Processing Centres (NPC) and City

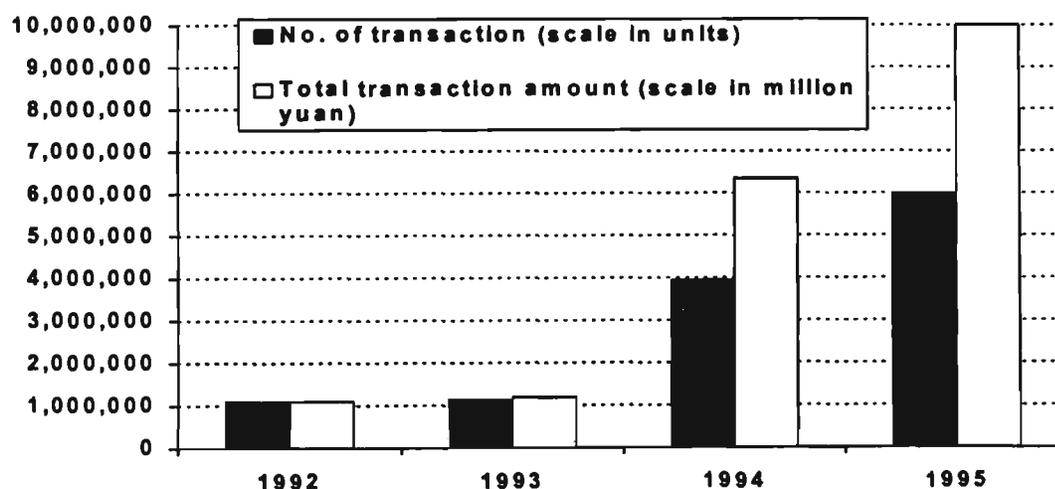
Processing Centres (CPC), and part of the County-City Processing Centres (CLB)⁷. In 1997, there were about 650 small satellite stations established (Jinrongshibao 12/12/1997).

From the information available thus far, it is apparent that the electronic network has been received positively by those adopted it. This is clearly apparent from Appendix I to this chapter, which summarises a wide range of reports from Jinrongshibao about the effects of different payments systems in China over the past decade. Many of these reports document at the local level the benefits achieved by the move to electronic payment and settlement systems.

As the CNFN expands its coverage in the country, the electronic inter-bank payment transaction volume cleared through the expanding network has also increased concurrently. The volume of payments transacted on the CNFN increased tenfold between 1992 and 1995 (Figure 7.4) and has undoubtedly continued to increase rapidly since 1995.

Figure 7.4

Electronic Inter-bank Payment Transaction Volume on the CNFN



Source: Selective Issues of Jinrongshibao.

In the CNFN formation, the People's Bank of China branches at the different processing levels have to be equipped with information technology facilities for interconnection among the branches, as well as for establishing linkages with the

⁷In 1995, the network covers 800 counties. It is intended that the network will cover more than 2,000 counties by the year 2000.

commercial financial units in the industry. At the initial stage of establishing electronic linkages with financial commercial units, the specialised banks constitute the main focus for the People's Bank of China branches. The central bank has laid down guiding principles to be followed in the establishing of electronic network linkages, for the purpose of ensuring network uniformity and connectability among the nodes. It was decided that in areas where no network (especially CN and CCN) is already established by the state-owned specialised banks and the People's Bank of China branches, the latter will be the leading force in organising and soliciting cooperation from the relevant departments of the state-owned banks in that locality to establish a consistent financial network structure. On the other hand, in areas where dedicated networks⁸ were already installed by the state-owned specialised banks, the People's Bank of China would construct its own network and solicit cooperation from the relevant departments of the banking units in that locality to establish electronic interconnection within the existing networks and with its constructed networks. Similarly, in areas where networks were established by some of the state-owned specialised banks, the People's Bank of China will encourage all these financial units to share networks with the network which has adopted the latest technology and encourage interconnection among the existing networks. Thus, in the establishment of the CNFN, the People's Bank of China has tried to play the role of agent for the different banks, to achieve compatibility and connectability among the existing and planned networks. In 1996, regulations regarding proper technology standards for network connection to the CNFN were issued by the People's Bank of China, to ensure proper adoption of technology for the CNFN development (Jinrongshibao 9/9/1996).

During the Eighth Five-Year-Plan period, about 20 WANs that cover localities at the second processing level were established (Jinrongshibao 30/7/1996). It was planned that the CNFN would link up all financial outlets at all the three processing levels by the early 21st Century (Jinrongshibao 1/8/1996). However, it was envisaged that the less developed regions would take more time to establish the connection with CNFN than the more developed regions (Jinrongshibao 15/8/1996 and 19/8/1996) because of the lack of supporting factors (Wang 1996a and Feng 1996b).

⁸ Specific network established by individual bank.

7.2 APPLICATIONS

7.2A) China National Advanced Payment System (CNAPS)

Because of the priority given by the government in achieving an automated national payment system, the construction of the CNFN is focused on supporting the application of an electronic national payment system, known as the CNAPS. In turn, the operation of this CNAPS has been used to trial the effectiveness of the CNFN infrastructure in the different development phases of the latter. Therefore, the discussion of the CNAPS in this section will raise a number of familiar points that were already presented in the earlier section regarding CNFN.

In 1991, the World Bank granted assistance to China to establish a modernised payment system which was estimated to cost approximately US\$750 million (Gebzberger et al. 1994). A loan of US\$42.5 million was made by the World Bank to the Chinese government for the purpose of technology adoption within the financial system, with 85% of this amount to be channelled into constructing the CNAPS and the CNFN. The rest of the financing has been largely provided by the People's Bank of China. In addition to the monetary aid, an international advisory committee was formed consisting of experts from the World Bank and the central banks of US (New York Federal Savings Bank), Britain (Bank of England), Germany (Deutsche Bundesbank), Japan (Bank of Japan) and Switzerland (Swiss National Bank), to provide assistance in the development of the Chinese payment system (Jinrongshibao 5/11/1991). The committee is headed by high ranking authorities from the central bank and the major state-owned banks in China. On top of the assistance received, the Chinese government has invested 4 billion yuan in setting up the infrastructure of the national electronic banking payment system (Jinrongshibao 25/4/1993).

At the outset of the plan, the network was intended to handle fund clearing transactions in 40 main cities, the total number of transaction being between 800,000 to 1,200,000 per year. It was envisaged that the electronic network would shorten the duration in clearing from at least 10 days (via postal system) to within a day.

The CNAPS comprises payment sub-systems like the automatic local bill clearing system, wholesale real-time payment system, retail batch payment system, credit card verification system, securities exchange settlement system and related information systems (People's Bank of China 1994). These are summarised briefly below.

1. Local Clearing House (LCH).

This handles payment settlement within the local area and its system has the features of batch processing, net settlement, fixed-time, document-based settlement.

2. High Value Payment System (HVPS).

This system handles transactions that involve large payment values that exceeds 100,000 yuan and which take place on an intra-city and inter-city basis, and is targeted to process these transactions on a real-time gross settlement basis.

3. Bank Card Authorisation System (BCAS).

This system supports the use of credit card, ATM and POS facilities for transaction settlement purposes.

4. Government Stock Entry System (GSES).

This is a paperless system which provides information on the Government Stock (Bond) prices, and facilitates transaction volume and settlement accounting entries, and bonds management.

5. Bulk Electronic Payment System (BEPS).

This system utilises the batch processing and net settlement mode for intra-city and inter-city small value transactions.

6. Financial Management Information System (FMIS).

This system provides information to the central bank on the country's economic and financial situation for strategic monetary control and management.

7. Financial Information Transmission Services (FITS).

This system serves as the exclusive channel for information transmission or exchange within the financial industry.

The CNAPS began to be installed in 1995 and the entire CNAPS is targeted for completion after a construction timeframe of 13 years. It is anticipated that it will enhance the stability of the domestic currency through the reduction of float in fund transfer. In addition, it was envisaged that the payment system will enable the central bank to control about 80% of funds transfer (Zhang 1996). The payment sub-systems are being built on the CNFN as outlined above.

Because the CNAPS is applied upon the CNFN, its structure of development followed closely to the construction of the latter. For example, the development structure of the CNAPS is based on the operations and needs of the central bank and the dominant

state-owned commercial players in the banking industry, and also prioritised in accordance to the geographical hierarchy structure, that is main cities first, then county-cities, and subsequently to include the rural areas (Jinrongshibao 16/2/1989). The direction of their development is considered appropriate in view of the banks being the core financial intermediary in the economy and the higher payment transaction volume in the well developed economic areas, in which the payment transaction volume in the big and medium sized cities of the more developed areas constitute 70% of the total payment transaction volume in the nation (Jinrongshibao 20/6/1996). The structure and the bid tender on the payment system were finalised during the Eighth Five-Year-Plan period. At the initial period, the provision of high value payment and inter-bank payment and settlement services to commercial banks reign high in priority. It was targeted that the 20 selected cities will be able to commence testing for the CNAPS during the early period of the Ninth Five-Year-Period Plan. To ensure future connectability with international networks for extending China fund clearing system and information system to international coverage, the SWIFT⁹ system has been used as a model for the network development. The automated payment system is regarded in the plan as the beachhead for further diffusion of the electronic payment system to other sectors of the economy (expanding the electronic payment network). The People's Bank of China, the leading force in the development of the payment system, acknowledged that the level of technology adopted in the payment system will have ramifications on the level of technology adopted by different sectors in the diffusion process (Financial Computer of Guangdong 1995). This process should have a dynamic character which not only links up the financial units in the domestic industry but also includes other economic units like commercial retail outlets (example, POS), household (example, telebanking), business enterprise (example computers in the accounting department) (Yin 1996). The eventual network achieved is envisaged to be a national electronic inter-bank network system that transcends corporate and geographical boundaries. In August 1994, discussions on payment system linkage between the central bank in mainland China and the financial bureau in Hong Kong, after the handover era, were initiated. The electronic linkage between the two payment systems was set to take

⁹ Society for Worldwide Interbank Financial Telecommunication.

place after July 1997. This is to facilitate an integrated payment system for trading activities that occur in these two regions.

7.2B) The Implications of the CNAPS for Economic Development.

It is difficult to assess in quantitative terms the cost of the slow adoption of information technology in the banking system at the national level. However, the cost of slow adoption of technology applications and of the inefficiency of the Chinese manual payment or weak technology supported system is demonstrated by anecdotal evidence. The inadequacies of documentation and of current statistical measures have made assessment of payment systems overly dependent on anecdotal information or on particular cited examples in published articles and in interviews.

i) Financial Development. The inefficient payment system has deterred the shift from bilateral settlement arrangements to inter-bank clearings in China. The technologically less advanced payment system and infrastructure, among other measures, has hindered the movement of liquidity from one city to another. The local Chinese banks have mostly confined their inter-bank lending and borrowing among themselves to a limited geographical scope, normally on an intra-city basis. The transferring of surpluses or liquidity among themselves has been on a bilateral basis, at bilaterally agreed interest rates rather than through a unified inter-bank market-oriented system. As a result, the interest rate does not reflect the actual market situation and this makes it difficult to control the money supply (The Banker, (57) Feb 1996).

It is expected that the national electronic inter-bank clearing system will provide control over monetary liquidity, money supply aggregates and monetary base, and contribute to the stabilising of interest rate and the currency (People's Bank of China 1995).

ii) Float. As noted several times previously, in the People's Republic of China, fund transfer through the antiquated banking system may take three to five days, ten days or even more than a month. Appendix I summarises some the anecdotal evidence of the varying number of days that the manual payment and settlement system in different banks took to settle transactions. In remote or rural localities where there is weak infrastructure support, the duration could be very long. For example, it was reported in 1988 that rural financial institutions took 53.5 days, Agricultural Bank of China took 149 days, and Trust Cooperatives took 232 days to complete a payment and settlement instruction (Jinrongshibao 4/4/1988).

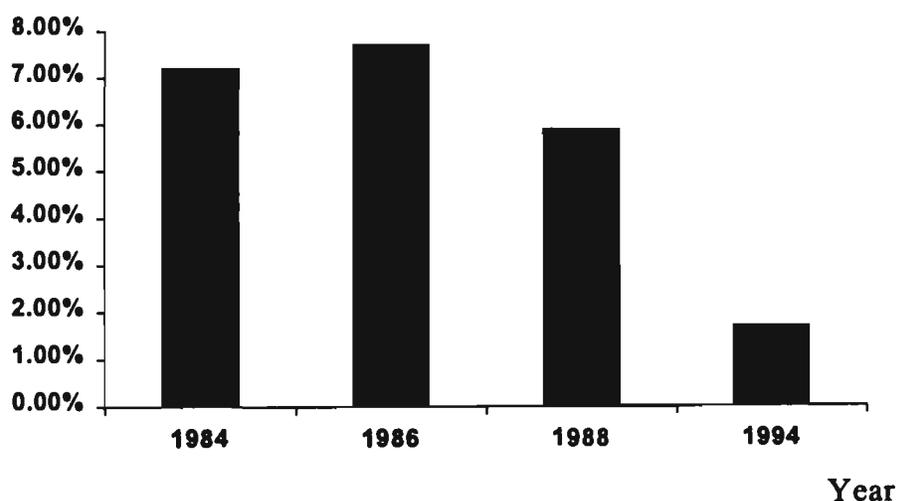
There have been efforts undertaken to minimise the duration of the float during the 1980s, by replacing the postal mode of fund transfer with road and rail transportation. The improved transportation mode reduced the float duration by an average of one to three days. However, document losses, delays and processing inaccuracies were common problems under either of these backward systems (Zhou 1991). Moreover, the improvement using the road and rail transportation mode is insignificant as compared to the information technology support in the overseas countries during that time. Some of the Chinese banks have tried to make further improvements in the speed of the payment information transmittal system by relying on a disparate range of stand-alone electronic equipment such as the telephone, telegraphy and facsimile machines. Unfortunately, this is only possible in developed region but not on a nationwide basis. Relatively extensive degree of manual efforts and processes were required to complete the payment and settlement process. In few cases where sophisticated information technology was adopted for the payment system in some major cities during the late 1980s and early 1990s, the float duration in the electronic system was generally not more than two to three days (Zeng 1995). In certain cases which involve small value payment and settlement between banks on an intra-city basis, information technology applications enabled transaction to be finalised within a day. From the evidence, the benefits derived from applying information technology in the payment system have included from efficient use of funds and savings on interest payment from borrowing due to delay receipt of fund caused by float; increase reliability, safety, speed and accuracy of the payment system; increased work

efficiency and management standard and the prevention of fraud (refer to Appendix I). These have significant macroeconomic implications.

The weak information technology infrastructure has aggravated the problem of finance in China hampering a more efficient rate of money velocity and circulation to meet the growing business demand for funds. Despite the potential of information technology in reducing the level of float in the system, the level of information technology adopted in the banking industry is still low in the mid-1990s. Interestingly, the limited information available on the float situation in China indicated that there was a significant decrease in the amount of float in 1994 as a proportion of M_2 as per below chart. The evidence in Appendix I suggests the adoption of information technology is one of the likely factors in reducing the float level in 1994. Despite this strong effect, the Chinese government continued to have a strong desire in reducing this float level further.

Figure 7.5

Float as a Percentage of M_2



Source: Selective Issues of Jinrongshibao.

iii) Cash. Float not only imposes a high cost of financing on the payees but also discourages the acceptance of any credit or bank instrument associated with the

system. As a result, cash has been a preferred mode of payment, in which some payees even offer 5-10% discount to encourage cash payment in closing a transaction (Jinrongshibao 13/6/1988).

It is estimated that in 1993, 20% of payment transactions were in cash (Jinrongshibao 30/8/1993 and Mao 1994). On an annual average basis, the rate of cash usage has also been estimated at 25% (Cao 1995), which is considered high when compared to the situation in the developed countries like Japan (7%) and the USA (5%). The then Secretary of State, Jiang Zeming, voiced his concern on 1st June 1993 over the huge use of cash to settle transaction in China. If this situation remained uncorrected, the high level cash usage will continue to have undesirable implications for the monetary condition of the economy. The high holding of cash has been a concern to the Chinese government for some time, for example because it could have a destabilising impact on government efforts to control inflation. Payment mechanisms such as debit and credit card facilities and electronic funds transfer were some of the advanced methods that the government decided to employ to reduce the extent of cash usage in the payment system.

iv) Flexible Processing Capacity. A comprehensive banking technological infrastructure provides flexibility to the banking system in supporting the economy's activities. Flexibility engenders reliability and, in turn, stability to the economic system. In Japan, the US, and the UK, the inter-bank funds transfer systems have high processing capacities. In Japan, the system is capable of processing the payment flows equivalent to the country's annual GNP in about two business days, whereas the US and UK systems take three and five-and-a-half business days respectively to turn over payment flows equal in value to their own country's annual GNP (Borio and Bergh 1993). The People's Republic of China's low technology-oriented and underdeveloped system, on the other hand, was estimated to take 400-500 days to turn over payment flows equivalent to the nation's 1992 and 1993 respective annual GNP figures (Wang 1994c). The government turned towards the CNAPS to resolve the inability of the manual payment system to cope with the growing volume of

transactions in the active Chinese market, and to resolve the bottlenecks this created in the financial system.

v) *Reliability, Speedy and Accuracy.* Information technology offers unprecedented potential in reliability, speed and accuracy for the payment system. The trial that was conducted on seven Chinese cities, mentioned in section 7.1B, highlighted the effectiveness of using satellite over manual system of payment clearing and transmission in terms of reliability, speed and accuracy. In addition, Appendix I also highlighted the benefits of information technology applications in some of the work processes that are directly or indirectly related to the payment system.

vi) *Fraud.* The high usage of cash has given rise to a high rate of increase in counterfeit currency activity, as shown in Table 7.1.

Table 7.1 - The Volume of Counterfeit Currency Activity in China

Year	Amount seized by the financial institutions	Amount seized by the police	Total amount seized	Number of cases
1988	323,000 yuan	515,000 yuan	838,000 yuan	N/A
1989	1,268,000 yuan	2,345,000 yuan	3,613,000 yuan	990 cases
1990	67,800 yuan	17,427,000 yuan	17,494,800 yuan	2,900 cases
1991	11,315,000 yuan	8,779,000 yuan	20,094,000 yuan	3,000 cases

Source: Jinrongshibao 22/5/1995

It is believed that there is still a substantial amount of counterfeit currency in the economic system yet to be detected. The government had tried to reduce this risk of fraud by promoting the use of credit cards as a mode of payment.

In addition to counterfeit currency in the system, the inefficient payment system can give rise to capital flight or unauthorised withdrawal of capital. It has been estimated that capital flight totalled to about US\$27 billion in the early 1990s with more than \$7 billion of China's foreign exchange reserves leaked out of the country financial

reserve system without a trace, and this depreciate the value of the domestic currency (The Banker 1993). The government intends that the construction of a national electronic payment system (that is, CNAPS) will also curb this unauthorised leakage from the financial system. The high value payments will have to be cleared by the central bank in the modern electronic payment system, and this provides better means of tracing the flow of funds than the manual system.

Cases of fraud occurring in the manual system of payment and settlement were frequently related to the reliance on manual efforts to check violations. For example, the manual system of payment traditionally verifies the authorised approval of the payer by means of an identification stamp on the document instructing payment. The absence of tight security measures and high dependence on manual effort have led to repetition of several similar funds embezzlement incidents, involving counterfeit documents with a forged identification stamp or a stolen stamp. In 1986, there were more than 287 such fraudulent cases costing the economy 65 million yuan; while in 1991, there were more than 1,265 cases with damages amounting to 213 million yuan (Li 1993). In 1996, there were 18,442 cases of reported and persecuted money laundering, fraud, and related illegal activities.

The difficulty in preventing such fraudulent practices from happening in the manual payment system is obvious from the experience of the ICBC branches in Changsha cities with their manual mode of processing. With 22 outlets, 20,000 deposit accounts and 400,000 identification stamps to mind manually in the old system, time delay and errors in payment processing were common. It has been acknowledged that the use of information technology has supported the implementation of tighter security measures and has improved the efficiency of the payment system in response to the growing demands of business activities. It has been stated by the Industrial and Commercial Bank of China that computerised security codes have been effective in curbing such occurrences.

On the other hand, the progressive adoption of information technology has introduced a new facet of fraud - technology fraud has been on the increase (Jinrongshibao 3/8/1997). In 1993, the report compiled for the Bank of China credit card frauds alone reached over 3,000 cases which listed them in its 179th volume report, while the Agricultural Bank of China has over 1,000 cases listed in its 7th volume report (Wang

1994b). Many of these cases are likely to be related to the inexperience in handling credit card and technology. Overall, whether the adoption of information technology in the payment system will lead to a lower occurrence of fraud than the manual system is a debatable issue. However, its technological potential for fraud reduction, by enabling a modernised and efficient payment system, is given great importance by the World Bank, Bank for International Settlements, developed countries as well as by the People's Republic of China.

7.2C) The Development of CNFN as a Constraint on CNAPS

At the initial stage of the construction of financial networks, the provision of high value payment and inter-bank payment and settlement services to commercial banks, through the CNAPS, were given high priority. However, progress in developing CNAPS depends in part on the construction progress of the CNFN. Due to the wide spectrum of financial business areas, the wide geographic landscape and the number of large and medium cities involved in the establishment of the CNFN's regional network, there are specific obstacles in the development of CNFN that impede the installation of the CNAPS. This is particularly relevant to the establishment of the Regional Network (RN). The construction of the RN in different regions has different completion schedules, which generally involve long installation timeframes, the earliest being in 1995 while the latest is after 2000. In addition, uneven development of telecommunication infrastructure in different parts of the nation has impeded the development of the CNFN. For example, the development status of the X.25¹⁰ public data network differs in each RN's city node. Some of the nodes have already extended the network to link up their local county's WAN, which together serve as a ready basic structure for the development of CNFN. On the other hand, other nodes have backward telecommunication infrastructure and inadequate facilities. The full electronic linkage between specialised banks and the People's Bank of China processing centres is also rendered difficult by the absence of compatible networking technologies (Jinrongshibao 18/7/1996). In some areas where networks were

¹⁰The X.25 international protocol standard is a well-known packet-switching interface standard for connecting a terminal device host system and a packet-switched network. X.25 network is capable of providing a relatively reliable and efficient service.

established by the specialised banks (Industrial Commercial Bank of China, Bank of China, et cetera) prior to the construction of the payment project, they were dedicated networks like SNA¹¹ (Financial Computer of Guangdong 1995). Few of the specialised banks' dedicated networks located at the CN level do have the X.25 protocol standard and this limits the advancement of the CNFN and, hence, the CNAPS.

The CNAPS project was at tender and model testing stage in 1994 (Jinrongshibao 26/9/1994) and commenced installation in 1995 (Financial Computer of Guangdong 1995). By end 1995, the development of the CNAPS was largely confined to supporting the payment system on an intra-city basis and in semi-automated processing mode. The People's Bank of China's processing centres in about 250 big and medium sized cities¹² rely on either network or electromagnetic transmission media (such as tape and disk) for transmitting instructions on intra-city payment clearing and settlement, while the internal processing of instructions was mostly carried out manually. Among the 250 big and medium sized cities, fully automated intra-city bill clearing process was achieved in processing centres located in 7 big and medium sized cities (Jinrongshibao 30/7/1996). The CNAPS was scheduled for a trial operation in 20 main cities (including Shanghai, Tianjin, Shenzhen, Wuhan, Shenyang, Xi'an, et cetera) between 1996 to 1997. In 1996, 10 of these cities (Shenzhen, Shanghai, Hangzhou, Shenyang, Ningbo, Dalian, Inner Mongolia, Wuhan, and Guangzhou) completed the testing process and commenced operation (17/10/1996).

7.2D) The Credit Instruments

Since reform of the payment settlement system began in 1989, the credit instruments that the government has been strongly promoting to support economic activities and

¹¹ The System Network Architecture (SNA) was a popular network architecture used in many networks during the 1950s to 1980s. Its high adoption rate was attributed to its capability in working well with backward telecommunication infrastructure. It was able to derive maximum performance from the then slow-speed circuits. However, this protocol is rendered redundant with today's advancement in transmission and information technology innovations.

¹² About 69% of the cities which were imbued with intra-city fund clearing system set-up, and were in the position for satellite communication networking.

reduce cash circulation have been cheques, bills, promissory notes and credit cards (which the Chinese termed 'three bills and one card'). The clearing and settlement of transactions conducted through these instruments are heavily dependent on the foundation of CNAPS and CNFN.

About 60% to 70% of the payment settlement transactions by enterprises involving credit instruments were done through cheques, bills and promissory notes. In large and medium sized cities, these mode of payments accounted for as much as 90% of transactions involving credit instruments, involving about 1 billion yuan of settlement value per day (Jinrongshibao 13/1/1997). In recent years, the average national usage of these credit instruments have been: 1 billion cheque items at total value of 36,000 billion yuan; 54 million bill items at total value of 4,500 billion yuan; and 8.6 million promissory notes (Jinrongshibao 14/4/1996).

Though cheques ranked as the most popular credit instrument used for payment, they are largely confined to inter-enterprise transactions (Jinrongshibao 14/4/1996). Prior to 1986, personal cheques were virtually nonexistent and today remain in low usage as a personal payment instrument. Shanghai was the first city to launch personal cheque usage in 1986. Though the central bank, the Industrial and Commercial Bank of China and the Agricultural Bank of China have jointly promulgated regulations governing personal cheque usage, the acceptance and usage of personal cheques remained low due to insufficient legal protection. In 1993, the People's Bank of China relaunched the concept of cheque usage. The financial laws that were enacted after 1995 have accorded a higher level of protection to the use of personal cheques. However, the absence of immediate verification facilities has resulted in cautious commercial retailers forbidding cheque payers to leave with goods until at least 3 days after the cheque has been cleared (Jinrongshibao 24/8/1996 and 29/1/1996). Anecdotal evidence of consumers carrying huge bags of cash to pay for big ticket item purchases are common. It is therefore obvious that the efficient adoption of information technology by the state-owned banks, for connection to the CNAPS and CNFN, are important to the widespread acceptance and use of personal cheques.

Similarly, the commercial bill, which was initially introduced to five sectors in the economy (coal, electrical power, metallurgy, petrochemical industry and railway transportation) during the mid-1980s, has remained underutilised. The function of the

commercial bill, especially its discounting feature, has major implications for the central bank's ability to sustain liquidity and control the proliferation of unsecured loans among enterprises (People's Bank of China 1996). The adoption of information technology is expected to instill credibility in the use of credit instruments in the economy, through the potential of information technology in enabling efficient turnover and availability of fund.

Another credit instrument for which electronic banking connection to the CNAPS and CNFN is the foundation of operation is the bank card (which includes credit card, charge card, debit card, ATM card, pre-payment card, et cetera). In 1993, the government launched a campaign known as the 'Golden Card Project' to encourage cashless transaction through the use of bank cards. The adoption of credit cards was recognised in the 3rd Plenum of the 14th Central Committee to be an important economy building component (Jinrongshibao 13/2/1995). The project has a ten-year implementation plan, and is targeted to realise cashless transaction in selected cities which have a total population of 300 million people. The project has an objective of achieving 200 million cards on issue by the year 2000. This credit instrument is directly associated with the construction of CNAPS and CNFN, which would support and enable the interoperation of ATM and POS facilities among different banks in different localities. It has been expected that the project will create great impetus for the installation of sophisticated information technologies and for the construction of technological infrastructure within the banking industry. At the initial stage of implementation in 1996, it was reported that the Golden Card Project has already brought about 75 billion yuan of demand to the information technology market, out of which about 30 billion yuan were direct purchases made by the banks (Jinrongshibao 9/12/1996).

7.2E) Other Applications

Some of the other information technology applications that are in the process of establishment in conjunction with the CNFN are:

- The initial stage of the 'Kuai Tong' (means fast communication) project involves establishing electronic information systems connecting the central bank, the State

Council and its 44 main branches at the provincial, autonomous region, and central government offices at the municipal level. The network will enable daily reports on the financial market in each respective locality to be fed by the local branches to the central bank. The primary objective of the network is to enhance the central bank's control of the economy. The electronic network will continue to expand its coverage to the lower regional branches during the Ninth Five-Year-Plan Period.

- An information technology system that is capable of tracking and monitoring funds flow in about 1,000 big and medium key state-owned enterprises in 215 cities is being constructed. This project was initiated by the State Council, which recognises the need to obtain updated information about these enterprises' position in fund usage, production and market performance.
- A securities trading electronic system that covers the main cities in the countries is being constructed.
- An accounting system has already been established which covers about 600 of the People's Bank of China's branches and sub-branches. Prior to 1989, the manual system of financial accounting report compilation and collation caused delay in providing information for effective control. Generally, the reports would take one year to complete under the manual system. By the time the data was ready, it was of historic value only and hence far less useful.

7.3 CONCLUSION

The CNFN was initiated by the Chinese government to accelerate the construction of inter-bank linkages, which were aimed to support the application of sophisticated electronic banking systems for the purpose of macro-monetary control and management. The project mentioned and credit instruments (applications on the CNFN) promulgated for the financial industry require the state-owned specialised/commercial banks to adopt information technology in the relevant business areas, in order to realise the national strategic direction of achieving an efficient banking system. Each bank has to be electronically equipped before it can be linked up to the network infrastructure constructed by the People's Bank of China,

which enables them to share interoperable systems or exchange information among different banks. It is essential that the banks adopt information technology that is compatible with this satellite based telecommunication network established by the People's Bank of China. At the same time, the banks also have an important role in diffusing the adopted payment technology to the other commercial and customer sectors which are the actual users of the payment system.

The slow and shallow pattern of information technology adoption within the banking system has been significantly reflected in the operation and utilisation of the CNFN (Jinrongshibao 13/11/1994 and 18/7/1996). The primary satellite communication based CNFN does enable payment instructions to be executed within 3 days, as compared to the previous postal mode that takes 8 to 10 days. However, this still falls short of the intended 24-hour payment clearance target. The operational result of the electronic system in actual reality has differed from the control experiment described in this chapter (Wang 1994a). The 24-hour timeframe was realisable in only a few developed cities, on an intra-city basis, such as Guangzhou, where the electronic payment system reduced the level of float by 3 billion yuan and saved 1 million yuan per annum in interest payment for the enterprises (Jinrongshibao 13/3/1995). Only a limited number of regional areas were able to make use of electronic support system in its full operational mode to execute and clear payment instruction. In early 1994, the one-way-delivery of documents containing fund transfer instructions from the state-owned specialised commercial banks to the processing centre still largely rely on telex and post office for transmittal and took between 3 to 5 days (considered the shortest delivery time), or up to a month in delayed processing. As a result, the minimal amount of information delivery time on the ground was 3 days even though information transmitted via the satellite communication network between processing centres takes only a few seconds (Jinrongshibao 13/3/1995). There was too much manual mode of processing involved. It was estimated that there was at least 10 billion yuan of float caught in the semi-automated payment system in 1994 (Jinrongshibao 13/11/1994). The People's Bank of China tried to rectify the situation in the late Eighth Five-Year-Plan period, through the development of sophisticated technology software for its infrastructure, the enforcement of regulations for adoption

of compatible technology standards (Jinrongshibao 6/10/1997), and the establishment of a special taskforce for the projects (Jinrongshibao 22/6/1996).

The potential of the CNFN remains ineffectively exploited. Since the operation of the completed part of the CNFN structure in 1991, usage by the state-owned specialised commercial banks has been low, although the inter-bank payment volume cleared through the CNFN has increased in the mid-1990s. After four years of constructing the satellite telecommunication network, with one central satellite, one backup satellite, and four hundred small stations, there were few users or few connections between the specialised commercial banks' dedicated network and the CNFN. For example, the People's Bank of China Xianning branch (in Hubei province) processed 180,000 foreign exchange fund transactions with a total value of 3.1 billion yuan in the first half of 1995, in which only 11 transactions with a total value of 25.12 million yuan were transmitted via the satellite telecommunication network (Jinrongshibao 3/9/1995). Even when the People's Bank of China tried to encourage electronic inter-bank connection among the specialised banks, the attempt was made difficult by too many technology incompatibilities and by the different stages of technology adoption within the different banks (Jinrongshibao 1/5/1995).

On the other hand, the CNFN itself was slow in development and lacks comprehensive coverage (Jinrongshibao 3/9/1995). The 400 small satellite stations established in the mid-1990s constitute only 13% of the expected total number of 3,000 small satellite stations for the full operation of the entire CNFN. There has been delay in the establishment of the later batches of small satellite stations. The first five batches of small satellite stations were constructed according to plan, but the sixth and seventh batches encountered delay in network connection and this resulted in only a small area being ready for testing. In addition, the eighth and ninth batches of small satellite stations also suffered delay in obtaining approval for construction. These factors contributed to the result of a limited network coverage and, in addition, also reflects an inconsistent structure of information technology adoption in different geographic areas within the banking system.

The Ninth Five-Year-Plan's national strategy in information technology adoption for the financial industry continues to focus on constructing a modernised and integrated electronic inter-bank system, with the national payment system as the first priority for

technology applications. The objective is that, by early 21st Century, the CNFN should link up all the financial outlets located at least above the county level in the geographical hierarchy. The electronic network coverage expansion of the CNFN is the main focus in the aspect of the Ninth Five-Year-Plan. In terms of the percentage of computerised financial branches within the national system, the target was set at about 90%. In conjunction with establishing the electronic systems and expanding the electronic network, the plan aimed to promote the widespread adoption of credit cards, which are the key mechanism for harnessing the electronic networks. To achieve the aims of the Ninth Five-Year-Plan, the financial system requires a much faster adoption and diffusion rate in information technology than the rate achieved in the Eighth Five-Year-Plan period. The banking system, the core financial component in the economy, is expected to be the most active adopter of information technology.

Appendix I
Table 7.2 - The Effects of the Different Payment and Settlement System in the Different Banks.
A Summary of Selected Reports from Jinrongshibao, 1987-1995.

Date	Province	Areas	Bank	No. of days taken in the past mode or present backward mode	Mode of transfer in the past	No. of days or processes shortened	Improvement	No. of days or length of time taken now	float in the past or backward mode	Benefits	Source: JRSB
1/03/86	Sichuan		PBOC	2 days	postal						19/09/88
Oct-86	Henan	Nanyang	ICBC	12 days			Intra-region physical on-the-spot exchange	8 days		Made 280 mil yuan available & saved 60+ bil yuan interest	30/06/87
May-87	Shaanxi			5-6 days intra-region 10+ days interregion					2.6 bil yuan		10/01/89
Jul-87	Jiangsu, Zhejiang, Shanghai, Shandong		ICBC		postal	1-2 days, at time 3 days	Clearing network using the support of vehicle				24/02/90
10/09/87	Henan	Zhengzhou, Kaifeng, Xingchun	ICBC	3 to 4-1/2 days	postal	2-1/2 days	Rail & road transportation	1-2 days		Reduce float by 600 mil yuan.	10/09/87
Early 1988	Yunnan	Kunming	PBOC	14 days intra-city		11 days	Intra-city computerised bills clearing	3 days		Enable the scope of intra-city clearing to expand	17/10/94
Feb-88	Henan & Shandong	Kaifeng and Heze	PBOC & ABC	5-6 days, 10 days to a month for longer distance. Ave 7-8 days.		6-7 days	Inter-province transmittal via microcomputer	1 day		Increase reliability, safety & productivity.	18/4/88 & 2/5/88
2/03/88	Hebei	Shijiazhuang	General	Hebei 116 days Shijiazhuang 60 days (Inconsistency)							2/03/88
9/03/88		Angyang	ABC	3-5 days intra-city, 1/2 month - 20 days inter city							9/03/88
25/03/88	Shanxi		General, PBOC	Average 1 to 1/2 day From Taiyuan to Xhangzhi telegraph should take 3 hrs but took 2-3 days, at time 5 days.	Telegraphic transfer has to go through postal & MPT		Some resort to phone.				25/03/88

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25/03/88	Wuhan & Nanfang		PConBC (Wuhan) & BOC (Nanfang)				Fund market was established with support of telegraph, telex, tel, mail, fax, etc.				25/03/88
4/04/88	General		Rural financial institutions, ABC, Trust Cooperatives	53.5 days, 149 days, and 232 days respectively.							4/04/88
27/08/88	Shanxi	Taiyuan	PBOC	4-5 days		2 days	Reform intra-city bill clearing centre. Adoption of 0520 computer increase productivity by 2 times. Also established clearing regulations.	2-3 days		Increase cash availability by 97%, save loan interest 3,406 yuan.	27/08/88
3/10/88	Shanxi	Wenxi county	ICBC		postal	2-3 days road transport	Road transport in May 1988, telephone in 1988			Both increase fund turnover by 1.2 times & fund usage by 1.3 times. speed up transfer.	3/10/88
End 1988	Shaanxi	Xiangyang	PBOC	5-6 days for statistical analysis & accounting report	manual	4-5 days	Computerisation	40 mins			20/11/95
28/01/89	Heilongjiang		General						6.6 bil yuan		11/02/89
8/02/89	Shanghai & Shenzhen		BOC	20 days or more, at time 1 month							8/02/89
11/02/89	Yunnan	Yunnan	PBOC				Computerisation.			Shorten clearing time, improve availability of fund, improve productivity over manual system by 4-5 times.	11/02/89
Apr-89	Anhui	Hefei	PBOC				Intra-city computerised clearing system			Fund available for usage within a day, from cleared bills or instruments, increased from 47% to 80%. Cash available is 30 mil	25/10/89

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8/11/89	Hainan	Hainan's Leidong county subbranch in Wangliu to Hainan's San'ah	PConBC to BOC	23 days for telegraphic transfer of fund even when distance between the area is only 90 km (reason given by bank was error in account).	telegraph						8/11/89
1/01/90	Tibet		General	Interregional fund transfer has to go through any of the 39 appointed organisation & took about 2 months to clear.			On 1/1/1990, the system will be merged with the national clearing network.				27/12/89
26/04/90	Hainan		PBOC		manual		Established computer centre at province level with 2 satellite telecommunication station in Hainan-San'ah, estd Hainan computer clearing centre.			There is 1.5 times increase in productivity over the manual system in bill exchange processing.	26/04/90
9/11/90	Anhui	Hefei	PBOC				Intra-city computerised clearing network system.			Fund turnover within a day increase from 47% to 80%, fund availability increased by 23.2 mil yuan. Increase productivity by 8 to 10 times and reduce errors.	13/11/90
Prior 1991	Guangdong	Guangzhou	PBOC		Manual labour processing was time consuming.						25/02/95
1991	Guangdong	Guangzhou	PBOC	3-5 days, at time 7 days.			Adopted computers.	1 day			25/02/95
1991	Shaanxi	Xiangyang	PBOC	2+ hours (planning, statistical analysis & accounting report)	manual	20 mins	Installed microcomputer for handling planning, statistical analysis and accounting.				20/11/95

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Apr-91	Guangzhou	Fushan	PBOC			4 days	Adopt computer for handling whole province's 8,000 staff wages.			23/01/95
15/04/91	Qiqihaer, Harbin, Changchun, Shenyang, Dandong, Dalian, Guangzhou		PBOC	Take a few days, at times more than 10 days.	postal	About 9 days.	Nationwide electronic network (satellite telecommunication).	1 day	Reduce float and increase fund flow efficiency. Beneficial to central bank macrocontrol and the economy.	19/04/91
24/04/91	Guangdong	Pearl Delta	PConBC	In the past, on the eve of interest computation in savings banks, workers have to work overnight for 1-2 days.	Intra-city network	1-2 days	Expand to intra-province network.	4-10 mins without error.	Fast & reliable.	24/04/91
12/06/91	Human	Changsha	ICBC	5-6 processes in fund flow operation	Manual		Computer adoption and network development	1 process	Savings to customers involved 2+ mil yuan.	12/06/91
31/07/91	Sichuan	Shuangliu (county)	PBOC	2-3 days, with high level manpower & overtime	Manual		Computerisation	Within about 2 hours	Decrease in manual labour, increase work efficiency and management standard, and reduce errors.	31/07/91
14/08/91	Guangdong	Guangzhou	PBOC	3-7 days of processing time	manual	2-5 days	Install NCR bill exchange processing	1-2 days		14/08/91
18/09/91	General		ICBC	Account clearing.			Computerisation	About 5 hours.	High level of accuracy.	18/09/91
27/09/91	Shenzhen		BOC	10 days to half a month			Faster transmission in bills clearing.	16 secs		27/09/91
2/12/91	Hubei (Laifeng county) & Hunan (Longshan county)		PBOC	Distance between them is 7.5 km.		More than 5 days	Interregional bill settlement network.	7+ days of float	Reduce float by 70%.	22/12/92
2/04/92	General		PBOC	10-20 days processing			Interregional clearing network.		Speedy, accurate, stable, clear, safe clearance. Fund available within a day is 50+%.	2/04/93

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1993	Hubei	Shiyan	PBOC	Long duration.			Fund clearing centre that makes use of the interregional satellite network			Resolve long duration & high risk exposure of float.	10/07/95
Apr-93	Hubei	Xiangfan	PBOC	5-7 days		4-5 days	Computerisation	1-2 days		Reduce float by 210 mil yuan. Fund available for usage within a day increased from 72% to 86%.	6/07/93
15/02/94	Yunnan	Luxi	PBOC	10 days	manual	9 days	Daily national treasury business processing	1 day		Increase in productivity, save on labour, time & reduce error.	15/02/94
4/04/94	Beijing	Haidian	ICBC & PBOC	Half an hour	manual	2-3 days	Inter-bank business computer mediated processing system.	10 mins		Work productivity increased by 10 times. Error committed reduced from 0.08% to 0.03%.	4/04/94
1/07/94	Beijing, Tianjin, Hebei		ICBC	3-4 days	postal	1-3 days	Bill exchange network	1 day			2/07/94
1995	Hebei	Daiming (subbranch)	PBOC				Subbranch conducted county bill clearance			98% of the fund could be used within a day.	14/06/96
10/01/95	Shandong		PBOC			1 day				Save 1 bil yuan.	10/01/95
23/01/95	Jiangsu	Nanjing	ICBC	20 days		1 day	Interregional electronic fund business				23/01/95
13/03/95	General		General	8-10 days	postal	5-7 days	Satellite data communication network	3 days			13/03/95
30/04/95	Zhejiang	Jiaxing	PBOC	2 persons working for at least 1/2 a day.	manual		Adopt information technology for information database.	1 person could process 4-5 enterprises' valuation data within 1/2 day		Work productivity increased by 10 times.	30/04/95
May-95			ICBC	5-6 days		2.5 days	Electronic fund transfer network	Less than 4 days		Enable fund available to the society at an annual amount of 399.6 bil yuan.	12/09/95
19/05/95	Beijing		ICBC			1-3 days	Corporate account savings network for withdrawal & deposit.				9/10/95

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30/05/95	Beijing		ICBC	4-9 days	postal	2-6 days	Headquarter started operating its national electronic fund transfer network system.	2 days		Speedy and reliable.	30/05/95
25/06/95		Zoucheng	ICBC				Intra-city operable withdrawal and			Reduced float by 30 mil yuan fund.	
30/05/95	Yunnan	Kunming	ICBC			3 days	Electronic fund transfer system network			Reduced float by 11 bil yuan which in turn saved interest payment of enterprises by 3+ mil yuan.	28/09/95
18/09/95	Jiangsu		ABC	3-5 mins			Established microcomputer network	2 mins		Increase competitiveness, increase work productivity, allow close coordination, efficient investment.	18/09/95
22/09/95	Guangdong	Guangzhou	ICBC		postal	4-5 days	Electronic fund system			Making 4 bil yuan available to society.	22/09/95
24/09/95	Wuhan		ICBC	12-15 days	manual	5-9 days	Electronic settlement	7-9 days		Saved enterprises of 18 mil yuan in interest payment.	24/09/95
18/10/95	Jiangsu	Yangzhou	PBOC	2 hours in 1.5 km intra-city clearing system				1 day		Bill usage rate increase from 35% to above 75%.	1/11/95
18/01/96	Shandong	Qingdao	ABC	3-5 days		2-4 days	Electronic fund transfer	1 day			18/01/96
4/02/96	Jiangxi	Nanchang	PComBC			1-2 days	Integrated computer business network system.				4/02/96
7/03/96	Liaoning	Anshan	PBOC	2-3 days		1-2 days	Intra-city cheque real time clearing	20 secs		Reduce float duration. Reduce float by 100 mil yuan.	7/03/96
25/03/96	Shandong	Jinan	ICBC			Reduced usual time by 1/2 using interregional electronic fund system. Settled at less than 2.5 to 3 days than stipulated in regulation.	Computerised interregional fund settlement system			Settlement time specified to be 5-6 days, but ICBC takes only 24 hour.	25/03/96

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23/04/96	Guangdong		ICBC	4 days		3 days	Computerised interregional fund settlement system.	1 day		3 days less than specified by regulation, the system reduced float. No illegal settlement since last year & Guangdong branch stopped 100+ cases of fraud & prevent 140 mil yuan loss.	23/04/96
9/05/96			BOC				National computer network.	3 secs for intra-city & 30 secs for inter-cities.			9/05/96
23/05/96	Anhui	Bengbu (countryside)	ABC	4-7 days		3-6 days	Computerised interregional settlement system and achieve electronic connection with headquarter in fund transfer network.	1 day			23/05/96
29/05/96	Shenzhen		Zhaoshang Bank				Electronic signatory and security measures implementation.			The transmitted information could be stored up to 6 years and used as 3rd party proof.	29/05/96
31/05/96	Hainan		BOC				Interoperable withdrawal and savings system.			Shorten float duration, speed up fund turnover, increase fund productivity and safety.	31/05/96

CHAPTER 8 : INFORMATION TECHNOLOGY ADOPTION IN THE FOREIGN BANK AND THE INDIVIDUAL STATE-OWNED BANKS.

Chapters 6 and 7 revealed that the adoption of information technology within the Chinese banking industry is slow and shallow. It has been slow, both relative to official plans and to global trends, and shallow, in the sense that information technology usage tends to be concentrated in a few branches, and is not widely spread through the operations of the banks. In these chapters, it was identified that the state-owned banks have been the main adopters of information technology, despite their declining financial intermediary role (as represented by their market share in Chapter 5, table 5.1) in the Chinese financial scene. These banks' adoption profile is largely attributed to their extensive geographical presence and early establishment in the country. In addition, their profile has been reinforced by the construction of the China's National Financial Network (CNFN) and its applications, which have been based on these banks. In fact, the state-owned specialised banks were assessed (by Ping and Grimshaw 1992) to be ahead of the average state-owned enterprises in technology adoption movement. The adoption profile of the individual banks, which is presented in Sections 8.2 and 8.3, shows that some of the new technologies adopted were the result of the initiative of individual banks. Although each state-owned specialised bank has shown a different pace of technology adoption, they have together set the trend in technology adoption for the other local Chinese commercial banks. This is most notable in the 1990s. The information technology applied by some of the newer banks is impressive and advanced. For example, Zhaoshang Bank (China Merchants Bank) implemented a telebanking facility after a short period of established presence in the market (Jinrongshibao 17/10/1996). Similarly, Guangdong Development Bank established an inter-bank ATM network to facilitate customers' withdrawal in both Hong Kong and mainland China (Jinrongshibao 13/2/1996). However, the investment in technology adoption by these other local

Chinese commercial banks tends to be confined to specific locations because of their confined business scope. Their effort is considered small scale when compared to the dominant national state-owned players.

Although Chapter 8 concentrates on the banks in the discussion, it is worth noting the extent of information technology adoption in the Chinese credit cooperatives. Credit Cooperatives have a widespread presence in the Chinese economy, but operate on a very small scale basis. The extent of their adoption of information technology is very low. Computer usage tends to be adopted on a standalone basis in outlets that use technology. It was reported that 60% of the credit cooperatives located in medium and small cities do not have any form of computer network linkage in their business operation (Jinrongshibao 18/5/1997).

Among all the local financial units in the Chinese financial industry, the state-owned banks stand out, despite their slow and shallow adoption of information technology, as the available conduit in the transfer or diffusion of banking technology to other local Chinese commercial banks and other industries. This is so even when compared to the foreign banks in the People's Republic of China (as revealed in section 8.1). The development of the information technology adoption and diffusion scene in China indeed challenges the popular premise that foreign direct investment is a major vehicle for technology transfer to a country. This also re-inforces the need to examine the factors that affected the pace and level of information technology adoption and diffusion processes within these pivotal banking entities.

This chapter reviews the extent of information technology being adopted by the foreign banks and by the individual Chinese state-owned banks. In addition, the role of the foreign banks as a technology transfer channel in the banking industry in China is also consider in this chapter. The factors that influence information technology adoption and diffusion processes are examined in Chapters 9 and 10.

8.1 FOREIGN BANKS

An important stream of research in the technology adoption and diffusion domain is that which studies the effect of foreign direct investment in the adoption and diffusion

process. Traditionally, multinationals have been a common conduit of technology transfer for the locally funded enterprises in the host country to adopt foreign technology (Morton 1986). In fact, it has been widely recognised that multinationals, through foreign direct investment activity can be powerful agents in affecting technology adoption within a technologically backward host country (Cassin 1979, Chen 1983, Kranzberg 1986, Morton 1986, Schive 1990, Antonelli 1991, and Hung 1993).

8.1A) Foreign Direct Investment to China.

During the 1980s, Deng's economic strategy for the Republic's progress and development promoted establishing relationships with the outside world. This led to an upsurge of activities involving the importation of foreign technology and management methods, involvement in international financial markets and participation with international economic organisations. This was very different to the Maoist economic development strategy and ideology towards foreign knowledge and learning.

In the area of technology 'catch-up', purchases of foreign technologies are a partial solution to overcome technical obstacles, but have been highly restricted by the availability of foreign exchange. For a developing country like China with limited financial resources, technology transfer through foreign direct investment represents a less costly means of catching up with developed countries in technology adoption for economic development. The Chinese government has indeed recognised that a significant potential benefit of foreign direct investment to its country lies in the provision of technical and managerial know-how and skills. In the Chinese economy, the Chinese government did address the issue of technology appropriateness in some of its relevant policies governing foreign entry. However, the measures to screen foreign technology were usually set up for, or were applicable to, manufacturing corporations that directly deal in the production and development of high knowledge intensity products, for example the electronic sector, rather than for corporations in the applications sectors.

8.1B) The Potential of Foreign Banks in Technology Transfer.

Foreign participation has been identified by research as an important attribute that provides the host country with ready access to an advanced level of technologies and know-how, and also to a pool of financing resources (Conroy 1992). According to the KPMG (1994) report, the rationale of the government's admission of foreign banks into the Chinese banking industry was to attract foreign capital and banking expertise. However the regulated nature of the industry during the Eighth Five-Year-Plan period has highly constricted the scope of foreign banking institutions' participation and the overall participation of these foreign banking institutions is very low. As a consequence, their impact on technology adoption has been insignificant. Even the sino-foreign joint-venture, which has been the most direct mean of technology transfer in other industries, is not easily accessible in the Chinese banking system. The highly confidential nature of banking business has kept this type of business formation at a low rate (interview source). Only 12% (17 companies) of the relatively active banking business entities were established on this basis in 1995 (Almanac of Finance and Banking 1996).

The author undertook primary research in October and November 1994, by means of a survey on foreign banks, to assess the role that they played in technology adoption and diffusion in China. As explained below, this research showed that there was little opportunity for the domestic economy to tap foreign expertise in the area of banking technology from the fully-funded foreign enterprises operating in China.

Beijing holds the most number of foreign representative banking offices and main regional offices in charge of all outlets in China. The author carried out the survey in this city because the interviewees tend to have the knowledge about the technology adoption level and plan for the overall business operation in the Chinese economy. All of the 98 main foreign banking offices located in Beijing at that time were approached, of which 67% responded to my telephone survey regarding their level of technology adoption in China.

Due to the operational restrictions imposed on the foreign banks in Beijing, the number of staff in the Beijing representative offices is being kept at a low level. 73% of the respondents described their organisation structure as involving the following simple configuration:

- Chief representative (normally expatriate from headquarters),
- Assistant representative,
- Secretary,
- Driver.

17% of the foreign offices surveyed did not employ computers to operate their activities and about half of this group were the Japanese banks. However, these banks were equipped with basic communication and paperwork processing equipment, such as a fax machine and copier. Word processing tasks and data processing tasks were carried out on a labour intensive scale, via typewriters and hand operated calculators. On the other hand, 40% of the respondents have computer facilities on a sharing basis of at least 2 person to 1 computer, whilst 12% of the offices surveyed provide a single personal computer station to every staff (except the driver). The latter group tended to be American, European, and Canadian banks. Only 4 % of the banks in the survey were equipped with computers that have international communication linkage, usually linked up with the headquarters. Only one bank office had domestic communication network linkages among its affiliated offices or branches located in China.

Almost half (53%) of the offices surveyed have branches or offices in other regions of China, and almost all the business branches that deal with business transaction, had adopt computer technology but with a low incidence of inter-organisational electronic linkage. Five foreign banks were selected for an interview about their intentions concerning the future adoption of banking technology in China. The interviewees were either the chief representative or an information technology staff member who had knowledge about the plans and the usage conditions in information technology.

The availability of technology support was regarded by the interviewees to be most inadequate in China and information technology staff was normally sent from headquarters. In addition, technology hardware and software tended to be sourced from overseas headquarters or from the main overseas regional office, where the application of technology was at a very sophisticated level. Business branches in most cities of the special economic zone were commonly characterised by a higher number of staff members than the representative office in Beijing. Computers were adopted in business branches for transactional purposes. However, the local users were seen as having weak capability in computer usage. Training was either

conducted on an inhouse basis or at the overseas offices. These foreign banks also experienced an unstable pool of staff. Overall, the plan to adopt further technology in these banks is dependent on the market opening for their participation and the infrastructure support (telecommunication and power) within the country.

Thus, the central issue in the availability of technology for transfer from foreign banks to the Chinese market primarily lies in the degree of market participation open to them. This ability to participate in the market is closely associated to the opportunity of earning profits. The infrastructural support took on second importance in attracting foreign technology introduction into the Chinese banking system. Thus far, the opening of the Chinese market to the foreign banks has been a carefully planned and controlled process, which explains the high passivity of foreign banks in technology adoption.

On the demand aspect of this technology transfer process, the ability to integrate or absorb any available foreign technology into the domestic system is also dependent upon technical expertise and managerial skills. In the Chinese banking system, not only is the opportunity for foreign technology transfer is low but the weak capability of the labour resources has not been able to absorb or assimilate any available foreign technology in the country. Even though the labour mobility factor¹ is high, it is not beneficial to the pattern of technology diffusion. The effective adoption of technology by the local Chinese banks will therefore require the support of the information technology related industry and the government, while the role of foreign banks remains limited in the Chinese system.

8.2 INFORMATION TECHNOLOGY ADOPTION BY THE INDIVIDUAL STATE-OWNED BANKS.

From the survey mentioned in the preceding section, it is clear that the foreign banks have not been permitted to realise their potential in technology transfer by the Chinese government because of the latter's priority in protecting, and retaining control of, the

¹ The movement of labour carries the potential of knowledge flow and constitutes a potential factor in technology diffusion among economic entities in the developed overseas countries.

local banks and the financial market (refer Chapter 5 section 5.2). This means the state-owned specialised banks are likely to be the leading financial units in technology adoption for a long period of time. When the technology adoption process of the different individual state-owned specialised banks is considered, it is clear that each has a different pace of adoption within their own banking system. It is also clear that some of their branches have been, in fact, leading adopters of the new technologies. This is apparent in the section below which highlights the history of technology adoption in the different state-owned banks and the adoption of the new technology applications in some of their branches.

8.2A) Bank of China. The Bank of China was the pioneer among all the state-owned specialised banks in China in undertaking computerisation in its branches. Prior to 1987, it had been the only specialised bank with an exclusive role in handling foreign exchange transactions and with branches established in overseas developed countries. Due to its contact with the overseas banks and its interaction with the competitive environment in the advanced host countries, the Bank of China² had early experience of the impact of information technology applications as compared to its other homebound specialised banks (Jinrongshibao 24/10/1991). In 1973, prior to economic reform period, it adopted computers for processing banking activities at its London branch. In 1974, the adoption of computing technology occurred at the bank's domestic headquarters in Beijing, whereby three Ricoh-8 minicomputers were adopted. These computers were used for foreign exchange and interest rate computation and accounting. When the economy was opened for trading with the world market in 1978, the Bank of China's Shenzhen branch became a prominent focal point for many of the bank's information technology adoption projects. This was because the branch plays an active role in foreign exchange transactions which arose from trading activities between China and the country's active trading partner, Hong Kong. In 1983, this bank branch was the first to establish its electronic intra-city interoperable savings system, which enables its account customers to carry out

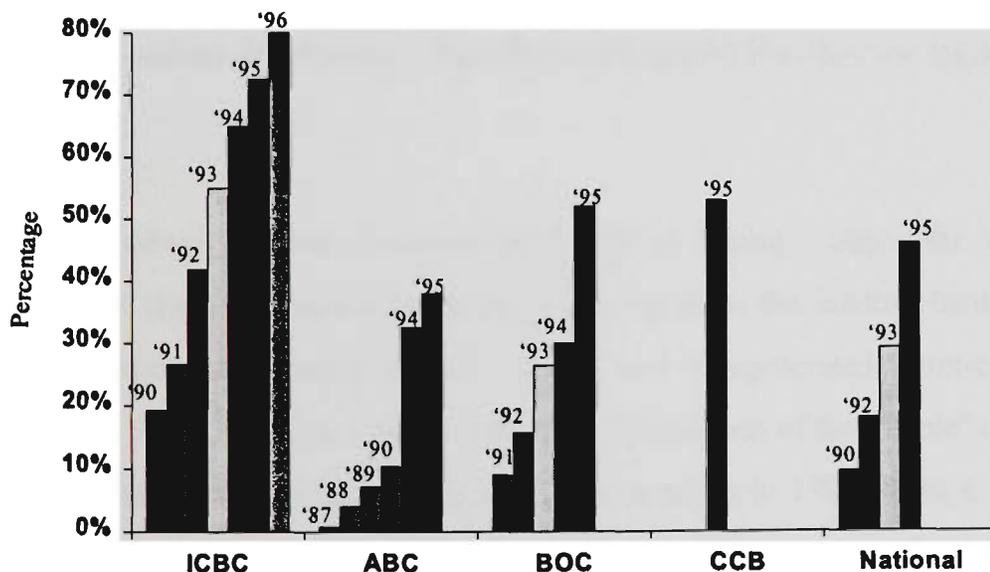
² Prior to 1978, although the Bank of China maintained a separate identity in the overseas markets, the adoption of computers within the banking sector was considered an undertaking of the People's Bank of China from the perspective of the monobank structure.

withdrawal and deposit transaction for accounts that were opened in any of the affiliated branches based within Shenzhen city. In 1985, the bank became a member of SWIFT and embarked on electronic communication linkage with overseas banking institutions. In 1986, the corporate cheque processing system was computerised in the Shenzhen branch. In 1988, the branch's front-counter or front-desk was automated and ATMs were installed in the city.

Despite the Bank of China's initial move in adopting technology in many areas within the domestic banking industry, there was slow diffusion of the technology to its branches in other localities. During the 1990s, it became obvious that the bank's pace in computer adoption was falling behind the Industrial and Commercial Bank of China which has higher number of outlets computerised than the former. The graph below reflects the extent of computerised outlets³ achieved by the major state-owned specialised banks and in the national financial system. It reveals a relatively slower rate of technology diffusion within the Bank of China as compared to the Industrial and Commercial Bank of China, especially prior to 1995.

Figure 8.1

Percentage of Outlets Adopted Information Technology in the Major State-Owned Specialised Banks and the National Financial System



Source: Jinrongshibao and Financial Computer of China.

Abbreviation:

- ICBC = Industrial and Commercial Bank of China
- ABC = Agricultural Bank of China

³ The term 'computerised outlets' referred to outlets that adopted computers.

BOC = Bank of China
CCB = China Construction Bank
National = The Overall National Financial System

The Bank of China's technology adoption strategy covers its overseas affiliates as well as the domestic branches. Because of the bank's past business legacy in overseas banking transactions and its traditional core activity in the international fund settlement business, conditions in the overseas banking industry have driven the bank to adopt information technology in its overseas affiliates first. The type of information technology applications adopted by the bank revealed a highly sophisticated level of applications in the overseas countries. For example, it had the largest data processing centre in Hong Kong⁴, which had a processing capacity of 70 MHz during the early 1990s. The centre utilises advanced technology to provide comprehensive support to the 13 affiliated banks and more than 400 sub-branches in Hong Kong (Jinrongshibao 24/10/1991).

In the local banking industry, the Bank of China and the Industrial and Commercial Bank of China share the title as the foremost banks in the adoption of advanced information technology. Both the banks commenced computerisation in the front-counter or front-desk of their domestic savings outlets. Prior to 1993, the bank had a comparatively less aggressive technology adoption strategy to support domestic savings business development than the Industrial and Commercial Bank of China.

8.2B) Industrial and Commercial Bank of China. Since the late 1980s, the Industrial and Commercial Bank of China has been the leading bank in having the highest number of computerised outlets and computerised front-counters in the country. When the bank took over the commercial arm of the People's Bank of China to enable the latter to take a role in central banking in 1985, most of the businesses that were transferred to the Industrial and Commercial Bank of China were located in the cities where the available facilities enabled the adoption of converged computer and telecommunication technologies. Under the new bank management, the

⁴The Bank of China established its first overseas branch in Hong Kong 80 years ago. Presently, it is known as the 'Bank of China Group' and is the second largest banking group in Hong Kong in 1997 (Jinrongshibao 28/9/1997).

commercial intermediary role continued to concentrate on household savers and commercial borrowers based in the urban areas. In 1985, the Industrial and Commercial Bank of China embarked on a computerisation strategy. The strategy, outlined in the bank's 'Seventh Five-Year-Plan', emphasised the adoption of computers by individual bank branches to automate the traditional core banking activities (interview source). This was due to the fact that domestic savings became an important source of funds for the newly transformed commercial bank. Although there were applications of technology in other business activities, like loan and office automation, computers were mainly adopted to computerise the front-counter or front-desk business work processes. In 1986, a rudimentary electronic information transmittal system was established. The bank's Shanghai branch established its own electronic network using the ICBT system for documentation and reporting to the headquarters. The Industrial and Commercial Bank of China ventured into electronic network development in 1987 (Jinrongshibao 28/1/1988). The Guangzhou branch was the first Industrial and Commercial Bank of China branch to operate an electronic intra-city withdrawal and deposit savings system in that year. During the Seventh Five-Year-Plan period, the bank's strategy in the adoption of banking technology began to focus heavily on establishing electronic intra-city network linkages among affiliated branches located in the same city, to enable customers located within a city to carry out savings transaction in any of the Industrial and Commercial Bank of China branches based in that city. Since then, many of its city-based branches have become relatively more aggressive in the adoption of information technology. In many cases, the Industrial and Commercial Bank of China branches were leading in the applications of new technology to its banking operation.

8.2C) Agricultural Bank of China. The Agricultural Bank of China started its computerisation strategy in 1984. It was stated by Duan (1995) that the initial technology adoption strategy focused on the computerisation of information systems. This approach was different from the other domestic specialised banks, such as the Industrial and Commercial Bank of China and Bank of China, which emphasised the computerisation of the accounting area, a core banking area of activity for a market-

oriented bank. The Agricultural Bank of China has a fragmented organisation structure whereby the bank's branches and cooperatives total more than 100,000 outlets. This inherent multiple organisational structure and bureaucratic levels of control and management hindered information flow and sharing. The Agricultural Bank of China adopted information technology to resolve problems in information flow and management. The bank encountered more restrictions in their technology adoption than the aforementioned specialised banks, which have branches in the more developed areas that provide better access to infrastructural amenities. Most of the Agricultural Bank of China's outlets are located in the medium and small sized cities, and in the agricultural countryside areas where facilities are not as developed nor as available as in the urban areas. In addition, the traditional business nature of the Agricultural Bank of China is that it basically functions as a rural area bank and each branch has low return from its operation and limited investment funds allocated to it. On the technology applications aspect, the bank had to design a 'maxi-minimal' computerisation strategy in view of the above mentioned constraints. Instead of adopting big and medium sized computers, which would involve a substantiate amount of capital investment to obtain a high level of work process integration, microcomputers were considered to be sufficient for the basic functions in view of the constraints. During the mid-1980s, microcomputers were very popular. They were compact in size, cheaper, easy to learn and apply, and also imposed lesser demand on the environment for infrastructural support than the big and medium sized computers adopted by the other specialised banks. The microcomputer was also deemed suitable as a learning tool for the staff at the Agricultural Bank of China's outlets, to enable them to master computer operations. As a result, the information technology adoption strategy of the Agricultural Bank of China focused heavily on microcomputers as the technology embodied equipment for adoption.

Nevertheless, the bank has made certain significant achievements in the adoption of computers for supporting the integration of its information systems. Although the established network was rudimentary, the partially automated information transmittal system between the headquarters and the branches mediated by microcomputer technology was proclaimed a major success and a breakthrough in technology adoption for the Agricultural Bank of China in 1985. The partially automated

network was accorded with praise from the Vice Premier Lipeng who listed it as one of the eight major computer network projects during the Seventh Five-Year-Plan period (Jinrongshibao 2/10/1991). During the Eighth Five-Year-Plan period, the development of electronic or computer-mediated intra-city networks in the big and medium sized city became a major element of focus in the Agricultural Bank of China's Eighth Five-Year-Plan, with the ultimate aim of linking up these networks to achieve a nationwide network linkage between the headquarters and its branches and sub-branches. However, this bank's movement in information technology adoption in this period lagged behind the Bank of China and Industrial and Commercial Bank of China.

8.2D) China Construction Bank. It was recorded that the China Construction Bank first adopted computers and established a computer centre in 1986 (Jinrongshibao 30/9/1994). From the tracking of the bank's technology adoption history, the initial area of focus given by the bank was primarily to support information exchange between the headquarters and the branches, for decision making and management. Not unlike the other specialised banks, China Construction Bank also faced the same predicament of resources constraint in its adoption of technology. It started to establish intra-city networks during the Eighth Five-Year-Plan period, to enable interoperable withdrawal and deposit savings systems among branches within a city. In 1995, the China Construction Bank Shenzhen branch became a member of SWIFT and established electronic linkage with the overseas members to facilitate foreign exchange settlement transactions. Although the bank was a late adopter of information technology, it has made significant achievements in the computerisation of its outlets by the mid-1990s, with over 50% of its outlet computerised by 1995 (Figure 8.1).

8.3 NETWORK DEVELOPMENT BY THE INDIVIDUAL STATE-OWNED BANKS

The material below provides a brief profile on the network development undertaken by the individual specialised state-owned banks.

8.3A) Bank of China. Because of its international business dealings with banks in overseas countries, the Bank of China used the BEELINE transmittal system and the SWIFT telecommunication system for its branches in Beijing, Shanghai, Guangzhou, Hong Kong, London and New York to exchange information and to communicate with 2,400 banks in the world during the late 1980s (Jinrongshibao 24/1/1992). With the increase in business transactions, the bank's technological capacity for supporting financial business processing and integrated financial information system development quickly became insufficient (Chen and Hu 1996). As a result, IBM 4361 and 4381 computers and an ES 9000 mainframe were subsequently adopted in the Eighth Five-Year-Plan period, to enhance the telecommunication capability and processing capability of the branches in electronic connection with other SWIFT members and hence to facilitate overseas funds transfer and processing (Wang 1992). Nevertheless, despite the early initiation of electronic linkage with the international network, the number of domestic branches that have international network linkage was still limited in 1995. The number of domestic outlets connected to the SWIFT network increased from three outlets in 1992 to 92 outlets at the end of 1995. Comparatively, the rate of international network linkage in the domestic Bank of China system was slower than the electronic intra-city network linkage achieved among the domestic branches.

During the Eighth Five-Year-Plan period, the Bank of China encouraged the construction of intra-city savings network among its domestic branches (Jinrongshibao 4/6/1996). About 7% of its outlets were involved in establishing electronic intra-city network in 1992. Based on the intra-city electronic network foundation, the bank formally appointed a USA network company AMNET in 1993 to expand the network to a inter-regional network that links the widely dispersed branches to its headquarters. The Bank of China experienced a relatively rapid pace of information technology adoption in the Eighth Five-Year-Plan period as compared

to other periods. Applications of networking technology for customer services also began to emerge in the early 1990s. For example, automated customer information services, telebanking, POS and ATM networks were emerging in this state-owned bank system (Jinrongshibao 21/10/1993). In 1994, its affiliated branches up in Hong Kong also extended its sophisticated electronic network to the branches in mainland China. Hong Kong's Bank of China established ATM interoperable network connection with Bank of China Guangdong provincial branch and extended further to Xiamen, Nanling, Changsha, Shanghai and Beijing cities (Jinrongshibao 31/7/1996). By the end of 1995, it was reported that the use of interoperable network connection in the major cities was becoming increasingly more common (Jinrongshibao 4/6/1996).

8.3B) Industrial and Commercial Bank of China. The Industrial and Commercial Bank of China ventured into network development in 1987 (Jinrongshibao 28/1/1988). At the end of the Seventh Five-Year-Plan period, the bank had built 26 large and medium-sized dedicated electronic intra-city networks in 23 big and medium sized cities, and host network computer centres in Beijing and Shanghai (Almanac of China's Finance and Banking 1991 and Jinrongshibao 2/10/1991). About 4% of its outlets were involved in establishing electronic intra-city network linkage via either local mainframe or mid-range computer system in 1990 (Jinrongshibao 14/5/1992). Among the Industrial and Commercial Bank of China branches, the Beijing and Shanghai branches were considered the first branches to establish an electronic intra-city computer-mediated network. In 1990, it was reported that the Industrial and Commercial Bank of China headquarters in Beijing established the nation's biggest banking information technology network in the city, with the highest number of linkages to outlets and the biggest processing capacity (Jinrongshibao 26/3/1990). During the Eighth Five-Year-Plan period, the direction of computerisation or technology adoption undertaken by the Industrial and Commercial Bank of China branches emphasised the applications of network technology. The adopters, which had focused on automating the internal branch operations (mainly front-counter) during the early stage of computerisation, began to focus on

establishing intra-city computer-mediated savings systems and electronic linkage with its other affiliated branches. Some of the branches subsequently expanded this intra-city network to an inter-regional network. During the Eighth Five-Year-Plan period, the incidence of outlets being computerised and of networks being constructed or developed began to pick up pace in the Industrial and Commercial Bank of China system. At the end of 1995, the establishment of intra-city networks has already extended to medium and small cities (Almanac of China's Finance and Banking 1996), which was ahead of the adoption process in the Agricultural Bank of China (Wang 1997). This bank also reinforced its reputation as the leading technology adopter in the late 1995, with its initiative in establishing a real-time verification network (known as the Peony Card Applications System) to facilitate credit card transaction for its credit card centres, savings outlets, POS and ATM facilities (Almanac of China's Finance and Banking 1996).

8.3C) Agricultural Bank of China. The Agricultural Bank of China began to establish electronic intra-city networks mediated by computers during the middle of the Eighth Five-Year-Plan period. The information technology adoption strategy was revised to focus on big and medium sized cities (Shenzhen, Guangzhou, Chongqing, Wuhan, Shenyang, Tianjin, Qingdao and Chengdu) for establishing electronic intra-city network. In addition, more powerful computers such as mainframes and mid-range computers were adopted under this strategy. In 1993, it purchased an IBM ES9000 to function as the network controller/server, while a UNIX platform and IBM AS400 minicomputers were adopted as the node's network interface unit for distributed processing⁵. In 1994, about 5% of the outlets were involved in electronic intra-city network linkage. This rate increased to 8% in mid-1995, by which time about 300 microcomputer mediated intra-city networks were established to enable ATM, POS, and telebanking systems to operate on an intra-city basis (Jinrongshibao 15/9/1995). In term of electronic linkages with international network, the bank began to establish electronic linkage with the SWIFT network in 1991. By 1994, it has 56 of

⁵ Sharing or distributing the workload in computing and communication between the local PC and remote mainframe or network server computer. Some computing and communication tasks are performed by the local PC, and others are performed by the mainframe or server computer.

its foreign exchange branch outlets connected to the SWIFT network. However, the rate of international network linkage is considered low. In fact, the adoption of networking technology by the Agricultural Bank of China was reported to be lagging behind the above mentioned state-owned banks by two to three years (Wang 1997).

8.3D) China Construction Bank. The China Construction Bank started to promote the construction of electronic network linkages during the late Seventh Five-Year-Plan period like the Agricultural Bank of China (Jinrongshibao 25/4/1989). Construction of this bank's intra-city electronic networks began in the Eighth Five-Year-Plan period and were largely established in its main market region. It was reported that the adoption of networking technology to realise electronic network was expected to be comparatively faster in the Ninth Five-Year-Plan period (Jinrongshibao 24/3/1997) because of driving force from its headquarters (Jinrongshibao 31/3/1997).

8.4 CONCLUSION

The state-owned banks, instead of the foreign banks, are the main adopters of information technology in the Chinese banking industry. Although Chapters 6 and 7 show that the pattern of technology adoption within the Chinese banking industry is slow and shallow, the individual state-owned specialised bank's adoption profiles reveal that some of their branches were, in fact, leading in new technology adoption. However, the initiation and adoption of advanced technologies were only confined to major city areas. Even so, the spreading of the adopted new technology from one city to another is slow. Most interestingly, the adoption of computer or information technology was slow despite favourable response obtained from outlets which adopted the technology. For example, the Industrial and Commercial Bank of China has given the ratio of 10:2 to illustrate the benefits derived from using the computer versus the abacus for their internal work process (Jinrongshibao 12/11/1991). Similarly, the People's Bank of China and Bank of China branches in Benxi (Liaoning) have commented favourably on the results achieved from their move in technology

adoption. Previously, the manual use of abacus required each transaction to be recorded ten times and the entry to be verified and checked six times. Favourable results were obtained with the application of technology to automate the work process, work performance was said to improve ten times, notwithstanding the fact that fund availability was increased by 22.3 million yuan (Jinrongshibao 14/11/1990). In published reports, the other specialised banks have also given favourable comments about the positive impact of technology on their processing of transactions. The impact of the technology is especially significant in the applications of networking technology to support electronic payment system⁶. However, the level of information technology adoption in the country's payment system is still low although it has been receiving prime attention from the State Council. These conclusions again highlight the necessity to investigate into the factors influencing the state-owned banks' technology adoption and diffusion process.

The computerisation strategy for the financial industry was declared by the government authorities as being implemented in several sequential phases (Chen 1994, Wang 1994c):

6th Five-Year-Plan (1979-84) was considered to be preparation for computerisation;

7th Five-Year-Plan (1985-89) was for setting the foundation;

8th Five-Year-Plan (1990-95) is popularisation;

9th Five-Year-Plan (1996-2000) for the full realisation of computerisation of the industry.

Two points are noted from the above claim. Firstly, it is apparent from the above categorisation that the experience of computerisation in the banking industry prior to the reform period (1949 to 1978) was not taken into account by the government, nor considered to be of significant influence on the path of technology adoption after 1978. It has been showed in Chapters 4 and 6 that the institutional structures and economic processes generally entail less demand for banking technology applications. Thus, the government considered computerisation in the banking industry from the period of 1979 onwards to be of relatively significant influence. The second point raises the question of whether the aim of the Ninth Five-Year-Plan is overtly

⁶ Refer to Appendix I of Chapter 7 for the benefits derived by the Chinese local banks from adopting information technology for the banking payment system.

ambitious for the Chinese state-owned banks to achieve. Overall, by the mid-1990s and after about 15 years of computerisation history in the reform period, the local banking industry has gone through at least two generations of information technology in its adoption path. However, the level of technology applications within the local banking industry still exhibits slow and shallow characteristics. Although information technology was initially adopted by the state-owned specialised banks during the Sixth Five-Year-Plan period (1981 to 1985) and government support for information technology adoption in the banking industry became increasingly apparent in the Seventh Five-Year-Plan period (1986 to 1990), the information technology adoption process during the reform period was considered slow, relative both to official plans and to global trend, and shallow, in the sense that work systems were not fully automated. Thus, it is of relevance to examine the factors that affected this low and slow level of information technology adoption process.

The beginning point of information technology adoption is within the organisation, hence it is appropriate to focus the analysis at the organisation level to explain this slow and shallow adoption process. The analysis in Chapter 9 determined the influence of the organisation factors on information technology adoption within the Chinese state-owned banks. The external factors that influence the state-owned specialised banks' adoption of information technology are similar to those that influence these banks' role in the diffusion of information technology. Therefore, the impact of the external factors on these banks' technology adoption process, is addressed in Chapter 10.

PART FOUR
ANALYSIS OF ADOPTION AND DIFFUSION

CHAPTER 9 : ANALYSIS OF ADOPTION PERFORMANCE AT THE ORGANISATION LEVEL.

The domestic state-owned specialised banking sector has been the dominant investor in information technology in the banking system, and also in the overall financial system, during the reform period. This is likely to continue to be so in the Ninth Five-Year-Plan period.

This chapter aims to identify the nature of the organisational factors influencing the technology adoption effort in these state-owned banks at the organisation level, over the different periods. In particular, it provides an account of the role of internal organisational factors in explaining the conclusions reached in Chapters 6, 7 and 8 concerning the adoption of information technology within the Chinese state-owned specialised banks. These were that information technology adoption within the Chinese state-owned banks was much slower than planned, even though it was more rapid than in other state-owned sectors, and that adoption was concentrated in particular branches and areas, with a slow spread of information technology adoption movement to the other branches of the state-owned banks.

9.1 THE CONCEPTUAL STRUCTURE AND INFORMATION BASE OF THE ANALYSIS

There have been a variety of models developed in the recent decades that present potential frameworks for this study. These models were developed mainly in the context of well developed market economies, especially the USA. Their emergence is consistent with the fact that information technology applications in these countries provide a longer history in technology evolution for the study. Among the various models, the 'stages of growth' model has been popular in the study of information system planning and development for organisations (Galliers and Sutherland 1994).

The 'stages of growth' model that this thesis will use for evaluation is not the original model founded by C. F. Gibson and R. N. Nolan (1974) nor the revised model by Nolan (1979). This initial model and its sequel have limited use for identifying the nature of the organisation factors associated with the stages of growth of information technology applications within an internal organisation. However, it is the later model adapted and revised by Galliers and Sutherland (1994) that is of interest and is relatively more robust as a descriptive and predictive tool for mapping the situation in information technology adoption in the state-owned specialised banks. Nevertheless, the original model and the subsequent revised models by the founders are examined, because they provide the conceptual foundation for the Galliers and Sutherland's model and in order to justify the choice of selecting the latter model over the prior model for our current purposes.

9.1 A) 'Stages of Growth' in Information Technology Adoption

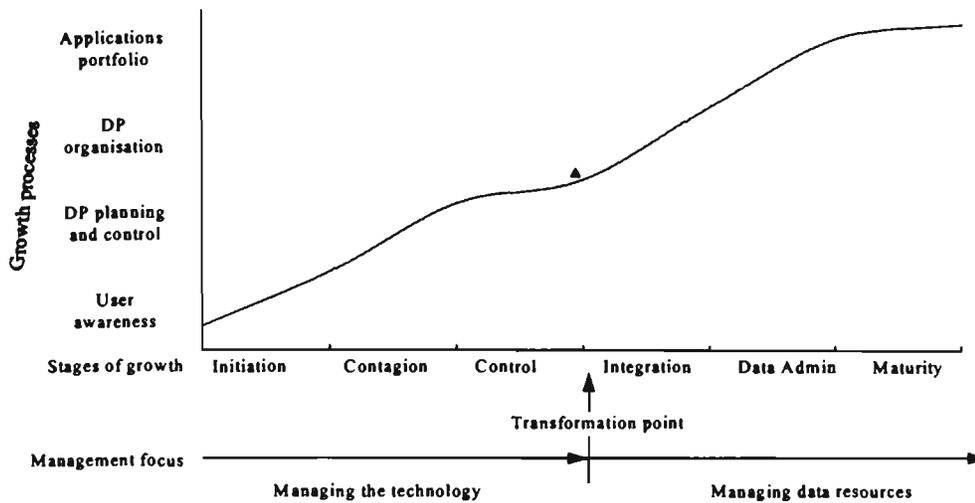
i) The Nolan Model

The Nolan Model was a popular 'stages of growth' model for application and study during the 1970s, when computing technology experienced an increase in its pace of adoption. The model's popularity is attributed to its status as being the first attempt to capture the growth of computing in organisations (King and Kraemer 1984). Even in the 1990s, there were information technology textbooks (like Parker and Case 1993, Martin et al. 1994, and Robson 1994) that made use of the model to facilitate readers' understanding of technology applications for organisation's information systems.

The original model was a four-stage growth model (Gibson and Nolan 1974), which later evolved to encompass six stages of growth (Nolan 1979) to capture the various stages of information technology adoption in an organisation.

Figure 9.1

Nolan Model of Six-Stage Growth Model



Source: : Nolan's six-stage growth model as presented by Galliers and Sutherland (1994).

The model postulates that the learning process of the organisation in information technology proceeds to form an S-shaped curve through the different stages of growth. According to this model, the organisation emphasised on different elements (as presented on the y-axis, ranging from user awareness to applications portfolio) for the adoption of information technology in the different stages of growth. In a brief explanation, the nature of the six stages of growth are as follows:

1. Initiation: A process of experimentation and adjustment with the new technology.
2. Contagion: Technology diffusion begins and lead to an increase in demand for the applications and use of computers.
3. Control: Management is concerned with setting standards to organise technology applications.
4. Integration: Formalisation of planning and control of information systems to achieve integration among the established different information systems.
5. Data Administration: Management aimed to achieve effective utilisation of databases through data administration functions.
6. Maturity: Technology matures. Both technology and management functions became closely related.

Since its conceptualisation, the model has been applied to at least 200 companies by the founder's consultancy company, Nolan and Norton Inc. On the other hand, the

model has also been criticised for its inadequate representation of the corporate reality and of the important management issues in information technology adoption. In most cases, the theory underlying the model has been destabilised by growing empirical research evidence over the years, initially with cautiousness (Lucas and Sutton 1977, Drury 1983 and Benbasat et al. 1984) and then with stronger criticism (King and Kraemer 1984, Earl 1989, and Galliers and Sutherland 1994). For example, Earl pointed out that surveys conducted on organisations in the USA and UK demonstrated that different learning curves could take place with different information technologies, rather than the S-shaped curve as postulated by the Nolan's model. This confirmed the earlier work of Lucas and Sutton (1977), whose earlier study had cast doubt on this area. Another major weaknesses of the model was its link to the 1970s data processing technology paradigm, the technology of which has been superseded by many technology innovations in the past two decades. Dury (1983) noted that the distinctive segmentation of the different stages of growth does not seem so well applied to the newly emerged technologies. This was supported by the research study conducted by Benbasat et. al (1984), who found Nolan's stage hypothesis unconvincing. Overall, the Nolan model has been criticised for providing a set of tight limits in determining an organisation's current stage of growth. Despite the shortcomings in the Nolan model, however, it has been credited with serving as a foundation for the development of many later models¹ in electronic information systems development. This acknowledgment was also expressed by the above mentioned critics of the model as well. Credit has been given to the model for encapsulating an organisation's growth in technology adoption in terms of phases. However, the framework postulated in the Nolan model is insufficient for determining the nature of the organisational factors influencing such a path. In summary, the Nolan model falls short of organisational and management perspectives in determining the factors influencing the technology adoption process, instead it is anchored on information technology expenditure spending as the influencing factor. In addition, the rigid technology paradigm in the Nolan model (focusing on data processing technology) restricts analysis of the technology adoption process and

¹ Example, McFarlan and McKenney (1983)'s modified 'stages of growth' approach; and those mentioned in Galliers and Sutherland (1994).

precludes it from covering the applications of different levels of technology in the adoption process.

ii) The Galliers and Sutherland's (1994) Model

Galliers and Sutherland (1994) have improved the Nolan model by incorporating the omitted perspectives in the information technology adoption process or growth stages. The authors have overcome the deficiencies in the Nolan's model by revising the model to incorporate organisational and management issues pertaining to information technology adoption, instead of focusing on expenditure on information technology. In addition, the Galliers and Sutherland's model accommodates a flexible technology paradigm that facilitates analysis of the adoption process involving the different stages of technologies, without confining to a specific technology paradigm. The Galliers and Sutherland model depicts the kinds of characteristic and organisational profile needed for an enterprise to move through the consecutive information technology growth stages. The framework in their model embraces the McKinsey Seven 'Ss'², in which each of these elements portray characteristics of the organisation in the different stages of growth as illustrated in Table 9.1:

² Structure, strategy, systems, staff, skills, style and shared values or superordinate goals (Athos and Pascale 1986).

Table 9.1 - The Galliers and Sutherland's Model

Element	Stage					
	1	2	3	4	5	6
	Ad hococracy'	Starting the foundations	Centralized dictatorship	Democratic dialectic and cooperation	Entrepreneurial opportunity	Integrated harmonious
Strategy	Acquisition of hardware, software, etc.	IT audit Find out and meet user needs (reactive)	Top-down IS planning	Integration, co-ordination & control	Environmental scanning and opportunity seeking	Maintain comparative strategic advantage Monitor futures
Structure	None	Label of IS Often subordinate to accounting or finance	Data processing department Centralised DP shop End-users running free at Stage 1	Information centres Library records. OA etc. in same unit information services	SBU coalition (s) (many but separate)	Centrally co-ordinated coalitions (corporate & SBU views concurrently)
Systems	Ad hoc unconnected	Many applications	Still mostly centralized	Decentralised approach with some controls, but mostly lack of coordination	Decentralised systems but central control and co-ordination	Inter-organizational systems (supplier, customer, government links)
	Operational	Many gaps	Uncontrolled end-user computing	Some DSS-ad hoc	Added value systems (more marketing)	
	Multiple manual & IS Uncoordinated	Overlapping systems Centralized	Most major business Database systems	Integrated office technology systems	More DSS-internal, less ad hoc	New IS-based External-internal integration
	Concentration in financial systems Little maintenance	Operational Mainly financial systems Many areas unsatisfied Large backlog Heavy maintenance load			Some strategic systems (using external data) Lack of external & internal data integration, intergration of communications	
Staff	Programmers/ contractors	Systems analysts DP Manager	IS planners IS Manager Data Base Administrator Data Administrator Data analysts	Busines analysts Information Resources Manager (Chief Information Office)	Corporate/ business/ IS planners (one role)	IS Director/ member of board of directors
Style	Unaware	Don't bother me (I'm too busy)	Abrogation/ delegation	Democratic dialectic	Individualistic (product champion)	Business team
Skills	Technical (very low level), individual expertise	Systems development methodology	IS believes it knows what the business needs Project management	Organizational integration IS knows how the business works Users know how IS works (for their area) Business management (for IS)	IS Manager-member of senior executive team Knowledgeable users in some IS areas Entrepreneurial marketing skills	All senior management understand IS and its potentialities
Superordinate goals	Obfuscation	Confusion	Senior management concern DP defence	Co-operation	Opportunistic Entrepreneurial Intrapreneurial	Interactive planning

Source: Galliers and Sutherland (1994).

However, this model is considered insufficient for the thesis' aim in determining the nature of the organisational factor influencing the adoption process in the Chinese state-owned banks. Firstly, in interpreting the model, the characterisation of the elements may not neatly describe an organisation at a particular technology adoption stage. In fact, the Galliers and Sutherland's was established and refined based on western organisations. Hence, the direct application of this model would obscure attributes or characteristics of the organisational factors that may be context specific to the Chinese situation. Ping and Grimshaw's (1992) use of the model in their

research findings on information technology adoption by the state-owned enterprises in China shows the inadequacies of the model in capturing the characteristics of the organisational factors influencing information technology adoption and the ‘stages of growth’. It has been acknowledged by Galliers and Sutherland (1994) that their model is not an universal model since the development and refinement of the model, was based on four organisations in Perth. The need to make allowance for the ‘non-fit’ characteristics of some of the ‘S’ in each stage of growth postulated by the model is consistent with my finding from the literature review in Chapter 2 that the nature of the factors vary greatly across different context.

Secondly, a more comprehensive and broader coverage of the internal organisational variables (that is, based on organisation context) is needed for examining their dimension as facilitators or inhibitors to technology adoption. It must be mentioned that this is not to ignore the Galliers and Sutherland (1994) model, but to adapt the model to suit the purpose of the thesis, which is to determine the nature of the factors affecting adoption capability.

9.1B) The Conceptual Structure Employed

The framework used in the thesis takes a combination of the organisational factors from the Davis and Olson’s (1985) version of organisational subsystems and the McKinsey Seven ‘Ss’. This framework will incorporate the ‘technology’ variable which is a component in the Davis and Olson’s (1985) modified version and is not a component in the McKinsey Seven ‘Ss’, and vice versa for the case of the ‘strategy’ variable, to obtain a wider latitude for conducting the analysis at the organisation level. The above mentioned are presented in the table below.

Table 9.2 - The Derivation of the Conceptual Structure for Organisation Level

Analysis

Davis & Olson’s version	Mckinsey Seven ‘Ss’	Focus in thesis
Technology	--	Technology
Structure	Structure	Structure
Task	Systems	Task/Systems
People	Staff, Skill	People
Culture	Superordinate goals	Culture
--	Strategy	Strategy

These elements constitute the set of organisational factors for analysing their respective influence on technology adoption process in the state-owned banking system. Instead of adhering to the different stages of growth as used in the Galliers and Sutherland's (1994) model for the information technology adoption path of the Chinese state-owned banks, the thesis model focused on the adoption process in the different time periods of special importance in China, exploring the stages of growth through those time periods. The nature of the factors influencing technology adoption within the state-owned banks is determined according to the pre-reform period and reform period, in which the latter period is subdivided into the different Five-Year-Plan periods.

It must be noted that this chapter focuses mainly on internal organisational factors that affect the state-owned specialised banks' path in information technology adoption. It cannot be considered a comprehensive framework of variables affecting the adoption of information technology in the state-owned banks, as it only depicts organisational variables. There are external variables that have an impact on the technology adoption process and are considered in the conclusion of this chapter and in Chapter 10 of this thesis.

The details of the organisational factors and their influence on the information technology adoption process, in the different periods, within the Chinese state-owned banks are laid out in section 9.2. Section 9.3 summarises and highlights the characteristics and influence of each organisational factor on the technology adoption process in the different periods. The chapter concludes with section 9.4, with a discussion on the interacting effect of the main organisational factors on one another and the influence of the main environmental factors on the technology adoption process in the Chinese state-owned banks. Before we proceed to section 9.2, the elements of the conceptual structure are reviewed briefly.

i) The Elements in the Conceptual Structure

a. Technology

Technology is added onto the framework because the different levels of technology adopted during the different time period will shed light on the role of the other

organisational variables in the adoption of the technologies. Indicators like the usage life span of technology equipment, the country of origin of the predominantly adopted technology equipment, the disposition of the Chinese state-owned banks in adopting technology and the average number of computers per computerised outlets are used to give the profile of the depth and extent of technology adopted in the different periods.

b. Structure

Chandler (1962) defined structure as '*the design of organisation through which the enterprise is administered*'. It maps out the logical relationship of hierarchical levels, formal communication channels and functional areas arranged in such a way as to enable effective achievement of the objectives and goals (Drucker 1974). According to contingency theorists³, the characteristics of the organisational structure have implications for the adoption of information technology. Woodward's (1965) and Perrow's (1970) studies have generated substantial focus on structural characteristics as an influence on technology adoption initiatives. Grover et al. (1995) summarised these characteristics as *formalization, centralization, integration, and complexity*. In this thesis, formalization is examined from the positioning of the information technology unit in the Chinese organisation structure. This will reveal the degree of recognition given to information technology as one of the *formal* means for achieving the objectives and goals of the organisation. For example, subordinating an information technology taskforce to the command of the accounting department limits its potential to being an accounting resource for departmental objectives, instead of an organisational resource for the overall corporate goals. The *integration* structural characteristic is determined from the relationship between the information technology department and other departments, which has an impact on the pace of technology adoption in the organisation. For example, organisation designs that result in hierarchies, bureaucracies and many levels of review and approval seem to be incapable of effective adoption and of rapid response to changes. *Centralisation* influences the extent of technology uniformity in the context of technology adoption for the overall corporate banking system efficiency. The type of structure for

³Contingency theorists in management stresses the importance of the contextual situation of factors in organisation and environment. They determined that the appropriateness of an information technology adoption approach is determined by the factors in that situation.

technology management at the different branch hierarchical levels has implications for the present assimilation and future integration of all information functions and technologies into an entire corporate system. The structural characteristics will collectively determine whether the information technology department plays a reactive or proactive role in light of emerging technologies applications and in continuous monitoring of system efficiency. *Complexity* refers to the number of different products and services offered by the organisation. In technology adoption, the range of the products and services will influence the extent of the technology used to support product and service delivery, as well as vice versa. The complexity attribute is significant in the Chinese banking system since its products and services have proliferated as the country transits towards a market economy. This characteristic is reflected more clearly in the organisational value chain, which is described in the task/system component.

c. Strategy

Strategy guides the activities of an organisational unit or of a business unit in contributing to the achievement of the organisation's overall goals and objectives. It determines the allocation of resources and the ways in which functions are to be managed to achieve the goals and objectives of an organisation (Chandler 1962). The efficient achievement of the overall organisation's goals and objectives has always been associated with high degree of consistency among the different working mechanisms within the organisation. This calls for a fit between information technology strategy and business strategy, because the aim of the organisation in information technology adoption should be to enhance or improve the organisational ability to achieve objectives. Studies conducted in this area commonly concur that their alignment indeed will maximise the return on investment in information technology (Pankratz 1991, Coates 1992, Luftman et al. 1993, Grainger-Smith and Oppenheim 1994, and Prairie 1996). Since the mid-1980s, research literature has begun to recognise the strategic potential of information technology and this calls for effective adoption of information technology as a vital competitive tool for harnessing strategic business opportunities. Research studies have determined that these required carefully planned and practical management processes. In the context of the state-

owned specialised banks in the People's Republic of China, this 'strategy' organisational variable is assessed in terms of its 'fit' with the organisation's objectives and the extent to which information technology has become an integral part in the pursuit of corporate objectives and strategic business opportunities. This is determined from the main direction of information technology adoption and its applications purpose within the state-owned banks - that is, the degree of alignment between the business operating capacity ('business strategy') and the motivation behind information technology ('information technology strategy'). In addition, the source of the firm's financial resources for technology adoption is evaluated. The availability and allocation of financial resources will provide further insight into the strategy approach of the management in funding technology adoption.

d. Task/System

Business process constitutes a systemic set of tasks or work processes which are parts of the sum of an activity that collectively form the value-chain of an organisation. These tasks will involve the utilisation of the organisation's inputs to create outputs that are demanded by the customers. Porter's (1985) value chain model, which reflects the set of activities undertaken by the different business or functional units, is useful for determining the extent the work processes begun to embrace information technology as an input in the pre-reform and reform periods ('technology relevance in the organisation's value chain'). The proliferation of products and services in the transitional market economy has an impact on the nature of the task/system in the different activities of the value chain. In the developed countries, banks used information technology to attain control by means of business system integration. It appears that the applications of information technology in the different activities and its interaction with the work process (in the bank's value chain) have implications for the achievement of the overall organisation's objective. The need for business system integration and the capabilities in business system integration are examined in the adapted model.

When work process began to embrace technology, the notion of restructuring work process to enhance the realisation of technology potential began to emerge in the 1990s. Hammer and Champy (1993) developed the management approach of

automating business processes within the organisation, which they advocated that it will 're-invent' the corporation to survive the aggressive competition in the marketplace. What surfaced from this new approach is that information technology was a crucial element in business re-engineering. In fact, the changes needed go beyond the work process, as the approach requires management processes to be redesigned, systems to be revamped, and people's mentality and forms of co-operation to be adjusted. The new approach has been observed to be significantly more beneficial than the past method of direct automation of work processes. How applicable this new concept is to the Chinese banks will depend on the extent to which the organisational variables are flexible to these changes.

e. People

The effective application and exploitation of information technology in the organisation requires competent support staff and willing users, and this involves a substantial process of learning. The learning opportunities available in the organisation have an impact on the extent of information technology being adopted and exploited within the organisation. Knowledge is essential to cultivating the necessary pool of talents and also to instilling cooperation among users. The profile of the information technology staff and users, in terms of their learning opportunities and skill level, is taken into account in this case study.

The profile of management support is also taken into account. In recent years, researchers have found that higher management support constitutes one of the crucial factors in information technology adoption (Leigh 1988, Grainger-Smith and Oppenheim 1994). Support from the senior management level is necessary in view of the absence of reliable measurement tools for determining the level of added-value contribution resulting from information technology investment.

f. Culture

Prior to 1979 (refer Reichers and Schneider 1990), culture⁴ was not seen as an organisational imperative for management functions. It was established later that

⁴ An organisation culture referred to the organisation's social system, prevailing norms, feelings, attitudes and values of people in the organisation (Hellriegel and Slocum 1989).

culture warrants attention in management studies, as it can have powerful consequences, particularly when cultural factors are established and strong. They each boost or dampen management's attempt to implement organisational change or information technology transformation.

Prarie (1996) identified cultural factors as the most important determinant of information technology strategic planning. Straub's (1994) study found that culture affects the use and choice of technology in Japan and the USA. Davenport (1994) found that information culture is often a formidable factor to overcome for successful implementation of information technology. According to Burn (1995), the conservative information culture of the Chinese people in the People's Republic of China did inhibit successful information technology implementation. These studies suggest that cultural characteristics have just as much importance as the observable characteristics which have dominated theoretical and empirical research. It was noted by Cooper (1994) that the bearing of this factor on information technology adoption has not been given sufficient attention by researchers in this field.

In this thesis, it has been difficult to track the impact of workplace culture on the adoption of technology within the Chinese state-owned banks, especially during the pre-reform era, due to the lack of data availability. The establishment of this factor's impact on technology adoption is a general one, based on interviews and discussions with the Chinese respondents, and drawing on other published sources for possible explanations. The impact of this sociological factor on technology adoption constitutes a potential area for further research in the future. A general profile is established on this factor, instead of segregating its impact by different planning phases.

ii) The Conceptual Structure

Table 9.3 below summaries the framework adopted for highlighting the role of the different organisational factors, and for investigating the nature of the influence of the various factors on information technology adoption within the Chinese state-owned banks.

Table 9.3 - Framework for Organisational Level Analysis

	Pre-reform period	Reform Period		
Period	1957 to 1978	1979 to 1985 (6th Five-Year-Plan Period)	1986 to 1990 (7th Five-Year-Plan Period)	1991 to 1995 (8th Five-Year-Plan Period)
Technology				
1. Dominant technology.				
2. Usage life span of the technology embodied equipment.				
3. Countries where adopted technology was mainly sourced.				
4. Disposition in technology adoption.				
5. Depth of technology applications: average number of computers per computerised outlet.				
Structure				
1. Information technology control in the organisation's structure.				
2. Information technology management structure.				
3. Coordination between information technology department and other departments.				
Strategy				
1. Main direction of information technology adoption strategy.				
2. Purpose behind technology applications.				
3. Investment funding for internal adoption of technology.				
Task/System				
1. Technology relevance in the organisation's value chain.				
2. Integration of the business systems.				
People				
1. Availability of information technology staff per computerised outlet.				
2. Skill of the information technology staff.				
3. Management support.				
Culture				
1. Work culture.				
2. Information sharing culture.				

9.1C) The Information Base for the Analysis

A variety of information sources are used to substantiate the analysis on the role of the organisational factors in technology adoption within the Chinese state-owned banks. The sources take the form of structured interviews, unstructured interviews, unpublished reports, and publications (for example, Jinrongshibao, official data and periodicals) as identified in detail in Chapter 2. Material provided in earlier chapters is also referred to in the process of substantiating the analysis. It must be mentioned little evidence on pre-reform period for the analysis is available, due to the nature of the closed communist system at that time. The analysis of the pre-reform period relied heavily on unstructured interviews, and on publications in the reform period, that described events in the pre-reform system.

9.2 THE ROLE OF ORGANISATIONAL FACTORS IN ADOPTION, BY PLANNING PHASE

9.2A) Period 1949 to 1978

9.2A - a) Technology. The earliest initiative to adopt computer technology was directed by national technology policy rather than generated internally within the monobank or the national account processing centre. The equipment introduced by the Russian in 1957 were 'electro-magnetic type analytic computers' (which were akin to the first generation vacuum-tube computers) and were at least seven years behind those in use in the Russian banking system at that time. After the Sino-Soviet political rift in the late 1950s, China had to source technologies on its own. Without the Soviet support, the Chinese banks faced difficulty in procuring high technologies against the COCOM administration's restriction on China's import and China's weak domestic industry in high technology production. In addition, the path of technology adoption between 1966 and 1976 was also affected by political instability and inconsistent technology policy (refer Chapter 3 for details). These resulted in the prolonged usage life span of the equipment, and information technology equipment in use commonly had a usage life span of 10 years. The few subsequent technologies adopted by the Chinese banks were stand alone 'Accounting Control Machines'

(ACMs) and considered relatively backward in the then existing marketplace (Zhang 1997). After the Sino-Soviet rift, the nature of the technology adoption was dictated by the offers of the external suppliers. Overall, the adoption pattern in the pre-reform period reflected a slow process of technology change.

9.2A - b) Structure. The structure of the monobank was that of a bureaucratic organisation with a rigid structure where functions are distinctly segregated and defined, with a strict hierarchy of authority (Bedeian and Zammuto 1991). The structure was initially modeled entirely on the Soviet Union's monobank structure, with many of its features retained after the Sino-Soviet rift and in spite of the changes in the accountability and reporting relationship experienced by the different banking units (as detailed in Chapter 4, section 4.2F). Information technology control in the organisation structure was the responsibility of the national accounting processing centre (refer to Chapter 6 section 6B.1 for the description of the centre's role) throughout the pre-reform period, as per the initial set-up arranged by the Soviet Union (Mao 1994). The functioning of the monobank was centrally controlled, coordinated and funded by the Ministry of Finance. The monobank's operation was based on directives from the Ministry. The flow of information was centrally controlled and vertically bounded in this structure, and there was no requirement for sophisticated applications of information technology. In addition, the subjection of technology to the control of the national accounting processing centre confined it to being an accounting resource. As a result, the adoption of technology continued to be in the form of an accounting tool during the pre-reform period.

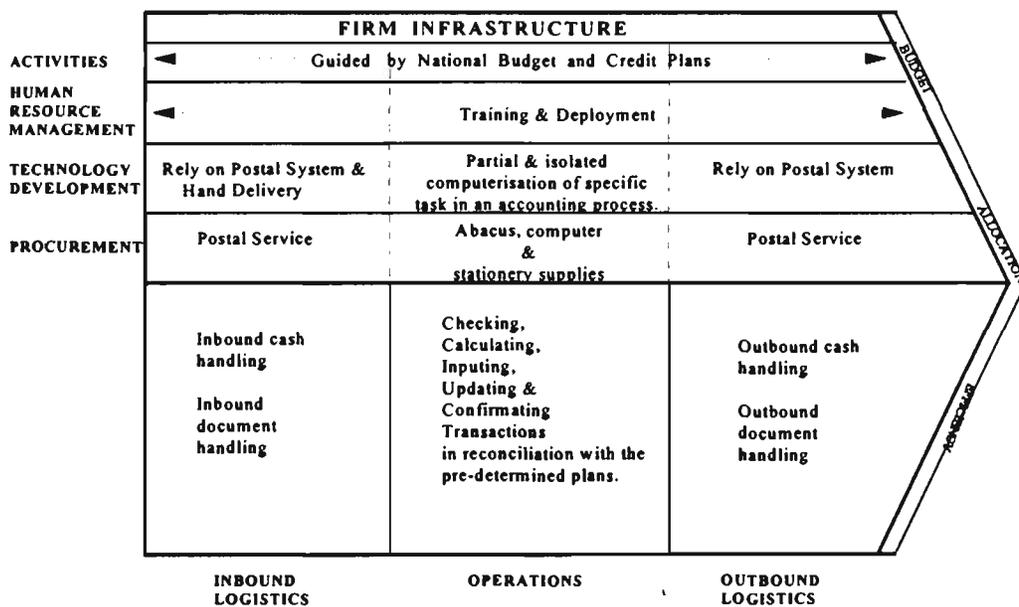
9.2A - c) Strategy. The adoption of technology in the banking system for the purposes of business strategy was insignificant during the communist command period. This was because the banks' operation was based on the directives of the Ministry of Finance, which in turn adhered to the government policy of giving low priority to this service entity in the allocation of investment funds for its technology adoption (refer Chapter 3 section 3.1A for national focus on development of key sectors during this period). There was no specific internal strategy for the adoption of

technology within the national accounting processing centre after the Soviet withdrawal in 1959.

9.2A - d) Task/System. The main purpose behind the application of computer technology to the specific tasks in the monobank system was to facilitate transactions. The technology was adopted to assist the reconciliation task in the accounting system. The value chain system in the monobank structure was simple, as is illustrated in the below value chain diagram, and handled mainly cash and documents involved in accounts reconciliation (refer Chapter 4 section 4.2A for the nature of the financial flows). The value chain did not include marketing, sales and other service components, since these were claimed to be of ‘capitalistic traits’ and were discredited in the centralised communist command period.

Figure 9.2

Value Chain of the Monobanking System in the Pre-reform Period



In the value chain portrayed above, performance measurement was based on the efficiency in reconciling fund flows, in accordance with the national credit plan or budget. The ‘business mission’ was to satisfy government expectations in China, which involved the administration and monitoring of financial fund flows to achieve planned goals. There was little value in this system in obtaining and processing information quickly. In view of the fact that there is little need to secure up-to-date information for the activities, technologies had limited relevance in the value chain of

the monobank system. Thus, the potential for adding value by applying information technology was not exploited.

9.2A - e) People. The accounting staff who handled the reconciliation task in the monobank were the users of the computer technology. The users were initially trained under the Soviet's technology assistance program but all learning and technology transfer programs were terminated by the withdrawal of all forms of Russian aid after the Sino-Soviet dispute in the late 1950s. Interview responses indicated that the computer skill of the accounting staff remained at a low level during the pre-reform period, given the technology sourcing difficulties due to external restrictions and political instability. There was also a low level of trust in new technology (refer Chapter 6 section 6.2A), which was a major inhibiting factor to the adoption process.

9.2B) Period 1979 to 1985

During this period, the banking system began to undergo major changes to its structure and internal work processes, when the economy began to move towards an open trade policy and when economic development became of primary importance. Planning for information technology applications to the work processes in the two-tier banking system⁵ was difficult because of the changes and inconsistencies that had to be sorted out.

9.2B - a) Technology. A small quantity of minicomputers was adopted by the Bank of China in 1982 in the domestic market, followed by the Agricultural Bank of China in 1984 and the Industrial and Commercial Bank of China in 1985 (refer Chapter 6 section 6.2B). From the trend in technology adoption within the banking system, it is evident that the new banking structure in 1985 provided impetus in driving the adoption of banking terminal technology for the automation of front-counters, because of the transformation of the banking role to commercial intermediary one. The main

⁵The segregation and demarcation of roles and functions into central banking and independent financial units means that the newly transformed specialised commercial banks operate under their separate identity and independent jurisdiction. Therefore, information technology adoption was considered to begin anew.

focus was on the acquisition of hardware for front-counter operations, because of the increasing focus on attracting savings deposits. The focus was also on a few selected outlets, for which the average number of computers installed was considerably higher than the average figure across a larger number of outlets in subsequent economic periods. For example, the Industrial Commercial Bank of China installed about 4.5 computers on average in selected outlets located in the major cities at the initial stage of technology adoption (data computed from Jinrongshibao 22/6/1994 and Statistical Yearbook of China).

In this period, the acquisition of more sophisticated information technology equipment gradually became possible with the progressive relaxation of control by the COCOM administration during the 1980s (refer Chapter 3 section 3.5E).

9.2B - b) Structure. When computers were formally adopted during the reform period, a computer taskforce was formed in many organisations, but was usually subjected to the jurisdiction and control of the accounting department. It was not until the automation of the front-counter transaction system became stabilised that the technical unit gained independence in the organisation structure of most banks, becoming a department which operated in a functional capacity equivalent in status to the accounting department (interview source). A specific title was accorded to this newly formed department, and it was commonly referred to as the 'Computer Department'.

9.2B - c) Strategy. There was no specific long term directional path in the adoption of computer technology. From the adoption pattern (refer Chapter 8 section 8B), the banks initially undertook computerisation according to their most immediate operational needs in their own banking system, which was either front counter processing or the information system within and among the branches. At the initial adoption stage, the Bank of China and the Industrial and Commercial Bank of China adopted minicomputers for transactional purposes. On the other hand, the Agricultural Bank of China adopted minicomputers for informational purposes. However, the focus gradually shifted to front counter automation, with the growing importance of the newly assigned commercial banking role in the mid-1980s. The

rationale for technology applications was still very much confined to automation of individual existing work tasks. In fact, the adoption effort was treated largely as part of the reform program by the banks.

Prior to 1985, funding for the adoption of information technology was largely based on government loans and government subsidies, passed down or allocated by the banks' headquarters. The value of the loan was able to be amortised in the books, and which the actual monetary repayment of the principal amount was not required. This source of funding posed as no financial burden to the banks (Chen 1995c). Because the funding of technology investment came mainly from the central headquarters, there was an implicit centralised structure in technology adoption (interview source). The headquarters allocated funds to branches according to the latter's potential to adopt and use technology for its business. The potential was assessed on the basis of its performance as well as to regional endowments, and therefore branches located in economically active cities were the selected branches. Because of the funds allocation system, the selected adopters coordinated closely with the funding source, that is the headquarters, in the acquisition and development of technology. A significant aspect of this process was the obligation of the first adopter to transfer or share the acquired technology with affiliated branches in other regions. The receiving branches, on the other hand, had to pay for the technology transferred by or shared with the first adopter. Although the ability to design, develop and apply technology was heavily dependent on external vendors, the branch that 'originated' the system enjoyed high recognition from its headquarters and from affiliated branches. It was not only credited with a high technocratic profile and hailed as a modernised branch in the banking system but its earning capacity was also bolstered by the technology transfer fee. This investment strategy has given rise to the adoption of coherent or uniform technologies within individual banks. Unfortunately, the change in funding and administrative policies in the later period has obliterated much of this unintentional impact of a centralised structure in technology adoption.

9.2B - d) Task/System. Although the transformation of the monobank system to a two-tier system increasingly revealed the need for an integrated system of operation, the overall technology applications remained activity specific, which resulted in high

level of partial computerisation within individual branches. As banking activities became increasingly complex in the open economy (Wang 1995a), the information technology staff found it difficult to meet the application requirements of the changing work process and business activities (interview source, Zhao 1993, and Mao 1994).

9.2B - e) People. Both the staff responsible in maintaining the machines and operating the machines were low skilled. Training relied upon equipment vendors and was inbuilt as part of the hardware procurement agreement.

9.2C) Period 1986 to 1990

9.2C - a) Technology. The technology adopted during this timeframe involved a diverse experience in the adoption of different technologies, ranging from minicomputers to mainframe and mid-range computers, and eventually to microcomputers. Although the domestic banking sector's ability to procure new technology was no longer constrained by COCOM's control, financial constraints had become an inhibiting factor in technology adoption. This is reflected in the inability to replace older technology in line with new technology developments and adoption patterns in overseas countries. Although the average equipment life was reduced from 10 years to between 6 to 8 years, it still lagged behind the international standard rate of depreciation which has been between 3 to 5 years (Mao 1994).

9.2C - b) Structure. With the decentralised responsibility structure, branches were accorded increased autonomy and responsibility in generating their own funds for technology investment (Chen 1995c and refer Chapter 5 section 5.1A). In terms of self-funding capacity, the branches began to develop their own information system and applied technology according to their branch requirements. Competition began to develop among some of the banks' branches in technology adoption and system development. The basis of competition was generally related to the desire to be categorised as a highly modernised branch and to be awarded with the highly competitive financial grants from the government, through developing the most advanced automated system. In addition, this success also meant additional revenue

in the form of technology transfer payments from other interested affiliated branches. This development gave rise to the adoption of diverse and incompatible technologies by competing branches of the same bank (interview source).

9.2C - c) Strategy.

The implementation of the decentralised responsibility structure in the state-owned enterprise system made information integrity and timely information availability important attributes in effective coordination by the central office. In this period, the government also began to openly encourage the use of information technology in the management and operation activities (Franz et al. 1991). The absence of information integrity and timeliness had been a critical problem to the central authority and to the banks' headquarters for prudent macro control (Jinrongshibao 5/10/1987) and for management of their individual banking systems (Xu 1993). Although the Chinese government had initiated the establishment of a national information system covering twelve key government organisations among which the state-owned specialised banks were included, the effort and funding were too dissipated to create any significant impact. It was only towards the late Seventh Five-Year-Plan period that there was specific action by the government in driving information technology applications for the banking industry (refer Chapter 6 section 6.2A and 6.2B). The 'China National Financial Network' and the 'China National Advanced Payment System' projects were the icons of the government's direct role and support of the development of electronic inter-bank network infrastructure for the banking system. The banks began to study and evaluate the impact of the proposed national system and there was an increase in the pool of information technology staff, recruited in preparation for the major projects.

Concomitant with the commercialisation of the state-owned specialised banks, the source of investment funding for information technology adoption shifted from predominantly government based to individual bank sources. Even the grants from the Ministry of Finance, which were considered an alleviating alternative to the heavy financial undertaking of the self-funding banks, were very competitive. The banks found it difficult to sustain the level of investment (Chen 1995c). The available funds within the bank was thinly spread over the large number of outlets to be computerised.

This was obvious from the large decrease in the number of computers per computerised outlet and in numbers of information staff per computerised outlet experienced by the banks (computed from Jinrongshibao and Statistical Year Book of China).

Because of the wide geographical dispersion of the bank branches, the high number of outlets, and the expertise shortage, the technology adoption process in the individual corporate banking systems took on a stepwise basis. The well endowed branches were the first to adopt technology. There were cases that the adopted technology in these earlier adopting branches became outdated or obsolete, it was transferred to the lower level branch for learning.

9.2C - d) Task/System. Front-counter computerisation continued to experience heavy involvement with computer technology during this period (refer Chapter 6 section 6.2(ii)). The computerisation of the savings activities within a branch took on a pattern of extending technology applications to the development of electronic savings system linkages (among branches that were based in a city) in selective cities for the purpose of merging customer account bases. This was usually undertaken by the branch after the adoption of banking technology for front-counter activity, after which the branch would tend to extend its electronic savings system⁶ to link up with other branches located within the city. However, the merger of customer account bases was to facilitate transactional purposes rather than to meet decision support (informational purpose) and strategic information needs (strategic purpose). The adoption and extension processes were strictly confined to affiliated branches belonging to an individual banking corporation. At this stage, the overall effort on the electronic network construction still lagged behind the development pace in the overseas countries (Jinrongshibao 12/6/1991). The overall pattern of technology adoption revealed pockets of technology applications and registered a common profile of partial computerisation in individual outlets (Jinrongshibao 16/12/1988 and Mao 1994).

⁶ Electronic linkage to enable the sharing of common database for the processing of withdrawal and deposit transactions.

9.2C - e) People. The banks were facing the problem of a critical shortage of information technology expertise and support that was necessary for the adoption of technology in further outlets. They suffered a lack of quality in the information technology staff (Jinrongshibao 14/11/1990). The majority of the information technology staff had low level skills, and it appears that on average at least two-thirds of the information technology staff in the banking system at that time had skills that were classified as at the intermediate level (computed from data gathered from reports on bank branches in Jinrongshibao). The low level of capability in information technology monitoring and support services contributed to the low trust of the users in the technology. Sometime, a branch had to be incapacitated for a few days to wait for the availability of expertise from the headquarters or from another branch (shared resources) to fix up a problem in the equipment or computerised system (Jinrongshibao 18/3/1993). This prolonged disruption to work created a negative attitude in the users towards computer applications. While the quality of support resources was weak, the users had almost no prior knowledge of the operation of the information technology equipment used for their job. The heavy reliance of users on weak information technology support services led to difficulties in exploiting technology at its fullest potential. There was a need to invest substantial resources to train the users so that they were able to overcome fear and insecurity when using the technology. The users were normally trained inhouse, either at the branch or headquarters, but such training places were very limited. On the other hand, training of the information technology staff still relied heavily on external parties, such as information technology vendors and overseas training opportunities. The banks tried to overcome the shortage of information technology personnel by recruiting and training staff in other departments, usually from the accounting department, for the purpose of cultivating hybrid talents - individuals equipped with the knowledge and capability of the technical applications of technology as well as the business operation aspect. The learning environment was especially tough at the lower branch level, where access to training was not readily available. It has also been known that staff undertook learning on a self-taught basis, but relevant materials were not readily available in the Chinese language (interview source).

9.2D) Period 1991 to 1995

9.2D - a) Technology. The dominant technology adopted by the state-owned specialised banks during this period was the microcomputer. Because of funding constraints, the equipment continued to have a usage life span of between 6 to 8 years (Zhou 1992).

In terms of the predominant technology adopted by the banks, microcomputers manufactured by foreign funded enterprises or by Sino-USA joint-ventures (AST, Compaq, and IBM) were the main products procured by the banks. The banks considered foreign manufacturers to be capable of providing more reliable products and support services than the local Chinese manufactured products. This preference for foreign brands was associated with the inadequacy of in-house resources and skill in the information technology support area (refer Chapter 3 and interview source). The banks tended to purchase equipment that was made by the local Chinese manufacturers when the need to procure less sophisticated or low technology equipment arose. Despite the funding constraint, the banks were set for the adoption of only new technology, instead of obsolete technology which would involve a cheaper initial investment cost for their tight budgets. Although the number of personal computer and professional workstation installed exceeded the number of word processors installed, the former type of technology equipment (which allows higher degree of usage freedom for the users) was underutilised.

In addition, the installation of different and incompatible computer systems was not uncommon (Deng and Qin 1995b, Cheng 1996, Shan 1996). This incoherent and uncoordinated standard was widespread at the lower basic level of the individual banks (Jinrongshibao 22/9/1995 and Wang 1996a). Decentralisation⁷, lack of overall control, and inadequate resource endowment at the basic level contributed to this problem (Jinrongshibao 2/10/1997). The lack of a strong information knowledge base and of a coordinated planning capability led to independent adoption and development of information technology hardware and software in the different branch levels, regardless of compatibility, future expandable capability and development suitability (Deng and Qin 1995b, Cheng 1996, Wang 1996a). In addition, any effort to comply

⁷Decentralisation involved the delegation of decision-making power to the lower level branches to enable decisions to be made in accordance to the stages of regional development and endowment.

with common standards was rendered difficult by the inability to improve the usage life span of the equipment towards the international standard. The incompatibility of systems explained the low usage of the electronic payment settlement system that was being developed by the People's Bank of China (Zhou 1995 and Jinrongshibao 3/9/1995). Although the second level payment network had began operation, connections between the satellite network and the earth network were found to be often incompatible at bank branches in this level (Wang 1996a and Feng 1996b). Data input had to be repeated or done via telephone lines, and exchange of data was reported to be slow in the network.

9.2D - b) Structure. The organisation and operation of the information technology department had been delegated to the different branch levels according to their geographical segmentation hierarchy level. Due to the lack of sufficient resources and knowledge to enforce a strong information technology management structure for managing the use of technology, security control was of major concern. Security has always been an important issue to the banks (Deng and Qin 1995b), because of the fear of inability to cope with hi-tech fraud (Wu 1996a). Although the availability of reliable information about the amount of computer crime occurring, and about the nature and severity of that crime, is scarce, the high turnover in information technology staff and the increasing use of technology means that tight management structures in security access and control became essential.

The structure of information technology delivery was still in-house based, which remained so even in software applications where the in-house capability was weak. The development and implementation of the majority of information technology software applications were carried out on an in-house basis because of the need for Chinese language applications and for business confidentiality. The participation of the vendors was largely confined to the supply of the basic technical products. The in-house structure was a strong characteristic feature of the local banks in the industry and was claimed to be consistent with the common notion that reform should be undertaken with 'Chinese characteristics'. There was resistance to the new concept of services outsourcing in systems maintenance and development. Only about 9% of the banks outsourced their software applications in 1993 (unpublished report 1993).

Unfortunately, the in-house software development quality in the local banks has been affected by the high rate of turnover in information technology staff.

The computer technology tended to bear the brunt of the blame when things went wrong. This continued to be a problem even when the adoption phase was involved with microcomputer technology at a higher stage of technology applications (Jinrongshibao 18/3/1993). As a result, the information technology department had a defensive relationship with the users (other departments).

9.2D - c) Strategy.

A panel of 38 experts examined the status of the adoption of information technology within the financial system in this period, and pointed out that the main problem of slow progression to an advanced level of technology adoption lay in the absence of coherent strategy and policy among the banks. Even though standards and requirements were set by the headquarters, these were not consistent across the different banks (Jinrongshibao 30/10/1995). The lack of a distinct national direction governing technology adoption strategy had led to the result of incompatible technology applications. It was stressed by these experts that financial computerisation should be listed as a national strategy, to realign adoption undertakings to ensure compatible technology applications (Jinrongshibao 27/3/1992). There was also the lack of strong strategic purpose in the information technology strategy of the different banks, that is application of information technology for creating competitive edge for banking business development. Information technology adopted for the banking business operation, was mainly applied along the line of government policy and objective. This is reflected in the 'Golden Card Project' which created considerable attention in the nation and constituted a major reference for the banks in their technology adoption strategies and plans. Although the adoption pattern registered an increase in technology applications under the impact of the Golden Card project, there was less focus in the use of information technology for creating competitive edge in the marketplace and strategic business development. In addition, the weak organisational structures of the banks were incapable of exploiting the strategic potential of information technology highlighted by government policy. For example, the aggressive promotion of the Golden Card project by the government

in 1993 raised awareness of the importance of competitive advantage derived from information technology. But this awareness has not been fully translated into strategic utilisation of information technology for competitive purposes.

The funding situation remained a significant issue. The state-owned banks faced difficulties, in their capacity as commercial banks, in generating and sourcing the required funds to support their technology adoption process. Despite the market protection fostered by the government for the state-owned specialised banks to strengthen their competitive position and their revenue earning capacities, the banks' financial position was still burdened by their past banking role to the state-owned production entities (Chapter 5 section 5.5). On the average, the amount of investment fund bore by some of the state-owned specialised banks was between 1,700 to 1,800 million yuan per annum in 1993 and 1994 (Chen 1995c). Availability of funds for technology investment undertakings was very limited and the branch's adoption of technology largely relied upon its internal funding capacity (Jinrongshibao 16/1/1995). Aggravating the constraint of the funding situation has been the difficulty of obtaining a short payback period on funds invested for computerisation (Jinrongshibao 27/3/1992). Although the China Construction Bank in Shenzhen achieved payback period of two to three years on its 250 million yuan investment (Jinrongshibao 19/12/1996), this short payback period has not been experienced by banks located in the economically less well-off regions (Deng and Qin 1995b). Generally, the computerisation budget was pegged against revenue of prior period rather than the technology's potential. On average, the four state-owned specialised banks' total average investment on information technology in 1993 and 1994 constituted about 5.1% of their total average profit and about 1.5% of their total average revenue in the two years. The latter figure was even smaller for the whole Eighth Five-Year-Plan period as a whole. The overall average percentage of revenue allocated to computerisation by the bank during the Eighth Five-Year-Plan was tracked by the experts to be generally less than 1% (Jinrongshibao 27/3/1992). The main issue here is not to focus on the appropriate the level of spending but to highlight the problem of the absence of a defined structure and strategy pertaining to how technology is managed and used in the presence of the funding constraint.

The banks began to be aware during this period of the importance of a flexible technology infrastructure to minimise the investment financing burden. The information technology infrastructure issue has been exacerbated by a combination of evolving technology platforms, integration of different application software and the rigidity of existing applications. There was an urgent need to integrate the existing 'islands of automation' into an integrated single operating system. Inhibiting the execution of system integration were the lack of information system standards, insufficient technical ability, inadequate coordination among functional departments, and inadequate infrastructure support. In this period, the banks began to look for open systems, networks, client/server architecture and standardisation of information technology products, and awarded high priority to upgradable technology in their purchasing decisions. The realisation of the need to build an infrastructure that remains flexible and responsive to change was brought about more by the financial constraint than by the lessons learnt from prior adopters in the banking industry overseas.

The market for such investment funding is still undeveloped in China. Although the option of leasing technology was welcomed by some of the bank branches (Jinrongshibao 13/1/1995), the market was almost non-existent.

Even though the bank headquarters might subsidise investment by its branches, this is often at a low level, not exceeding 5% of the total investment amount in the branch (e.g. Wang 1996b). In addition, the banks complained that the accounting system has not been favourable to their effort in the adoption of new technology. Computers that had a value of less than 50,000 yuan could not be listed as a capital item (Mao 1994). In addition, loan repayments on borrowings for the technology acquisition were not tax deductible (Jinrongshibao 27/3/1992). The banks' local clientele was still far from accepting the practice of paying for computer support services or service charges. Therefore, the burden rests very heavily on the financial capacity of the banks.

The shortage of funds has also hindered the development of software. The development of software was largely carried out via manual processes, because of insufficient funds to invest in prototype or aided software design tools. The problem was profound at the lower branch level, where the inhouse software staff were unable

to cope with the complex requirements. The problem of lack of funds has forced some of the staff to master software knowledge on a self-taught basis (Wang 1996a), but the limited information and materials for individual learning (Feng 1996b) aggravated the tough learning environment in the organisation.

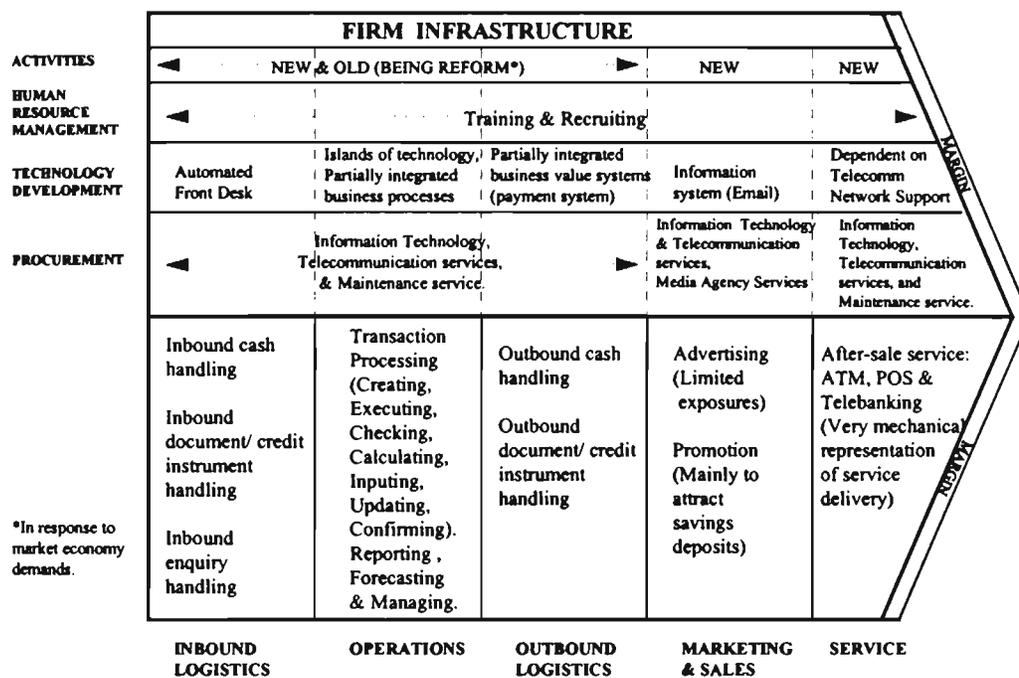
The central bank was not an exception to the predicament facing the state-owned specialised banks (Jinrongshibao 23/4/1996 and 6/9/1997). Its investment funding was between 500 to 600 million yuan per annum and relied on the State Council and its own internal funding. No policy loan was established for the investment in technology adoption (Chen 1995c).

9.2D - d) Task/System. The internal organisational work system was slow to change or reform to support or recognise the introduction of technology. There were still islands of automation (Wang and Yang 1995 and Zhou 1995). The assessment and monitoring of work processes or performance appraisal were still mainly focused on the manual mode of processing. This even prevailed in areas where computer technologies were used, due to the weak knowledge base in managing technology as an organisational resource. This has cultivated the perception that computer knowledge is unimportant (Jinrongshibao 18/3/1993). In addition, the continuation of dual work processes by the user continues to camouflage the effect of this incongruence in some of the branches. On the other hand, changes to the non-technological operation process were slow. Within the banking system, the adoption of networking technology has been made difficult by the varying operational criteria, even among branches of the same bank (Mao 1994 and Zhou 1995). For instance, savings procedures and policy differed from one bank to another, as exemplified in the computation of interest rates. Some of the banks compute interest rates based on 360 days while others do so based on 365 days (Jinrongshibao 17/10/1995). This has persisted despite the national effort to establish accounting standards for computer networks and financial operations. The standards were finalised at the end of 1990 and were reinforced in 1992 and 1993 by the People's Bank of China (Jinrongshibao 27/4/1993) for the respective specialised banks to comply with, in their mandatory reports submitted to higher authority and in their network establishment.

Although the value chain of the bank in the reform period reflects more information technology support in the bank's activities than in the pre-reform period, the technology applications are still characterised by a non-integrative and partial nature. Shan (1996) attributed this outcome to the previous unplanned method of computerisation which he described as like a guerilla warfare setup. This has led to the requirement that further investment be undertaken to migrate many of the systems to achieve uniformity.

Figure 9.3

Value Chain of the State-Owned Specialised Commercial Banks



Unlike the developed nations where the adoption of technology in the banking industry was driven by cost factors, and subsequently by competitive factors, this has not been the case for the state-owned specialised banks in China. Competition related threats and opportunities, that accounted for aggressive adoption of information technology in the overseas banking industries, were very much diminished and obscured by the domestic entry and mobility barriers erected by the Chinese government. With the high level of protection in the banking industry, the value-added potential from the application of information technology has less significant implications for the business strategy of these banks. Simultaneously, the banks were still relatively new to the 'marketing and sales' and 'service' components in their value chain. Their lack of information and inexperience were inhibiting their effort to

develop marketing policies. The degree of technology adoption effort being devoted to direct support for products and services among the state-owned specialised banks was low. The Industrial and Commercial Bank of China which has been the relatively more aggressive bank in the industry devoted 21% to 30% of its total technology investment to supporting products and services, while the less aggressive Agricultural Bank of China devoted 10% (Wang 1997).

From the perspective of the tight funding situation, the use of the electronic payment system does not accord attractive benefits to the banks compared to their customers. While the specialised banks have to bear the heavy cost of technology investment financing and their clientele are still not used to the concept of service charges, the undertaking has more immediate monetary benefits to the clients than to the banks. For example, the bank which invested in the technology may seem to benefit from savings derived from postage fees (which yet have to be weighted against other costs), but it is the clients who stand to benefit more from interest savings obtained from faster electronic transmittal capability. The adoption of information technology has a high probability of eliminating the age-old advantage, that was previously enjoyed by the banks, which involved using the float duration as an excuse in the manual mode to gain surplus interest earning on deposits ('delayed' payout to customers) lodged with the central bank or to ease the tight fund situation (Jinrongshibao 3/9/1995). In the previous manual mode of operation, when a bank's branch did not have enough funds to fulfil a customer's order for payment, the branch will deliberately use the excuse of fund float to delay payment. Information technology has the potential of eliminating this excuse and may even exacerbate a tight funds situation (Jinrongshibao 3/9/1995). Indeed, this was the critical situation in 1988 that led the government to initiate the development of a payment settlement support infrastructure. This deliberate behaviour still accounted for some billion yuan of float in the 1990s (Jinrongshibao 10/6/1994).

9.2D - e) People. The shortage of information technology staff has been a critical problem in the adoption of information technology within the banking industry (Jinrongshibao 27/3/1992, 18/3/1993 and 1/5/1995). In addition, the available information technology staff has limited skill to cope with the complexity of advanced

user applications systems (Jinrongshibao 6/9/1997) and this difficulty has resulted in many different system applications (Wang 1996a). There were IBM mainframe systems, open systems, traditional systems, fund ,savings and credit card systems, which were all developed individually and demanded all types of different application environments. Because of the prolonged usage life span of the equipment, changes to enable uniform systems will take a long time.

Information technology staff, who were knowledgeable in both technology application and in business organisation, remained scarce and difficult to recruit (Yang 1993, Jinrongshibao 7/4/1996 and Shan 1996). The knowledge of the information technology staff was largely confined to applications skill, rather than skill in debugging and resolving problems which arose in the applied systems (Jinrongshibao 18/3/1992). The lack of strong skill in this area was further aggravated by an unstable information technology support force. With the new labour reform policy in force, these banks faced tough competition in the labour market in attracting, as well as in retaining, a stable pool of the required talent and expertise (Mao 1994). For example, in 21 Industrial and Commercial Bank of China branches 230 core information technology support personnel left for higher salaries in the information technology industry within a very short period of time (Jinrongshibao 27/3/1992). The banks were extremely frustrated with losing their heavily sponsored employees to companies which could afford higher wages and benefits. Even in the Special Economic Zones, where staff resources were comparatively richer in quantity and quality than the other areas, and where the bank branches registered a higher computerisation rate, the problem of shortage of higher skilled information technology personnel constituted a crucial problem. The bank branches were found to have poor information technology support, maintenance and technology management standard (Jinrongshibao 18/3/1993). User participation has been exceedingly low and there is an invisible wall between information technology staff and users (Mao 1994).

In quantitative terms, the Chinese local banks had a substantially thin layer of technology support force. When compared to a market dominant player in the Singapore banking industry, United Overseas Bank, which has a ratio of 6% information technology staff to total staff, China's ratio was not even at the mark of 3% in the mid-1990s (Shan 1996). The author computed the ratio to be about 1.4% of

the total staff employed in the state-owned specialised banking system. In terms of the national average ratio of the number of information technology staff to number of computers, it was computed to be about 0.23 information technology staff per computer. In the geographical areas that were less well endowed with resources like the China Construction Bank's branch located in Guangxi, the ratio was about 0.15 information technology staff per computer and there were 0.086 information technology staff per computer operator (Wang 1996a). The situation with underutilised high-powered computers is especially significant at the lower level bank branches (Jinrongshibao 8/4/1997).

9.2E) Culture: A General Profile.

Among the organisation factors, the Chinese culture generally involved an established set of characteristics throughout the different periods. Despite the need for an intensive investigation of the influence of this factor on technology adoption, the constant nature of the Chinese culture is consistent with previous research study focus on this area that culture could remain similar for more than a decade (Kotter and Heskett 1992 and Roddy 1994).

Generally, two cultural traits were identified as having a significant impact on technology adoption within the Chinese state-owned banks: that is, adherence to higher authority's orders and a conservative attitude to information.

It has been generalised that the Chinese subordinates in the workplace were expected to be unquestioningly obedient and subservient in executing orders and instructions given by higher authority (Redding 1993 and Chow et al. 1995). There was little worker participation in managerial decision-making and there was an absence of individual initiative involving risk. It was not the position of the workers to question higher authority's orders and instructions issued. This cultural characteristic was reflected in the high level of tolerance accorded to orders that were found difficult to implement. This appeared to be so in the case of new technology adoption in the monobank during the pre-reform period. Although there was little trust in the technology introduced into the work process in the national accounting processing centre, this attitude did not materialise in the form of blatant resistance towards the

use of technology (Jinrongshibao 13/3/1989). The computerised tasks were executed in conjunction with the manual work processes, and this resulted in a higher amount of resources being expended on the duplicated work processes. From this perspective, the adoption of the new technology was accommodated as a burdensome factor instead of an alleviating factor improving work productivity. Interview respondents have indicated that there were no known cases of blatant resistance to the use of computer technology in the different planning phases, and subordinates tend to work with new technology despite their complaints about its effectiveness and reliability. However, there were many cases of tasks automated by computers being complemented by parallel manual work processes. This suggests that the traditional authoritarian and patriarchal Chinese culture has suppressed resistance towards new technology and created dual work processing. The Chinese have been reticent about resistance towards new technology applications in work process. However, Yang's (1992) article voiced the sentiment of resistance against the introduction of technology in the work process system of the local banking technology leader, the Industrial and Commercial Bank of China. He upheld the concept of parallel work processes, using the abacus⁸ and the computer, resulting in the duplication of workload. In addition, he advocated that the abacus should remain as the core instrument in the work process instead of the computer. There was great distrust for the intrusion of technology, but this distrust was derived from a poor knowledge base in information technology. Wu (1996a) has noted that staff in the banks tended to resist new ideas or applications that were unfamiliar to them. This also resulted in slow adaptation to new technology applications. Although the degree of resistance at the different levels of management is unknown, there were cases where higher authorities demonstrated their support for the adoption of new technology to set an example for subordinates to adapt to changes (Jinrongshibao 7/4/1996). However, interviews have found that the degree of support from higher management tended to be subjected to the availability of funds for investment.

⁸The culture of using the abacus was exceptionally strong in the Chinese economy. According to Yang (1992), this was associated with the traditional educational system in which individuals learned to use it as a mathematical tool and as a working tool since they were young and used it throughout their life.

A contrasting aspect of the culture which also has a negative impact on technology adoption is the strong by conservative attitude to information held by many Chinese people. Evidence of this is drawn from the frustrations experienced by information technology staff in their initial efforts to apply technology in the work process within other departments. According to Burn (1995), this trait had impeded the development of a strong information sharing culture that is relevant to the development of an information society. A weak information sharing culture inhibits the adoption of technology at an advance level to achieve an efficient flow of information. Chow et al. (1995, p. 44) attributed this to the cultural trait of '*large power distance and strong uncertainty avoidance ... means the preference for secrecy is relatively high*'. Some of the results from the interview suggest that this characteristic was linked to the past communist organisation structure that confines information flow within the department or unit (see Lieberthal's 1991 section on 'Flaws in Leninist Systems'). It has also been claimed that the past communist ideology and political upheavals have cemented this attitude in the Chinese people.

In sociological studies on the adoption and diffusion of innovations, cultural mores were considered an important factor in the process (refer Roger 1971 and 1983). Herbig and Palumbo (1994) have found that different cultures have different diffusion rates and different threshold values towards the same technology. It was pointed out earlier by Kedia and Bhagat (1988) that cultural influences matter significantly in the adoption and diffusion of innovation in developing countries, and warrant attention in the analysis. This thesis recognises that the Chinese culture indeed has a degree of influence on the technology adoption process within the Chinese state-owned banks. However, the full determination of the extent of this influence would require an extensive research undertaking, which would be tantamount to another thesis in pure sociology.

9.3 OVERALL REVIEW OF THE ROLE OF ORGANISATIONAL FACTORS

The characteristics of the key organisational factors and their influence on the information technology adoption process within the Chinese state-owned banks over the period considered is summarised below.

9.3A) Technology

- The initial adoption of technology within the Chinese banking system was led by the Soviet Union in 1957. Although the technology transferred by the Russians was outdated and the transfer process was short-lived, the technology remained a working tool for specific tasks in the work process throughout the pre-reform period.
- After the Sino-Soviet rift in 1959, the banks have always aimed for newly emerged and high-end technology in their independent decisions to adopt or replace technology. This was so even during the communist command period, when there were international restrictions imposed by COCOM on the export of high-end technology to China.
- In order to overcome the international restrictions imposed by COCOM during the pre-reform period, the country attempted to secure high-end technology from other disparate sources. China turned to France, Western Europe, Japan and other countries at different times to gain access to high-end technology. This resulted in the lack of a stable technological platform for the evolution of a consistent technology application paradigm. It was only during the reform period, when there was relaxation in the export restrictions, that China began to gain regular access to up to date high technology. The technology adopted by the state-owned banks was sourced primarily from the advanced countries, the USA being the most popular technology source. Thus, the banking system has no longer been constrained by externally imposed restrictions on its technology adoption process since 1985.
- During the pre-reform period and the early Sixth Five-Year Plan period, the lack of ready access to high technology has resulted in the usage life span of the computer equipment in the Chinese banking system being stretched to 10 years. Although there has been some improvement during the reform period (the Seventh Five-

Year-Plan period and the Eighth Five-Year-Plan period), the 6 to 8 years usage life span prevalent in these five-year-plan periods was still well beyond the international standard usage life span of 3 to 5 years. The prolonged usage life span of the technology has had an impact on the technology adoption process within the Chinese state-owned banks. The Chinese state-owned banks always adopt newly emerged technology in the market place (whether adopting it for the first time or replacing old technology). However, the older technologies were often inconsistent with the new technologies, and this inhibited the full exploitation of the potential of the latter for a considerable period of time. This accounted for the slow progression towards the integration of different organisational activities into an integrated business system.

- The depth of technology applications became more and more shallow over the different periods, as limited resources were thinly spread over the large, dispersed banking system.

Table 9.4 - Technology as an Organisation Factor in Information Technology

Adoption

Technology	Pre-reform period	Reform Period		
Period	1957 to 1978	1979 to 1985 (6th Five-Year-Plan Period)	1986 to 1990 (7th Five-Year-Plan Period)	1991 to 1995 (8th Five-Year-Plan Period)
1. Dominant Technology	Stand alone Accounting Control Machinery (ACM) was commonly used. Technologies adopted during this period were largely more backward than those adopted in the overseas countries.	Minicomputer was the common technology being adopted.	Mainframe and microcomputer were the popular technologies being adopted.	Microcomputer became the common technology in adoption.
2. Usage life span of the technology embodied equipment.	10 years	10 years	6 to 8 years	6 to 8 years. This usage life span is about twice longer than the international standard of 3 to 5 years.
3. Countries where adopted technology was mainly sourced.	<ul style="list-style-type: none"> 1957 to early 1960s: Soviet Union. Mid-1960s to 1978: France, Western European countries, Japan, etc. 	Japan	USA	USA
4. Disposition in technology adoption.	<ul style="list-style-type: none"> 1957 to early 1960s: Technology adoption led by the Soviet Union. 1966 to 1978: Political instability and external restriction affected the adoption of technology adoption. 	The Chinese state-owned banks experienced a more liberalised control on their import of high-end technology, than its communist counterparts. However, they were restricted in quantity for adoption.	COCOM lost its effectiveness since the mid-1980s. The state-owned banks were able to procure high-end technology without being subjected to external restriction.	The state-owned banks were able to procure high-end technology in terms of quantity and quality, without external restriction.
5. Depth of technology applications: average number of computers per computerised outlet.	Computers were adopted in the national processing centre and the overseas branch in London. Hence, the ratio is insignificant during this period.	Data is only available on the Industrial Commercial Bank of China in 1985, for which there were 4.5 computers in each outlet involved in technology adoption.	The national average ratio was 2.5 computers per computerised state-owned bank outlet.	The national average ratio was 2.2 computers per computerised state-owned bank outlet.

9.3B) Structure

- Although the control and use of information technology has shifted from an accounting department focus to organisation focus over time, there are still inhibiting structural attributes that prevent effective exploitation of information technology potential.
- The vertically segregated departmental relationship (a characteristic of the Chinese banks' organisation structure) among the functional units confined the sharing of information to a vertical and departmental based top-down or bottom-up flow pattern. This has accounted for the weak coordination between the information technology department and other functional departments, which has inhibited the effective adoption of technology within the organisation. The rate of change of this attribute to admit a more rapid rate of technology adoption is expected to be slow. The government has attempted to reduce such barriers through its policies, by making some areas of information divulgence mandatory.
- There has been the absence of a coherent structure for technology management within the different banking corporations, at both the organisational and corporate levels. This has led to a failure to achieve adoption of consistent technology standards or compatible technology, which has hindered the formation of electronic networks at the organisation, corporate, and national levels. In addition, there is no facilitating structure to develop the codification of business activity for information sharing and electronic network connections.

Table: 9.5 - Structure as an Organisation Factor in Information Technology Adoption

Structure	Pre-reform period	Reform Period		
Period	1957 to 1978	1979 to 1985 (6th Five-Year-Plan Period)	1986 to 1990 (7th Five-Year-Plan Period)	1991 to 1995 (8th Five-Year-Plan Period)
1. Information technology control in the organisation structure.	Accounting Department	Accounting Department	Computer Department	Computer Department
2. Information technology management structure.	Initially, this was centrally controlled by the Soviet Union. After the Sino-Soviet rift, there was no formal information technology management structure.	There was no formal system in managing information technology adoption.	There was no formal system in managing information technology adoption. This began to affect the integration of the various technology applied systems.	There is considerable awareness on the need to have an efficient information technology management structure that ensures the adoption of consistent and compatible technology and standards for connection among the different systems. Action in these areas has been slow.
3. Coordination between information technology department and other departments.	Because the application of technology was confined to the accounting department and the information technology staff were subordinated to the accounting department, there was coordination between these groups.	The coordination between these groups remained the same as the previous period, under the same chain of command structure.	The information technology task unit moved away from being a subordinated unit to the accounting department, to become an independent functional unit in the organisation. However, the vertical and segregated organisational relationship between departments made it difficult for the newly established unit to implement and monitor technology applications on business process.	The government policies of making certain information divulgence a mandatory task has diminished the reluctance of other departments in sharing information and cooperating with the information technology department. There were some forms of control, but generally there is still weak coordination between the information department and other functional departments in information technology applications.

9.3C) Strategy

- During the period when China was receiving assistance from the Soviet Union, the strategy of technology adoption and application was led by the latter country which played the role as the technology transferor.
- After the Sino-Soviet rift, information technology strategy was mainly driven by government policy. This occurred even during the reform period, when the banks were supposed to operate in an independent commercial capacity.
- The heavy application of information technology for transactional and informational purposes reflected the lack of strong alignment of information technology strategy with business strategy (that is, for strategic purposes). In this sense, the strategy of technology adoption was not aligned to the business strategy of an independent and self-funding commercial bank.
- During the reform period, the government withdrew its responsibility for providing non-obligatory funds to the state-owned banks for their technology investment and the banks had to seek and source the required investment fund in their own right. This created substantial difficulty for the banks' self-funding capacity, because the banks were burdened with past non-performing loans and a customer base that was not ready to pay for banking or computing services. There was limited opportunity for the banks to generate business revenue to meet its interest obligations to the pool of depositors (Wang 1994d). As a result, the motivation of the individual banks in the adoption of technology was largely dependent on the availability of internal fund. Management has also been inclined to support technology adoption when there is excess funds and a pressing necessity.
- Despite the shortage of available talents to develop information technology applications within the organisation, the banks have not been open to the concept of outsourcing, nor to cooperation with other banks to investigate technology application possibilities. This closed and self-dependent strategy requires substantial resources to cultivate the necessary talents for the technology adoption process and, inevitably, involves a longer technology application period.

Table: 9.6 - Strategy as an Organisation Factor in Information Technology Adoption

Strategy	Pre-reform period	Reform Period		
Period	1957 to 1978	1979 to 1985 (6th Five-Year-Plan Period)	1986 to 1990 (7th Five-Year-Plan Period)	1991 to 1995 (8th Five-Year-Plan Period)
1. Main direction of information technology adoption strategy	Between 1957 to early 1960s, the direction of the technology adoption strategy closely followed the technology transfer plan set up by the Soviet Union. After the Sino-Soviet rift, technology adoption strategy largely remained the same - continued to focus on the same activity in technology application.	The agenda to reform non-technological work process took priority over information technology adoption.	The two-tier banking system propelled the individual banks to adopt technology to facilitate their financial intermediary role. The undertaking of the government to establish a national information system (in which the banking sector constitutes one of the twelve participants) had little impact on the banks' internal adoption of technology.	The move of the government in initiating information technology projects specifically for the financial industry (example, the national payment infrastructure and the 'Golden Card' project) has been a strong driving force in the adoption of technology within the state-owned banks.
2. Purpose behind technology applications.	The application of technology on the specific reconciliation activity was for transactional purpose. Informational and strategic purposes were not necessary in the pre-determined and simplistic work system.	State-owned banks applied technology for transactional or informational purposes in the two-tier banking system to facilitate their financial intermediary roles.	Information technology continued to be applied largely for transactional and informational purposes.	There is limited application of technology for strategic purpose.
3. Investment funding for internal adoption of technology.	Investment funding for internal technology adoption was allocated from government budget. However, the funding was small because the banking sector was not a high priority economic unit.	The transformation of the state-owned banks role to an independent commercial capacity had changed the structure of government funding for technology adoption. However, the new structure of government funding did not exert repayment pressure on the state-owned banks because it was in the form of amortizable capital loan and government subsidy.	The government abolished the non-obligatory method of loan retirement by the state-owned banks. Government loans to banks for technology adoption required repayment in monetary terms. In addition, the loans made out to the banks were of limited amount. The banks faced substantial pressure in vying for government loans and grants from the Ministry of Finance, and also in generating internal funds for the technology investment.	The state-owned banks have to rely more and more on their internal funding and headquarters' funding for internal adoption of technology.

9.3D) Task/System

- The scope of information technology applications was limited and mainly involved in the document reconciliation process during the pre-reform period. This is because the work processes in the monobank system were simple, and technology applications had limited relevance to the pre-determined workflow system.
- When the banking system was transformed from a monobank system to the two-tier banking system, the emphasis was focused on the reform of the internal non-technological work system. When the tasks and activities became more complicated and also increased in volume, the state-owned banks began to apply technology to support their independent commercial role in financial intermediation. The initial area of technology adoption was, primarily, the front-counter savings system for the financial intermediary role and, secondarily, the information system for coordination and control of their bank branches.
- As the country moved towards a market economy, the opportunity for information technology adoption increase. However, information technology was applied to the existing working processes and was not enhanced by any business reengineering process approach. In addition, the development of new tasks and systems in the transitional market economy system rendered the task of technology applications difficult and complicated.
- As the other business areas of operation within the organisation, such as lending and foreign exchange activities, began to adopt technology for automation purposes, there emerged a great need to integrate the different business systems. The evolving nature of the tasks and systems impeded the transparent application of technology. There was the lack of integration among the different business systems within the organisation. The application of technology remained islands of automation.
- The need to integrate the saving and payment systems among the different banking branches, to enable a virtual corporate processing system in support of the banks' basic intermediary role, was met only in the major city areas. In addition, electronic linkages and connections tended to be confined within the individual banking corporation.

Table: 9.7 - Task/System as an Organisation Factor in Information Technology

Adoption

Task/System	Pre-reform period	Reform Period		
Period	1957 to 1978	1979 to 1985 (6th Five-Year-Plan Period)	1986 to 1990 (7th Five-Year-Plan Period)	1991 to 1995 (8th Five-Year-Plan Period)
1. Technology relevance in the organisation's value chain.	Technology has limited application in the simple value chain where the flow of activities was pre-determined.	The state-owned banks' newly assigned intermediary role, under the two-tier banking system, has propelled the banks to adopt technology for the front-counters and information systems.	As the banking business became complex and increased in volume, technology was also applied to other areas of activity which are beyond front-counters and information systems. However, the adoption of technology remained islands of automation.	The pre-existing computerised systems were unable to support an efficient payment settlement and clearing system.
2) Integration of the business systems.	Technology was applied on the core reconciliation activity which was based at a specific location. There was no demand for the integration of this activity with other business systems.	The need to integrate the activities within the savings system and the information system was met in branches located in the major cities. The feasibility in applying technology for activities integration was confined to intra-branch basis.	The application of technology for the integration of activities within the savings system, extends from intra-branch to intra-city basis. Branches located in the major cities were the likely outlets to link up their electronic savings system with one another.	During this period, there were bank branches which integrate their business activities with their affiliated branches, both located within the well developed province (inter-cities connection). Electronic linkages and connections tend to be confined within individual banking corporation.

9.3E) People

- China has long been reliant on outside sources to advance its indigenous technological capability. The termination of Soviet's technological assistance to China in the early 1960s forced China to seek alternative sources to train its local talent in technology capability. The common means employed was to incorporate training as a requirement in technology procurement agreements. This lacked consistency in the development of skills to a higher level, because of the specific nature of the technology procured, and hence of the training provided in each agreement.
- There has always been a shortage of human resource talents to support the implementation and adoption of information technology in the banking system. Although the pool of information technology talents have been increasing at a moderate rate, it has remained insufficient to support the existing technology adoption rate. The bank branches had to resort to sharing these scarce resources among themselves.
- In addition, the quality and quantity of information technology staff were such that it was not possible to ensure a consistently reliable electronic system for the work process. Besides the fact that a large portion of the information technology staff belonged to the intermediate skilled level, the high turnover of this scarce resource aggravated the inconsistent development of information technology applications. On one hand, this high turnover level frustrated the banks' effort in cultivating a stable pool of much needed skill. On the other hand, the unstable support services from the information technology staff instilled an attitude of distrust towards the adopted technology among the users.
- In turn, the attitude of the users also contributed to the weak coordination between their departments and the information technology department, and this impeded an efficient rate of technology adoption within the organisation.
- The base of support accorded by the management for information technology adoption revealed that there was limited understanding of the potential impact of technology application, in the absence of concrete measurement indicators.

Table: 9.8 - People as an Organisation Factor in Information Technology Adoption

People	Pre-reform period	Reform Period		
Period	1957 to 1978	1979 to 1985 (6th Five-Year-Plan Period)	1986 to 1990 (7th Five-Year-Plan Period)	1991 to 1995 (8th Five-Year-Plan Period)
1. Availability of information technology staff per computerised outlet.	Not available.	Not available.	Available data revealed that the ratio was 2.2 in the Industrial and Commercial Bank of China in 1987 and 0.6 in the Agricultural Bank of China between 1987 to 1990.	The national average number of technology staff per computerised outlet in the state-owned banking system was 0.5. Qualitative data noted a lack of information technology staff in these banks and such resource tends to be utilised on a sharing basis.
2. Skill of the information technology staff.	The banks were highly dependent on the overseas technology transferor to train their in-house information technology staff. The training constituted a requirement in the procurement agreement.	<ul style="list-style-type: none"> • There was an insignificant number of information technology staff at high skill level. • About 13% of the staff were at medium skill level. • Majority of the information technology staff were at intermediate skill level. 	<ul style="list-style-type: none"> • About 4% of the information technology staff were at high skill level. • About 29% of the information technology staff were at medium skill level. • About 67% of the information technology staff were at intermediate skill level. 	<ul style="list-style-type: none"> • About 6% of the information technology staff were at high skill level. • About 36% of the information technology staff were at medium skill level. • About 58% of the information technology staff were at intermediate skill level. <p>Majority of the information technology staff were at intermediate skill level.</p>
3. Management support.	Management support for technology adoption was given in line with the government policy and allocated funding for technology investment.	Management support for technology adoption was in line with the ability to obtain loans from the government and grants from the Ministry of Finance.	With the change in government funding for technology investment, management support for technology adoption is largely dependent on the availability of internal funds.	Management support for technology adoption is largely dependent on the availability of internal funds.

9.3F) Culture

- This factor had both a negative and a positive impact on the adoption of information technology within the Chinese state-owned banks.
- The strong trust dynamic in manager-subordinate relationship has been a largely positive factor in the adoption of information technology within the banks. The paternalistic nature of the direct working relationship has ruled out confrontation between the boss and his subordinates. This has suppressed resistance against changes and engendered tolerance to modernisation. On the other hand, the high level of tolerance often resulted in the wastage of resources, as the users executed dual work processing, because of their unwillingness to rely fully on the adopted technology.
- The common conservative attitude to information in China resulted in information being closely guarded within the department and extended with limited trust beyond the department. This made the initial effort of the information technology department to automatise work process exceedingly difficult.

Table: 9.9 - Culture as an Organisation Factor in Information Technology Adoption

Culture	Pre-reform period	Reform Period		
		←		→
Period	1957 to 1978	1979 to 1985 (6th Five-Year-Plan Period)	1986 to 1990 (7th Five-Year-Plan Period)	1991 to 1995 (8th Five-Year-Plan Period)
1. Work culture	Generally, there has been strong trust dynamic in manager-subordinate relationship, except during the cultural revolution which resulted in low trust dynamic among everybody.	Strong trust dynamic in manager-subordinate relationship.	Strong trust dynamic in manager-subordinate relationship.	Strong trust dynamic in manager-subordinate relationship.
2. Information sharing culture.	Information divulgence is highly contemptible in the communist command era.	The Chinese remained information conservative.	Information conservativeness persisted. Access to information is possible only through higher authority approval.	This cultural attribute is unhealthy to the establishment of an information organisation. The government has made certain information reporting a mandatory duty to overcome this barrier.

9.4 CONCLUSIONS: EXPLAINING THE PATTERN OF ADOPTION

The objective of this chapter is to provide an account of the role of internal organisational factors in explaining the conclusions reached in Chapters 6, 7 and 8 concerning the adoption of information technology in the Chinese state-owned specialised banks. These were that information technology adoption within the Chinese state-owned banks was much slower than planned, even though it was more rapid than in other state-owned sectors, and that adoption was concentrated in particular branches and areas, with a slow spread of information technology to other branches of the state-owned banks.

In providing this account of the role of internal organisational factors, it is recognised that internal and external factors impinging on the banks interact, and that it is not possible to confine the discussion strictly to internal factors. Individual factors, both internal and external, are also closely linked to one another. The main organisational

factors influencing the adoption outcomes in the major state-owned banks are summarised below.

9.4A) Reasons for Slower than Planned Information Technology Adoption

i) Lack of a Clear Business Structure and Strategy.

Information technology adoption in the case of the Chinese state-owned banks over the post 1979 has fallen between two potentially viable models - one in which adoption is directed, controlled and funded by the government, in pursuit of specific planning objectives, and another in which information technology adoption is driven by the identified commercial needs of the banks, and hence is shaped by these needs and is funded by bank's internal resources, or external funds raised, in anticipation of the resulting increased earnings.

In practice, information technology adoption was undertaken largely at government instigation, but as part of a process of movement towards the creation of full commercial banks. But adequate funding and infrastructure and technology support were not available from the government, as might have applied in a command model, nor were the internal strategy and resources consistent with the commercial model available. Most of the internal factors were linked to this fundamental uncertainty in business structure and strategy.

ii) Funding Constraints.

The transformation of the state-owned banks, from a wholly sponsored government entity under the command system to full commercial banks in support of the creation of a market economy, has resulted in the shift of internal investment funding responsibility from the government to the individual banks. The relinquishment of internal investment funding responsibility by the government to market forces may be considered premature, in that it inflicted considerable hardship on the state-owned banks in their adoption of technology for their improved operations. The state-owned banks faced difficulty in their capacity as commercial banks, in generating and sourcing the required funds to support their technology adoption process. Internally, they are new to the role of being self-funding and independent commercial banks

required to exploit market-oriented opportunities to boost their earning capacity. On the other hand, they are burdened by the unprofitable portfolio of lending to state-owned enterprises acquired both during the pre-reform period and also during the reform period. In addition, the rudimentary stage of market development in the Chinese economy provides limited opportunities for funds generation for the state-owned banks. The local customers are still not used to the practice or concept of paying fees for bank services. In addition, market facilities or institutions (for example, for leasing information technology equipment or for financing technology adoption), which might have alleviated the heavy investment financing responsibility of the state-owned banks, were either underdeveloped or non-existent. These factors have placed the state-owned banks in a heavily constrained funding situation.

iii) Technology Application Deficiencies.

After the mid-1980s, the banks were not constrained by political factors in the technology they could acquire. This allows a clearer reading of the indigenous capability of the state-owned banks in exploiting the acquired high-end technology. The nature of technology utilisation in the state-owned banks indicated a weak internal organisational capability in exploiting the adopted high-end technologies. The underutilisation of the capability of the equipment was due to the low skill level of the information technology staff and users, the lack of a total management approach to technology application, and the lack of clear business strategy and structure. Although the technologies acquired for initial adoption or for replacement purposes were normally the leading commercial innovations in the international marketplace, these technologies were mainly imported from overseas or procured from foreign manufacturers. Such procurement was comparatively more expensive than the local Chinese production, which output was seen as lacking quality (this also reflects the effect of a weak information technology industry on the technology adoption process). Together with the limited technology application capability, this has made technology adoption an inefficient and expensive process for the self-reliance banks. The strain of costly equipment on the tight financial position of the banks has resulted in the deliberate prolongation of the equipments' usage life span. In turn, this course of action produced a negative reaction on the technology adoption

progress. As a result of the different levels of technology in use, the inconsistent technology standards inhibited the effective application of electronic networks for business process integration. In addition, the prolonged usage life span of the technology equipment has also led to the intense need for maintenance support, which creates a further strain on the availability of scarce support resources within the organisation.

iv) Lack of a Total Management Approach.

Although the information technology (or computer) department was detached from the control of the accounting department, and became a functional department in the organisation structure about the Seventh Five-Year-Plan period, the shift in the recognition of information technology as an accounting resource to an organisation resource did not immediately result in the full exploitation of its potential. There was no proper management approach in organising information technology applications and in exploiting the full information technology potential. The inability to exercise a total management approach that fully assimilated and integrated all information functions and technologies into the entire corporate system, resulted in pockets of information technology application in different areas of the banks' activities. In addition, the change in the investment funding system, so that each branch had to finance its own technology investment programme, also diminished the past implicit centralisation in technology adoption among the branches within the banking system. On the national front, there was the lack of a national direction or coordinated effort in enforcing the adoption of coherent technology standards among the state-owned banks until the mid-1990s. This also resulted in the slow development of network connectability for a national electronic banking system⁹.

v) Failure to Adopt Business Process Re-engineering.

Business process re-engineering has been recognised as central to information technology applications in the advanced overseas countries. However, the Chinese state-owned banks have been unable to implement business process re-engineering in

⁹ Only 5% of banking technology applications were carried out according to the standards laid out by the People's Bank of China in the mid-1990s. (Zhang 1997).

its traditional business areas of activities (Mao 1994). The reasons behind this inability are several. Firstly, it is related to the lack of skilled information technology professionals. The majority of the information technology staff are at only intermediate skill level, and lacked the practical knowledge of the organisation's business process necessary to implement business process re-engineering for enhancing the technological potential of the applied technologies. Secondly, the new system of operations, as the banking system evolved towards a market-oriented system, imposed complex requirements on the information technology staff in the applications of information technology. The implementation of business process re-engineering and the exploitation of the technologies were hindered by the lack of a stabilised work process system and a flexible information technology infrastructure that enabled a sophisticated work process system.

vi) Failure to Adopt External Experience about Conditions of Technology Adoption.

The Chinese banks were not open to adopting external experience about the conditions and requirements of technology adoption. This was evident in their movement towards a flexible technology infrastructure only after lessons from their domestic applications, rather than on the basis of lessons from overseas experience. Generally, the Chinese banks are very conscious of the 'Chinese characteristics' in their own system and of the view that assimilation of technology has to be carefully conducted in order not to introduce shock waves into the evolving banking system. On the other hand, the shortage of relevant expertise has also hindered the ability to exploit and assimilate overseas experience.

vii) Skill Shortage.

Although information technology is recognised as an organisational resource in the formal organisation structure, the problem with the lack of skilled workers and expertise in the application and support of information technology has led to inefficient implementation and exploitation of the potential offered by information technology. This factor also accounts for the inability to enforce a coherent adoption effort among the branches. While the banks are having problems retaining a stable

pool of required talent, the nature of their traditional inhouse development approach has restricted their willingness to seek outsourcing. Outsourcing is a potential channel for not only assuring more consistent support, but also for the Chinese banks to gain knowledge transfer.

The creation of a sufficient pool of information technology talents by the government through the education system, to meet market demand, will take at least a decade. The support from the information technology industry is also weak, as highlighted in Chapter 3 of this thesis. The shortage of information technology expertise has forced most of the branches to share skilled resources, which often involves delays in the response to any technical outage problem and results in a delayed maintenance schedule. The 'stretched' availability of resources affects the reliable functioning of information technology and instills a low level of trust towards the new technology in the inexperienced users. Although the cultural characteristic of complying with higher authority's issued instructions has interestingly 'forced' acceptance and learning about technology to take place in the organisation, the banks face an urgent need for experts and experienced users that are capable of effective exploitation of the applied technologies. These mean that the state-owned banks have to take a major responsibility for training information technology staff and users - another weight on the banks' tight financial resources.

9.4B Reasons for Adoption in the Banks being Ahead of Other State-Owned Enterprises.

Despite the fact that technology adoption within the state-owned banks has been lagging behind plan, the pace of technology adoption has been ahead of that in other state-owned enterprises. The major underlying factor accounting for the relatively more rapid adoption movement in the state-owned banks has been the government's influence. This influence is exercised through the reform agenda and through the specific projects directed at establishing the information technology infrastructure for the banking system. The state-owned banks have been identified as the core supporting economic units for the economy's development and also as a perfect beachhead for technology adoption and diffusion within the financial system and

within the economy. Hence, the government has been focusing on the state-owned banks as the base for constructing and developing the banking network infrastructure. From this perspective, the push towards modern infrastructure has generated considerable impetus in the state-owned banks' adoption of technology and has propelled a relatively rapid rate of technology adoption. From another perspective, the state-owned banks, being banks owned by the state, have to respond to the government's effort to promulgate the Golden Card Project and the electronic national payment system. The projects have made the state-owned banks' adoption of technology a pre-requisite to the realisation of pervasive credit card use within the economy and to the creation of a well-connected electronic national payment system and, ultimately, a national financial network. The implementation of the above mentioned projects has progressively brought about a stronger profile of technology adoption in the Five-Year-Plan working agenda of the state-owned banks.

CHAPTER 10 : THE DIFFUSION ROLE OF THE CHINESE STATE-OWNED BANKS IN CONSUMER SERVICE TECHNOLOGIES.

In the discussion of information technology diffusion in this thesis, the ATM (Automatic Teller Machine) and POS (Point-of-Sale) payment technologies are focused on because their diffusion has been considered important in China, for example in helping to maintain monetary control within the economy. These technologies were the earliest form of banking information technologies implemented for customer use. The specialised state-owned banks in China were the main force driving the adoption of these customer service technologies. It was also evident that, in the context of the Golden Card Project, that these banks were expected by the government to play a heavy role in diffusing these technologies to their customers.

This chapter aims to investigate the ability of the Chinese state-owned banks to play a major role in technology diffusion to the consumer sector. The consumer sector is the choice of focus because it constitutes the primary objective of the Golden Card Project - one of the key projects to maintaining monetary control within the economy (refer to Chapter 7).

The ATM card and the POS card constitute key mechanism for using the ATM and POS technologies. In China, credit card issuance has been subjected to tight control and distribution, and majority of the card issued by the banks are ATM card and POS card. Thus, these two cards are largely referred as 'bankcard' in China. This term is applied differently by developed countries where 'bankcard' is treated as synonymous with credit card. The ATM card is a mean of access to conducting banking transactions at the ATM. The transactions conducted at the ATM were normally deposit withdrawal, saving and enquiry transactions that could be conducted over the bank counter. POS card, on the other hand, is a mean of access to conducting electronic payment for goods and services between the seller and buyer (who is also the POS cardholder). The degree of use of the ATM and POS technologies by the

customers and their acceptance by the agents is an indicator of the level of technology diffusion. Varied factors, both internal and external to the banks, shaped the diffusion role of the banks in these externally applied technologies. Hence, these factors must be examined to determine the magnitude of their influence on the diffusion role of the Chinese state-owned banks.

Organisational factors, infrastructure support and policies adequacy are among the factors which have played a part in determining the diffusion role of the banks in these technologies. The organisational factors, which were extensively examined in Chapter 9 for their impact on the state-owned banks' technology adoption process, are reviewed in this chapter for their impact on these banks' diffusion role in ATM and POS technologies. The impact of infrastructure and policies on the diffusion role of the state-owned banks is assessed in this chapter. As has been pointed out in Chapter 9, these factors (external to the banking organisation) also have an impact on the adoption of technology for internal applications by the different banks. Besides the above mentioned factors, it is also of relevance to contrast the position and interests of the parties involved in using the customer service technologies. These parties are the agent (in the case of POS technology), being the payee and acceptor of the payment mode, and the cardholders, being the prime users of the payment facilities. They have a major role in accepting the new facilities. Comparatively, the cardholders (corporate and personal) constitute the key force in the success of the external applications of the payment technologies, since they have a direct role in using or initiating the use of the facilities.

10.1 BANK CARD AND ITS TECHNOLOGIES IN THE PEOPLE'S REPUBLIC OF CHINA

In comparison to the available data on the countries in the Table 10.1, the time interval involved in the introduction of the ATM and POS was a one-year difference in the case of China, which is faster than the earlier adopters such as Japan, the UK and the USA. China is considered a late adopter of these technologies, as compared

to Japan, the UK and the USA, and the country is relatively new to the function of payment card and the supporting technology.

Table 10.1 - Adoption of Payment System and Its Mechanism in Different Countries.

Country	Year when the following was introduced:				Inter-bank Funds Transfer System	
	Bank Credit Card	ATM	POS	Home-banking	Name of the system (some in abbreviation)	Year of Launch
People's Republic of China	1986	1986	1987	1992	• CNAPS	• 1992
Australia	1970s	1981	1987	1985 ¹	• BITS	• 1987
Japan	1960	1969	1984	1979	• BOJ-NET • FEYSS • Zengin System	• 1988 • 1989 • 1987
UK	■	1967	1989 ²	1988	• CHAPS • Town Clearing	• 1984 • 1946
USA	1951	1969	1984	■	• Fedwire • CHIPS	• 1982 • 1970

Source: Various

Note: 1. Telecom's Viatel public videotex network.

2. National EFTPOS.

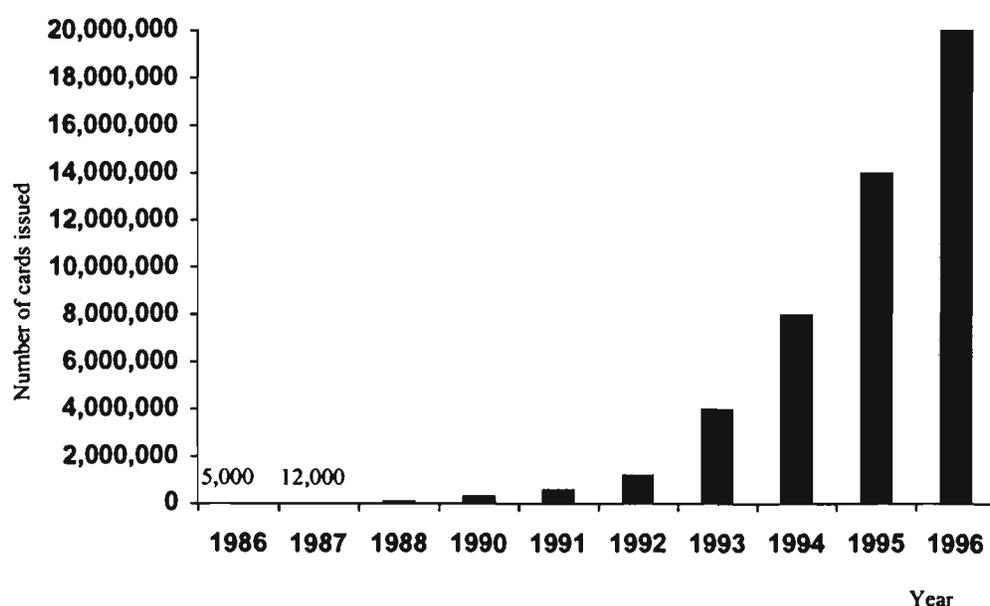
■ Information not available.

In 1979 the Bank of China became the first agent in the country to handle overseas issued credit cards. This role has exposed the bank to experience in and to the value of the credit card business, and led to the initiative to issue a domestic bank card in 1985. The Bank of China Pearl Delta branch issued the first bank card in the nation in that year. It was a 'local card' which was only useable within the Pearl Delta region. In 1986, a nationwide bank card, known as the Great Wall Card, was introduced by the Bank of China branch in Beijing for domestic usage in local currency. After the bank joined the Master International and Visa International as a member of the respective organisations in 1987, it issued the first international Great Wall Card. From 1989 onwards, the other state-owned specialised banks became members of these organisation and began to issue similar bank cards.

Figure 10.1 shows the accumulated number of bank cards on issue since 1986. By 1996, there were nearly 20 million cards on issue in China.

Figure 10.1

Accumulated Number of Bank Card on Issue



The Golden Card Project promulgated aggressively by the government in 1993 has actually added great impetus to the issuance of bank cards by the banks. The above graph shows a significant increase in card issuance from 1993 onwards. The aim of the Golden Card Project is to issue 200 million cards in more than 400 cities and prospering county-cities, which have a total population of 300 million dwellers, within a 10-year time span from 1994 to 2003. This is part of the government's plan to encourage the spread of bank card usage to displace cash usage. The government has been concerned over the high level of cash usage in the Chinese economy as discussed in Chapter 7. It was found in a survey that the use of bank cards for sales transaction payment in many of the departmental stores in China, which were contracted agent for bank cards, accounted for less than 1% of the total number of sales transactions in mid-1990s. This is very different from the 70% rate in the USA and Japan, and 40% rate in the developing Malaysian economy (Zhang 1995c and Wu 1996). In terms of the cardholding density in the Chinese economy, there were 297 persons per card in 1993 (Jiang 1995). This card penetration rate, however, reflects a vast contrast to the overseas experience where every person in the USA holds 5 cards, there are 1.5 cards per person in Japan, 4 to 5 cards per person in Singapore, and 1

cardholder to every 4 persons in Hong Kong (Jinrongshibao 14/10/1996 and 1/12/1996). Even Guangzhou, which is a prime contributor to the Guangdong province and to the Chinese economy, registered a ratio of one cardholder to every 23 persons in mid-1995 (Chen 1995a). When the Golden Card Project's target is taken into account, even if the 10-year objective is achieved in 2003 there would still be a lower card density rate in China, with one cardholder to every 6 persons in China. It is also to be expected that the major cities would register a higher card density ratio than the national average.

At the initial stage of the Golden Card Project, bank cards were largely issued to employees of the state-owned enterprises for automatic crediting of their wages and salaries into their bank accounts. The majority of these bank cards issued by the Chinese banks were mainly savings (ATM) cards and debit cards, rather than of credit card. Business China (1997) reported that the number of actual credit cards that were issued in the domestic economy did not exceed 5,000 in 1996. Their issuance have been subjected to tight control and distribution. This is because the Chinese government does not want to lose control over credit creation within the economy.

The savings (ATM) cards entitle the cardholder to conduct withdrawal and deposit transactions at authorised ATM locations. Debit cards incorporate the withdrawal and deposit features of the savings card. But they have an additional attribute of being a payment card that allows the cardholders to close transactions through their escrow accounts, which have a pre-existing credit balance to cover a certain value of total transactions. The transactions will not be aggregated like the credit card on an accrual basis but are supposed to be debited directly on an 'on-line'¹ basis at the cardholder's bank account, as soon as authorisation is given by the cardholder for each transaction. The extension of the debit card is the combination card which allows credit aggregation to a limited value, exceeding the deposit amount in the escrow account (Zhang 1995e), but the latter card is subjected to tight restrictions in issuance. The majority of the issued cards are magnetic strip products, which are sensitive to the type of technology supporting the payment system (Jinrongshibao 15/4/1997). Thus, a comprehensive and integrated information technology support

¹ 'On-line' means the equipment that reads the magnetic-strip card is directly linked to the processing bank or clearinghouse computer.

system (computer, telecommunication networks, electronic financial instruments and equipments) is of critical importance for a flexible, convenient, fast and secure on-line payment system.

The rate of card usage varies in different cities and regions. More developed areas tend to register higher rate of card usage. In Jiangsu, the 1994 statistics revealed that a card was used once every ten days (interview source). In Hengyang city (Hunan province) where a total of 25,000 cards was issued, statistics revealed that each card had an average usage rate of 0.5 times in 1994 (Zeng 1995). On average, the use of bank card by the cardholders, especially personal cardholders, was relatively low. Besides the infrequent usage of the bank card by the cardholders, about 30% to 40% of the ATM and debit cards issued were dormant and not used by the cardholders (Jiang 1995).

Despite the low usage of bank cards, the transaction value per bank card is high, as shown in Table 10.2.

Table 10.2 - Average Transaction Value Per Bank Card

Bank	Average Transaction Value per Bank Card
State-owned Specialised Banks	61,111 yuan (1994) 64,286 yuan (1995) 69,000 yuan (1996)
Industrial & Commercial Bank of China	146,300 yuan (1993) 43,857 yuan (mid-1996)
Agricultural Bank of China	40,000 yuan (1994) 72,321 yuan (1995)
Construction Bank of China	25,000 yuan (1993) 30,000 yuan (1994) 34,978 yuan (1995)
Bank of China	85,714 yuan (mid-1996)

Source: Jinrongshibao, and Computer and Credit Card.

The transaction value per bank card are considered high by international standards. This reflects the fact that the average value was boosted by enterprise business

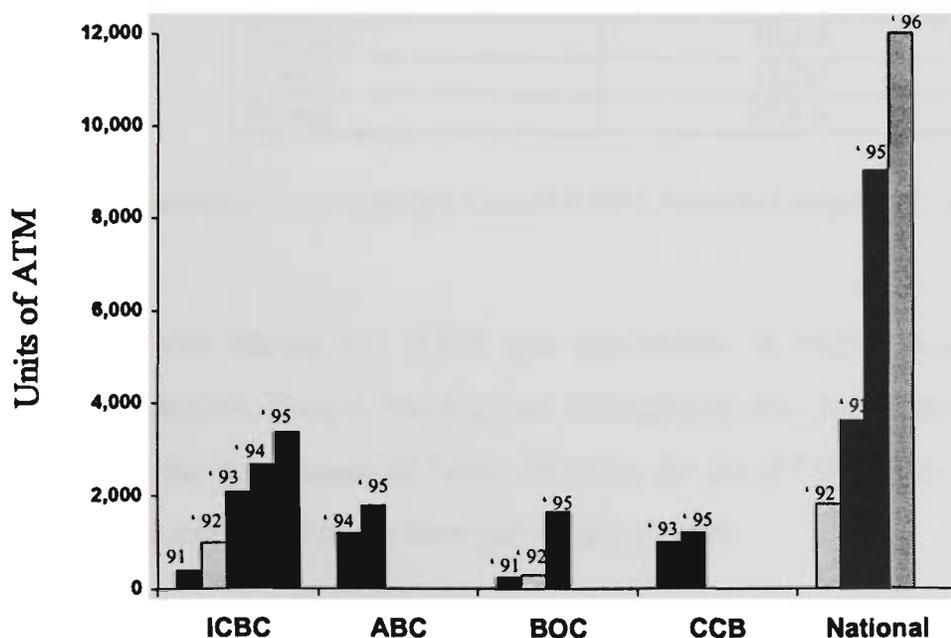
transactions (corporate cardholders) through bank card settlement. It has become a requirement for the state-owned enterprises to conduct high-value business transaction via a bank payment instrument (which includes bank cards) instead of by cash. Bank cards used for retail consumption (by personal cardholders) registered a much smaller transaction value per card. In the Agricultural Bank of China's card transaction business, for example, the ratio of the value of average business transactions to the average of retail consumption transactions was 125: 1. Retail consumption spending per card averaged 1,600 yuan per card whereas business transaction value per card averaged 200,000 yuan (Jinrongshibao 30/4/1996). The Industrial and Commercial Bank of China had also reported that the average value of consumption transactions per card was 1,293 yuan in the major cities in 1992 (Jinrongshibao 18/2/1993).

10.2 ATM: ACCESSIBILITY & USAGE

Figure 10.2 below shows that the state-owned specialised banks have been the main financial units involved in adopting and installing ATM units during the 1990s. In 1995, the total number of ATM installed by these state-owned banks constituted about 90% of all the ATM installed within the overall national financial system.

Figure 10.2

Number of ATM Installed by the Major State-Owned Banks and the National Financial System.



Although the number of ATM units installed in the nation has been on the increase, the rate of accessibility for trial and usage is still low. The number of inhabitants per ATM in China is about 40 times higher than in the overseas developed countries, as reflected in Table 10.3 below. The increase in accessibility of ATM units for the population means imposing heavy financial undertakings on the banks. It is also made more difficult by the inadequate telecommunications coverage (especially in the less developed inner regions), which restricts the feasibility of sharing and networking ATM facilities among the banks. Most of the ATM facilities in China are operating on a nonsharing basis.

Table 10.3 - Number of Inhabitants Per ATM in China

Country	Inhabitants per ATM
Period: End 1992	
France	3,281
UK	3,162
Sweden	3,936
Australia	3,229
Germany	4,263
USA	2,926
Japan	1,150
Period: End 1995	
People's Republic of China	133,333 ²
Jiangsu's Wujian	127,279
Jiangsu's Suzhou	142,305
Jiangsu's Nanjing	47,465
Guangdong's Guangzhou	4,583
Shanghai	10,206
Tianjin	68,283
Beijing	25,476

Source: Australia Payments System Council (1994), Financial Computer of China 1996 (1-3).

Table 10.3 also shows that ATM unit availability is higher in major cities, like Nanjing, Shanghai, Tianjin, Beijing and Guangzhou, than in the country as a whole. The reasons for this pattern of faster diffusion for the ATM technology in the major city areas are examined in the later part of the chapter.

² Calculated on the availability basis of 9,000 ATM units (Jinrongshibao 1/8/1995) for its population.

The withdrawal transaction time in China was estimated to be 40 to 60 seconds (Sung 1995 and Jinrongshibao 23/12/1996), which was a little slower than the average standard time of 30 seconds in the developed countries (Bank Marketing 1996).

The overall level of card usage by ATM is low. Even in major cities where the ATMs are linked to a clearing network, the average rate of card transactions per ATM was about 540 per month in 1997 (Jinrongshibao 31/10/1997). In Guangdong where one-fifth of the nation's bank cards were issued in this province and where card usage is relatively more active than other regions, the 1994 scenario reflects an underutilised usage situation for the savings or ATM cards in its major cities (Table 10.4).

Table 10.4 - Automated Teller Machines in the Major Cities of Guangdong

Locality	Industrial << Commercial Bank of China>>			<<<<<Bank of China>>>>>			<<<Agricultural Bank of China>>>			<<Construction Bank of China>>		
	Total no. of ATM	No. of ATM Cards Issued	Daily average no. of transaction per ATM	Total no. of ATM	No. of ATM Cards Issued	Daily average no. of transaction per ATM	Total no. of ATM	No. of ATM Cards Issued	Daily average no. of transaction per ATM	Total no. of ATM	No. of ATM Cards Issued	Daily average no. of transaction per ATM
Guangzhou	121	35,000	100	27	300,000	150	38	138,000	100	36	15,000	100
Shenzhen	130	26,000	100	56	200,000	300				15		
Zhuhai	18	8,000	300							14	2,000	
Huizhou	5	1,500	50	16	60,000	80				10		40
Dongguang	4	11,700	30	12	80,000	40	5	200		30	2,500	100
Zhongshan	50	30,000	100	47	130,000	70		10,000	200	10	2,000	40
Fushan	34	10,000	125	54	180,000	100	48	17,000	30	30	2,000	40
Qingyuan	5			2	2,000	50				6		40
Jiangmen	26	20,000	100	32	100,000	50				10	4,000	40
Shantou				18	150,000	50				8		40
Zhanjiang				11	140,000	80				6		40
Shaoguang				11	50,000	30				1		40
Maoming				10	40,000	60				3		40
Nanhai							10	2,800	10			
Shunde							18	5,800	110			
Qiqing										3		40
Meizhou										2		40
Heyuan										2		40
Sub-Total	391	141,200	113	294	1,432,000	88	119	173,800	90	186	27,500	49
Grand-Total	990	1,774,300	85									

■ Data Not Available

Report commissioned by a major bank. Source: Confidential.

The average monthly number of transactions for each ATM in the major cities of Guangdong was about 2,550 per month, and this is below the overseas usage levels. In the USA, the average monthly number of transaction per ATM machine in 1994 was 6,800 per month (Mitchell 1994), Europe was 3,500 and Finland was 5,000 (Tuo 1996). Guangdong's rate of card usage on the ATM is not even as high as the average 1980s level of usage in the USA. Volume is a vital criterion in the justification of operating ATM on a cost-efficient basis, because of the derivation of

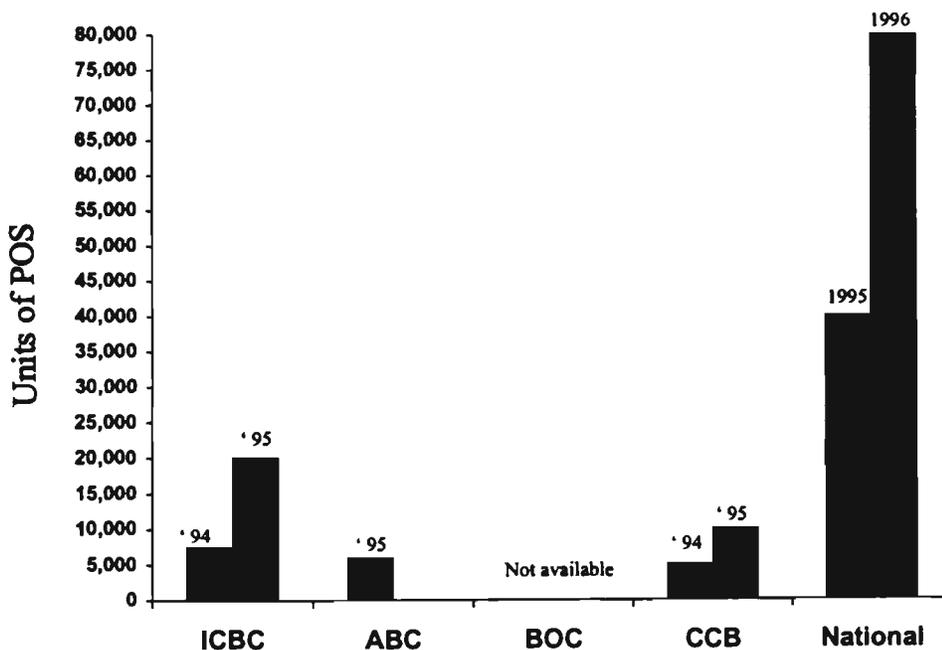
scale economy benefits. To achieve a marginal level of operation, there must be at least 4,000 card transactions per ATM per month. It was estimated that such volumes would then provide a payback period of 3 to 4 years on the investment cost of the ATM³ in China (Gao 1995). There is the need to encourage card usage among dormant cardholders to achieve higher transaction volume for the machines.

10.3 POS SYSTEM: ACCESSIBILITY & USAGE.

The state-owned banks have remained the major adopter of this technology in the national financial system, as is evident from Figure 10.3. The POS system installed by the Industrial Commercial Bank of China, the Agricultural Bank of China and the China Construction Bank together accounted for about 80% of the total POS system installed within the overall national financial system.

Figure 10.3

Number of POS Installed by the Major State-Owned Banks and the National Financial System.



³ Depending on the features of the ATM, the cost could range between 76,000 yuan to 300,000 yuan (Interview Source and Zhang 1995a).

Although the trend in the graph above registered a sharp increase in the installation of the POS system between 1995 to 1996, there has been a high level of resistance to the use of the debit card as a payment instrument, by both the cardholder and the agent. The parties to the transaction do not have confidence in this new form of payment, because the payment system lacks credibility and also because they have limited knowledge of the use of the card facilities. There were 180,000 contracted agents (merchants) and 120,000 financial units that were contracted or appointed to 'accept' POS cards in the nation in 1995 (Jinrongshibao 21/12/1995 and Xie et al. 1996). However, only 10% of these agents and financial outlets installed POS technology in their premises. Among the agents, the POS technology penetrated only 1.6% of the retail and wholesale outlets (excluding individual and private outlets which tend to be smaller in business size) and hotels in China. Substantial efforts were required for cultivating a higher level of acceptance by the agents, as their intermediary position in the payment system could either stifle or realise the consumers' desire to trial and use the technology. The actual utilisation level of the installed POS technology is actually lower than the figures above suggest, as it is known that there are agents who have refused to honour payment by card with various excuses (Zhu 1995, Wang 1995a, Jinrongshibao 29/1/1996 and 24/8/1996). In another survey, it was revealed that out of 100,000 contracted agents, about 15% refused to accept card as a payment instrument despite their contractual obligation (Sun and Wang 1997).

The Chinese population has a lower accessibility and exposure to the POS system than is common in large overseas countries, as shown in Table 10.5.

Table 10.5 - Number of Inhabitants Per POS Terminal in China

Country	Inhabitants per POS terminal
Period: End 1992	
France	179
UK	263
Sweden	607
Australia	610
Germany	1,564
USA	2,221
Japan	3,794
Period: End 1995	
People's Republic of China	40,000 ⁴
Guangxi's Nanling	3,066
Guangxi's Guilin	5,687
Guangxi's Luizhou	7,294
Guangxi's Beihai	5,474
Guangxi's Wuzhou	15,732
Guangxi's Qinzhou	62,025
Jiangsu Province	34,200
Jiangsu's Wujian	4,941
Jiangsu's Suzhou	7,701
Jiangsu's Nanjing	39,555
Guangdong's Guangzhou	3,134
Shanghai	3,433
Tianjin	5,182
Beijing	3,591
Sichuan's Chengdu	4,708

Source: Australia Payments System Council (1994), Financial Computer of China 1996 (1-3).

Thus, the number of inhabitants per POS terminal in China, on a national basis, ranges from being 10 to being over 200 times higher than the situation in individual overseas countries. When individual cities in the country are taken into account, the availability of the POS technology to the Chinese inhabitants in the major cities is relatively high. On an overall basis, the higher number of transaction per POS terminal in China (as portrayed in Table 10.6) was the result of a higher number of inhabitants per POS terminal. Between the two forms of technology, the level of transaction volume per POS is higher than per ATM due to the use of POS by the state-owned business enterprises. The low usage of bank cards for retail consumption (via POS technology) was confirmed by Shen and Lin (1997), who found this rate to

⁴Calculated on the availability basis of 30,000 POS units (Jinrongshibao 21/12/1995) for its population. It was targeted to achieve 500 inhabitants per POS terminal by the year 2000 (Jinrongshibao 10/11/1997).

be 6.6% of the aggregate value of transactions conducted through bank cards, while 93.4% of the value was conducted for the purpose of deposit, withdrawal and funds transfer. Although data on the average daily number of transactions per POS terminal in overseas countries are not readily available, the overall POS terminal usage rate in China is comparable to the situation in Australia in 1993/1994. However, this situation needs to be interpreted in the light of the use of the POS system by the state-owned enterprises in the Chinese economy. The rationale is examined in the further section of this chapter.

Table 10.6 - The Volume of POS Transaction in China and Other Countries

Market	Average Daily Number of Transactions per POS Terminal	Average Daily Amount of Payment per POS Terminal
USA (1986) :	4.56	
Australia (1993/1994) :	15.84	
China (1997)	8.4	
Jiangsu Province (1994):	20.9	26,865.67 yuan
Wujian	1.69	835.40 yuan
Suzhou	0.63	1,016.47 yuan
Guangxi Province (1995)	12.94	792.79 yuan
Nanling	20.3	42.33 yuan
Guilin	3.50	47.61 yuan
Luizhou	8.50	12.74 yuan
Beihai	40.00	2,130.95 yuan
Wuzhou	3.20	78.95 yuan
Qinzhou	3.00	267.50 yuan
Yulin	2.00	12.25 yuan
Fangchenggang	23.00	3,750.00 yuan

Source: Felgan and Ferguson (1986), Interview Source, Lu (1995), and Jinrongshibao 31/10/1997.

10.4 CONCLUSION: PATTERNS OF DIFFUSION OF CONSUMER SERVICE TECHNOLOGIES

The state-owned specialised banks have been the main providers and suppliers of the ATM and POS technologies and the major issuer of bank cards to their customers for access to these technologies. Within the national financial system, these state-owned banks have been playing an increasing role as the initiator of, and as the channel for, the diffusion of the ATM and POS technologies. Although the respective indicators measuring the national average number of inhabitants per ATM and POS reflected a low level of accessibility to the technologies for the population in China, some of the major Chinese cities registered an access rate that is comparable to some of the developed countries. However, the general profile of the diffusion of ATM and POS technologies from the banking sector to the users revealed a relatively limited and superficial national pattern. Given the number of units provided and the number of bank cards issued by the banks (the supply side), the rate of acceptance and support from the cardholders and agents has been relatively weak (the demand side). Technologies must be accepted and used before diffusion is considered to have occurred. Hence, this review shows that the state-owned banks have not been able to exercise fully their role in the diffusion of the ATM and POS technologies to the consumer sector. The factors influencing the general pattern of diffusion are examined in the following section, to determine the nature of their influence on the general pattern of diffusion. In particular, their influence in accounting for a higher technology diffusion level in the major city areas is highlighted in the section. Although the examination of the factors is based on the consumer sector, the position of the state-owned enterprises in the use of the POS technology is also highlighted, to determine the magnitude of the influence of such factors on the capability of the banks in their diffusion role.

10.5 FACTORS INFLUENCING THE DIFFUSION OF TECHNOLOGY TO THE CONSUMER SECTOR

10.5A) Internal Banking Organisation

i) **Resources.** Internally, the banks lacked resources, resource management experience, coordinating skill and talent in developing this new area of business. The issues identified by the analysis in Chapter 9 of their internal organisational difficulties are inevitably reflected in the structure of technology adoption for service delivery to the customers. As mentioned before, the dominant market players' priorities in computer and information technology adoption mainly focused on front counter applications, largely for transactional purposes and, secondly, for informational purposes. The strategic use of technology for new service delivery to customer was still rudimentary. The banks' technological capability and resources were strained to support the adoption of technologies for external service support to customers. This is especially significant in the POS system, which has a higher rate of installation than the ATM and which involves more intermediary processing points. The internal processing of card settlement for POS services by the bank involved too many manual processing points (Hou 1995 and Feng 1996a). The existence of incompatible technology within the internal organisation resulted in the inability of the banks to realise a virtual electronic network for a fully automated POS system. This was also aggravated by the shortage of experienced staff in the bank card department to conduct verification activities, particularly during non-working hours and public holidays, rendering the system ineffective (Ma 1996b).

In addition, there has been no proper management system for installed POS systems at the agent's outlets, and this led to some of the installed POS systems being deliberately unused for a long time. Generally, there has also been a shortage of expertise available to repair the POS equipments, as well as the ATM, and this led to operational outages for considerable periods of time, sometimes 1 to 2 days or even 7 to 8 days (Zhang 1995c). The number of ATM and POS units awaiting maintenance and repairs averaged between 10% to 15% during the mid-1990s. The equipment's prolonged usage life span⁵ has made most of the installed technology systems

⁵The normal 5 year life span of the POS unit was normally stretched to 7 and 8 years (interview source).

incompatible with the newer systems, which created much inconvenience for software adjustment and for repair and maintenance.

The majority of this equipment was imported, because the domestic information technology industry was not capable of producing these hi-tech products. These imported products were expensive, which imposed further on the tight financial position of the banks (Cai 1995). In addition, the weak internal resources and limited local industry support made it difficult to adjust the imported technology to suit local conditions and usage, and this led to a frequent need to repair and maintain the units (Zou 1996). For example, an unsuitable environment in the location of the ATM has rendered the equipment to break down faster and more often. Not all shopping complexes in China have air-conditioning facilities, and the temperature at some locations may fall outside the required range of 5°C to 35°C.

The frequent need to repair and maintain the machines imposed further constraints on the availability of expertise to support further technology adoption by the bank. At times, the procurement of spare parts for replacement involved a considerable time lag because the required parts had to be delivered from the overseas manufacturing plant (Li and Xing 1995). The low domestic capability in modifying the imported ATM for local use has also contribute to its low usage level. In some places, for example, the instructional language of the imported machines tend to be the language of the country where production of the machines occurred, frequently the English language. The Chinese users tend to have little knowledge of English, and this led to low confidence in the use of the technology by the user.

The organisational resource constraints were even more significant in the lower level bank branches located in the city outskirts or in non-urban areas. Generally, the lower level bank branches' were often given second priority relative to the higher level bank branches in accessing limited resources.

ii) Policy. Prior to the implementation of the national bank card legislation on 1st April 1996, the policy of individual banks had been the main governing force in bank card management (Jinrongshibao 31/3/1997). The different policies established by the different banks created an incoherent card usage environment, and led to an array of different developments in the bank card business. The unfamiliarity of the parties

towards the bank card system and the absence of a relevant regulatory structure at the national level have created an uncertain environment for personal cardholders, and have also led to the failure of the parties to abide by the policies set by the banks. The inadequate legislative structure did not afford sufficient protection to the individual cardholders and agents in the event of fraud and, thus, discouraged them from using or accepting cards as a reliable payment instrument. Neither was the behaviour of the business enterprise adequately regulated and controlled. The enterprises tended to treat debit or combination cards as a form of 'unaccounted' credit instrument (Xie et al. 1996). The business enterprises favoured the bank card because of the loose control of the banks, which allowed the enterprises to overdraw to a level that far exceeded the deposit amount in the escrow account or credit limit; allowed a repayment time span that was much longer than the one stipulated in the banks' policies and which allowed withdrawal of large amounts of cash from the escrow account (Zhu 1995 and Yang 1996c). The loose control was the result of the bank employees' unfamiliarity with the administration of the bank card business.

These practices violated the intended procedure for debit card payment settlement, which required the enterprise to transfer funds from its basic bank account into the debit card or escrow account as a deposit for the impending settlement transaction. No withdrawal or deposit of cash was to be allowed from or into the escrow account. Payment settlement activated through the bank card was to involve the transfer of the funds from the escrow account to the payee's account. The desired aim was to monitor the movement of funds for macro-management of the economy. The failure of the bank staff and enterprises to abide by the varying bank policies (Zhu 1995) resulted in the accrual of credit that exceeded the stipulated credit limit (Jinrongshibao 18/8/1997). Available data on such incidents indicates that the average overspending tended to be at least 5% of the deposit amount in the escrow account.

Some enterprises used the debit card account as an alternate bank account (to the basic account), to overcome the legislation that required enterprises to keep only one basic bank account for all its fund flow. The escrow account was also used as an alternate account to evade detection of the ability to repay loans by the loan department (Jinrongshibao 2/9/1996). The bank staff treated credit extension through cards as unrelated to their affiliated loan department's business (Jinrongshibao 31/3/1997).

This had repercussion on the Chinese government's attempt to control credit creation. In addition, the high target set by the banks' headquarters, and competition among the banks to attain higher card issuance volume, only perpetuated the unregulated behaviour of the business enterprises and the banks. On the other hand, individuals responsible for making and executing the malpractice decision on behalf of the enterprise were not prosecuted for infringing the bank policies, in the absence of direct legislation to punish the responsible individuals (Jinrongshibao 31/3/1997). This problem was prevalent in the national system, in all geographical areas.

10.5B) Infrastructure.

i) Telecommunication Infrastructure.

Besides the problem of incompatible technologies for electronic inter-bank linkage, the weak telecommunication infrastructure and the lack of a coherent national framework have contributed to an unreliable and uneconomic (when credit risk exposure is taken into account) bank card verification facility. In fact, the above factors constitute the greatest inhibitors to the spread of bank card adoption. ATM and bank cardholders continue to face difficulties in areas outside the city of issuance (McGrath 1995). The satellite-based inter-bank network being built by the People's Bank of China is still at the initial stage and has been unable to provide processing convenience to either the agents (commercial and retail outlets) or the customers. Intra-city and inter-cities bank card verification and payment settlement transactions have not been comprehensively supported by information technology (Fang 1995). This has impeded the spread of card usage and its technology adoption in these sectors.

Although there are alternatives for the banking industry to overcome the telecommunication infrastructure inadequacy, they are imbued with limitations. For example, cellular and wireless communication infrastructure may serve as ideal alternative, they are only temporary solution to the telecommunications bottleneck as it have limitations in telecommunications flexibility. Similarly, smart card have been considered as an alternative to overcome the vulnerable features inherent in the magnetic-strip card and the inadequate telecommunication infrastructure in the

country. Smart cards functioned as a stored value card through its computer chip instead of the magnetic strip to store information. Information about the cardholder's authorised withdrawal or spending amount via card is stored in the card where the technological system will deduct the transaction value from the cards. The card will be rendered inoperable when the stored value is used up. Comparatively, the smart card provides a higher level of security than the magnetic-strip card and allow flexibility in the transmission of information (permits off-line⁶ transaction to happen). However, magnetic-strip bank card constitutes at least 75% of all the bank cards issued in China. The smart card technology is relatively new to the world and is being adopted only by a few banks in discernible developed areas like Shenzhen, Shanghai and Hainan in China⁷. Theoretically, China can leapfrog the USA in the adoption of the smart card technology but the investment cost is the inhibiting factor. The sponsorship in the banking service technologies to the customers largely come from the Chinese state-owned specialised banks. Each Smart card costs 30 yuan (local made) to 70 yuan (imported)⁸ which on average, is 19 times more expensive than the magnetic card (Jinrongshibao 19/8/1997). In addition, a terminal that reads smart card costs 4 to 5 times higher than one that reads magnetic-strip card. Smart card could be a mean to avoid the cost of modernising the country's telecommunication system. However, the replacement of magnetic-strip technology with smart card technology means more capital investment with an uncertain or prolonged payment period for the banks. The need to re-train employees and users presents another financial weight to the banks. From the trend in the early Ninth Five-Year-Plan period, the Smart card is being introduced in more number and cities (Jinrongshibao 19/8/1997), however, it is expected the magnetic-strip bank card would remain the dominant card in the diffusion process for a considerable period of time.

Because the banks operate their own dedicated electronic network, the absence of shared ATM and POS facilities has made it very costly and inconvenient for the agents and the customers to adopt bank card usage. The specialised banks are willing

⁶ Transactions recorded by the agent or merchant and processed in a batch at the end of the day, no call is made with each card payment transaction.

⁷ The number of smart card issued in the mid-1990s is about 3% of the total card issued in China (Jinrongshibao 16/9/1996).

⁸ Foreign produced smart card and equipments were stated to be of higher quality and better reliability than the locally produced smart card (Ah 1995).

to share the payment technologies among themselves⁹. However, the absence of a strong coordinating force in network establishment and consolidation and the antiquated telecommunications infrastructure have been the blockages to a unified national payment network among the various banks. This is especially significant in areas where telecommunications infrastructure is underdeveloped. Even in the major cities, the telecommunications infrastructure is still inadequate to provide support for a reliable and efficient telecommunication network comparable to that in the overseas developed countries.

a) ATM. Overseas experience suggests that the evolution of ATM networks often consists of five phases: proprietary, shared, multiple members, direct links, and universal (or global sharing). In terms of an ATM network, China is at the 'proprietary' stage. This is due to the technological incompatibility of the equipment in the banks and the weak telecommunication infrastructure in the country. China's ATM systems have to move away from proprietary architectures to a more open software design that uses industry standard operating systems. However, mechanisms to establish the use of industry standard operating systems in China have been weak. The region that adopted relatively more sophisticated ATM network facilities is the Guangdong province, which has been one of the highest regional investors in ATM installation. Although the table below shows that 78% of the ATMs in selected cities of Guangdong were connected on a network basis in 1994, this level would be lower for the province as a whole. It was reported that the proportions of ATMs connected to the network for the whole province was 50% at the end of 1995 (Nuoming 1996) and had increased to 60% by mid-1996 (Yang 1996c). Most of the ATM connections were confined to dedicated bank networks.

⁹ The banks' willingness in having the interoperable and sharing facilities are evident in Guangdong and Shanghai where telecommunication infrastructure is relatively well developed (Kang and Zhang 1996).

Table 10.7 - Percentage of ATM on Network in the Major Cities of Guangdong

Locality	Industrial << Commercial Bank of China>>			<<<<<Bank of China>>>>>			<<<Agricultural Bank of China>>>			<<Construction Bank of China>>		
	Total no. of ATM	Total no. of ATM on a network basis	Percentage of ATM on network	Total no. of ATM	Total no. of ATM on a network basis	Percentage of ATM on network	Total no. of ATM	Total no. of ATM on a network basis	Percentage of ATM on network	Total no. of ATM	Total no. of ATM on a network basis	Percentage of ATM on network
Guangzhou	121	121	100%	27	27	100%	38	14	37%	36	36	100%
Shenzhen	130	30	23%	56	56	100%				15	15	100%
Zhuhai	18	18	100%							14	14	100%
Huizhou	5	5	100%	18	16	100%				10	10	100%
Dongguan	4	4	100%	12	8	87%	5	3	60%	30	13	43%
Zhongshan	60	50	100%	47	47	100%		20		10	10	100%
Foshan	34	34	100%	64	43	80%	48	14	29%	30	30	100%
Qingyuan	5			2						6	6	100%
Jiangmen	26	10	38%	32	16	50%				10	10	100%
Shantou				16	16	100%				8	8	100%
Zhanjiang				11	11	100%	2			6	6	100%
Shaoguan				11	11	100%				1	1	100%
Maoming				10	10	100%				3	3	100%
Nanhai							10	2	20%			
Shunde							18	18	100%			
Qiqing										3	3	100%
Meizhou										2	2	100%
Heyuan										2	2	100%
Sub-Total	391	270	69.05%	294	261	88.78%	119	73	61.34%	186	169	90.86%
Grand-Total	990	773	78.08%									

■ Data Not Available

Report commissioned by a major bank. Source: Confidential.

b) POS System. The inadequate telecommunications infrastructure is one of the factors that resulted in the highly manual mode of credit card verification in almost all parts of the nation (Jinrongshibao 13/11/1994). For example, the leading investor in banking technology, Industrial and Commercial Bank of China, which equipped 99% of its card issuing outlets with information technology equipment, found that the telecommunications infrastructure still impedes information receipt and transmittal (Feng 1996a). In most of the bank branches or agents' outlets, verification of card usage remained dependent on manual checking via the telephone line (Cai 1995, Qiu 1996, Ma 1996a, and Zhao 1996). Computer technology for bank card processing within the bank is applied to a specific activity in the card payment settlement process which requires extensive support of manual recording processes (Deng and Qiu 1995, Nie 1995 and Tung 1996). For international organisations, such as Master International¹⁰ which has adopted technology extensively to support its Mastercard business in overseas countries, has found problems in implementing a similar level of technological support to develop its business in China. In 1994, only half of the 40,000 local agents that accept international Mastercard had on-line verification

¹⁰ It was the first organisation to introduce international verification and clearing network (BankNet) in China to assist member banks to process international transaction. This was confined to the well developed telecommunication infrastructure regions (Guangzhou, Shanghai, Beijing and Shenzhen).

facilities (Day 1994). Visa International faces similar problem in its card business (McGrath 1995).

The bank card verification target for the 10-year timeframe for POS transaction through bank card that has been set by the government was as follows :

Table 10.8 - Bank Card Verification Target Set for 1994 to 2003.

Period Year	1 1994	2 1995	3 1996	4 1997	5 1998	6 1999	7 2000	8 2001	9 2002	10 2003
Number of Transactions per second	4.0	5.0	6.3	7.8	9.8	12.2	15.3	19.1	23.8	29.8
Number of seconds per Transactions	15.0	12.0	9.5	7.7	6.1	4.9	3.9	3.1	2.5	2.0

Source: Interview

It was reported that the verification of a POS transaction takes 10 seconds to process in China (Jinrongshibao 23/12/1996), which on paper conforms to the target set earlier for 1996¹¹. This is only realised in areas where telecommunication infrastructure support is well developed (Li 1995). However, cases of consumer complaints that verification processing time in China was at least 15 minutes, and sometimes half an hour or even half a day, have been common (Li 1995 and Cai 1995). On some occasions it has even taken hours to verify a transaction (Hou 1995 and Chen 1995b). In the developed countries, POS transaction usually takes less than 30 seconds (Marti and Zeilinger 1982) and may even be faster with sophisticated technology¹². In the USA, for example, the use of satellite networks for POS system at 50,000 registers located in the chain of retail outlets enabled processing time to be less than 7 seconds, and usually under 4 seconds (Markowitz 1994). In China, the time spent on processing, via telephone, a transaction paid by card via telephone was assessed to be equivalent to the amount of processing time for 3 to 4 cash transactions (Li 1995). In terms of card payment settlement transactions, the maximum processing time in the USA for normal transactions was 3 days (Banking World 1990). By contrast, the processing time is inconsistent and can be very long in China. It was noted that inter-regional card payment settlement transactions through card usage in China could take

¹¹ The advanced verification network, for POS transaction, established by Bank of China on 1/1/1997 only manage to process at the rate of 20 seconds per transaction (Jinrongshibao 13/4/1997).

¹² Mastercard's average processing time around the world is 4.5 secs (Jinrongshibao 30/10/1995).

15 days or even 1 to 2 months for finalisation (Deng and Qin 1995a). For intra-city settlement transaction, it could take 2 to 5 days (Wang 1995a) or at times, 6 to 7 days (Liu 1995b) for payment finalisation. As a result, agents have been very reluctant to accept payment through card usage, because of the long period involved in the payment settlement process.

In the event of card loss, the prevention of unauthorised usage is also time consuming and tedious. When the loss is reported by the cardholder, the notifying branch will transmit the information to the headquarters by telephone line (telephone call or fax message). Specialised staff at the headquarters will execute the instruction accordingly, either by notifying the various branches on the card loss through telephone line or waiting for the branches to call up for routine updating of details. This manual process of notification takes 10 days from the time the loss is lodged by the cardholder to the time the notification is received by the branches. This involves an unduly long period of time when compared to 1-day notification timeframe in the overseas country with developed information technology support systems (Fang 1995). By the time the 'blacklist' or the 'hot card' list reaches all the agents in China, half a month has expired (Jiang 1995). Besides the long timeframe involved, the process could be very costly to the bank. Wang and Wang (1995) illustrated the situation using the case of the Industrial and Commercial Bank of China which has 234 card issuing outlets. They estimated that if there are, on average, 10 daily cases of card revocation that required urgent notification to these issuing outlets via fax or telegraph, the message has to be transmitted 2,330 times to the relevant outlets. Based on the cost of 3 yuan per transmitted message over the communication lines, the total cost for this procedure will be 6,990 yuan per day and 24,000,000 yuan per annum.

For the detection of fraudulent use of cards in the system, the fraud is normally unveiled after 7 to 30 days, because of the heavy reliance on postal system for payment settlement (Ma 1996a, Zhang 1995f, Liu 1995b). The long timeframe exposes the bank, the agent and the cardholder to the possibility of accumulated credit risk.

The proprietary architectures of the various POS systems and the absence of open software design and industry standard operating systems have also resulted in duplicated resources for debit and combination card facilities (Yang 1996b). For

example, a departmental store in Guangzhou has to install five different POS systems for the different banks at each of its 36 checkout counters. Each unit requires an investment cost of 8,500 yuan¹³, so the total investment is 1.53 million yuan for all installations at the 36 counters. The cost of investment and installation is borne by the banks. If an inter-bank sharing facility was available for the POS set-up in this departmental store, the investment cost would be only 306,000 yuan, without duplication of resources and wastage of installation space and telephone lines (Sun 1996). Moreover, the shared networks also benefit the banks, because they facilitate a larger integrated cardholder base for more efficient and profitable utilisation.

ii) Power Supply Infrastructure.

The power supply is important for ensuring the continuous functioning of the technology intensive equipment. For example, the ATM is a highly sensitive machine which will easily go out of service if there is inconsistency in the power supply (Li and Xing 1995).

According to data released by the Ministry of Power Industry (MOPI), as quoted by Schneider et. al (1993), about 10% of the Chinese population lives without any source of power supply. The 32 counties where these people have been residing are located in inland rural and remote areas. Even in the major cities where power supplies have become relatively more consistent in the late 1980s and early 1990s, there are still incidents of power outage every month. Power supplies has been a main economic problem which cost the economy up to 20-40% of its potential of its industrial production (Schneider et al. 1993), and has been listed as one of the main obstacles to Chinese economic development. The growth in power output has been lagging severely behind GNP growth. The problem of financing power developments is a highly pertinent issue in Chinese infrastructure development. The government has been attempting to resolve this problem through investigating the most effective way of soliciting foreign participation in the industry (Jinrongshibao 13/4/1997).

Viewed in terms of Chinese infrastructural development for supporting the operation of CNFN in developed regions (first and second processing level regions), failures in

¹³ It has been quoted by Liu (1996) that an imported POS unit costs about 10,000 yuan while a local manufactured POS unit costs 4,000 yuan (interview source). However, most of the the POS units installed were imported (Yang 1997).

communication are a more acute problem than failures in power supply. The disaster recovery solution for the former requires a comprehensive communications infrastructure (as terrestrial communications support is necessary to implement an effective disaster recovery strategy for satellite communications failure), while the latter failure can be effectively overcome through the use of battery backup power, an oil power generator and an automatic power switching system. In addition, there are electrical power controls to protect systems which can be installed internally or on-site, to protect systems against power cuts and fluctuations in power supply. Shortage in power supplies, however, are a major inhibitor in the adoption and diffusion of technologies at the county level (which is the next targeted regional level in the Golden Card project), where severe infrastructural problems exist.

10.5C) The Policy and Support Framework.

i) Regulatory and Coherent Framework.

Prior to 1st April 1996, the legislative structure was not able to provide sufficient protection to the card issuing bank, the agent or the cardholder in the event of fraud or breach of use (Zhang 1995f and Chen 1996). The cash management legislation was used as a proxy reference for regulating market behaviour. In addition to the low level of knowledge about the use and operation of card facilities, and poor infrastructural support, overspending and card fraud have become quite serious problems. In the case of personal cardholders, the level of default in overspending incidents is small (Jinrongshibao 2/9/1996). For example, a 1994 report by Wu (1995a) revealed that about 80% of the overspending cases in the use of the Great Wall Card involved less than 1,000 yuan in value. The legal pursuit of such cases could cost many times more than the overspent value, and are uneconomic for the issuing banks. Cases that involve overspending by a small amount normally involve recall of card and revocation of rights to card usage, and the banks tend to be the bearer of the losses (Jinrongshibao 2/9/1996).

Legislation concerning card management was formally implemented on 1st April 1996, to govern the proper use of bank cards. This represents a significant step towards a coherent operating framework for bank card usage. In addition, the

legislation has covered many of the loopholes that were prevalent in the past. The frame of reference for the proper use of cards and penalties for infringement were specifically laid out in the legislation (Xie et al. 1996). The failure to repay overspent amounts exceeding 5,000 yuan is now punishable as a crime of fraud.

The tables below (Tables 10.9 and 10.10) summarise the relevant details and conditions for bank card usage by the different state-owned specialised banks before the enactment of the legislation. It shows the existence of varying operating framework for both the agent and the customers (as per Table 10.9) until the 1996 legislation that consolidated these to a standardised framework (as per Table 10.10).

Table 10.9 - The Operating Framework of the Different Specialised Banks before 1st April 1996

Card	First Card Issued	Bank	Credit Limit (for combination card)	Daily Interest Computation	Card Fee	Deposit
Peony Card	1989	Industrial and Commercial Bank of China	<ul style="list-style-type: none"> • Ordinary card 1,000 yuan • Gold card 5,000 yuan 	Within 15 days, 0.05 of the credit amount; 16 to 30 days, 0.1; above 30 days, 0.20.	<ul style="list-style-type: none"> • Ordinary card 20 yuan per annum • Gold card 80 yuan per annum 	Nil for gold card and 1,000 yuan for ordinary card.
'Long' or Dragon Card	1990	China's Construction Bank	<ul style="list-style-type: none"> • Ordinary card 1,000 yuan • Gold card 20,000 yuan 	Same as above.	<ul style="list-style-type: none"> • Ordinary card 12 yuan per annum • Gold card 80 yuan per annum 	Ordinary card 1,000 yuan and gold card 20,000 yuan.
Golden Wheat Card	1991	Agricultural Bank of China	<ul style="list-style-type: none"> • Ordinary card 2,000 • Gold card varies from 5,000 to 20,000 yuan 	Same as above.	<ul style="list-style-type: none"> • Ordinary card 15 yuan per annum • Gold card 50 yuan per annum 	Ordinary card 1,000 yuan and gold card 10,000 yuan.
Great Wall Card	1986	Bank of China	Varies.	Within 15 days at 24.12% per annum; and higher rate for over 15 days.	<ul style="list-style-type: none"> • Ordinary card 20 yuan per annum • Gold card 80 yuan per annum 	Ordinary card 1,000 yuan.
Pacific Card	1993	Bank of Communications	<ul style="list-style-type: none"> • Ordinary card 1,000 yuan • Gold card 5,000 yuan 	Within 15 days, 0.05 of the credit amount; above 15 days, 0.20.	<ul style="list-style-type: none"> • Ordinary card 10 yuan per annum • Gold card 50 yuan per annum 	Gold card 10,000 yuan and ordinary card 1,000 yuan.

Source: Fu & Wang (1993), Ye (1995), and Computer and Credit Card (1996), Vol 3: 1-8.

Table 10.10 - The Operating Framework After 1st April 1996

Legislation	Date of enactment	Credit Limit	Daily Interest computation	Maximum overdrawn period allowed
Bank Card	1/4/1996	<ul style="list-style-type: none"> • Ordinary card 5,000 • Gold card 10,000 	Within 15 days, 0.05 of the credit amount; above 15 days, 0.01; and above 30 days, 0.15.	60 days

Source: Fu & Wang (1993), Ye (1995), and Computer and Credit Card (1996), Vol 3: 1-8.

It is expected that the legislative structure will continue to evolve on a gradual basis to ensure the appropriate development of the bank card business in China (Jinrongshibao 31/3/1997). Although the legislation was in place during the Ninth Five-Year-Plan period to govern behaviour in card usage and credit creation through this instrument, there remains the problem of compliance to these regulations. It is evident that there is the complementary need for a strong enforcement authority (Jinrongshibao 18/8/1997).

Although the bank card has existed in the Chinese economy for about ten years, there has been the absence of a strong coordinating authority at the national level in directing the development of an electronic payment system and its structure. Generally, the People's Bank of China has been weak in exerting the necessary role. The problem in achieving a coherent and operable framework is complicated by the various competing interests and by the heavy dependence on different participants - local government departments, the central bank, commercial banks and their departments, and processing centres (Jinrongshibao 17/3/1997). The need to foster close cooperation among the participants in the framework, as well as technological uniformity, is crucial for the efficient utilisation of tight financial resources.

Since the promulgation of the Golden Card project, there is an emerging movement of coordination in some market regions. This is evident in the developed regions which are targeted regions for the launch of bank cards for example Beijing, Shanghai and Guangzhou. The relevant card issuing banks have joined forces with their local central bank branch and telecommunications bureau to establish a coordinating panel for the project in their region. This movement is relatively new, as many of these coordinating panels only began to be set up in the mid-1990s. Nevertheless, inter-bank electronic networks have also begun to emerge in the Ninth Five-Year-Plan

period, under the coordinated effort of the banking participants in areas like Guangdong and Tianjin. Strategic partnerships allows the banks to pool resources and to realise the much needed economies of scale. The coordination panel also has important implications for the standardisation of the technologies adopted by the different banks. As this process prove to be successful in some places, it has a positive effect on the rate of the diffusion process in other regions, through the adoption of similar coordination approach.

The overall coordination barrier is expected to become less important over time, provided a developed telecommunication infrastructure coverage emerges. The action of the People's Bank of China in leading all commercial banks to establish the National Bank Card Administration Office (Jinrongshibao 3/8/1996) and in stipulating technology standards for constructing the CNFN (Jinrongshibao 9/9/1996) were attempts to overcome the coordination barrier in 1996.

ii) The Golden Card Project/ CNFN Project/CNAPS Project.

The nature of the above projects has dictated very clearly the pattern of banking technology adoption and diffusion. They set out to focus on major cities as the initial localities in technology adoption and diffusion, as described in Chapters 7, 8 and 9. Thus, these projects were also factors that accounted for the higher level of ATM and POS technologies diffusion in the major cities.

iii) Support from the Domestic Information Technology Industry.

The Golden Card project has brought some 75 billion yuan worth of demand to the information technology market, of which its direct demand on the market was about 30 billion yuan (Jinrongshibao 9/12/1996). However, the domestic information technology industry has been unable to produce bank card technology equipment (the ATM and POS) efficiently and the banks have had to import the equipment from overseas. The capability of this domestic industry was examined in Chapter 3 of this thesis. This chapter further substantiates the fact that a strong domestic information technology support industry is necessary for a cost-effective diffusion of the payment

technologies. The conditions in the information technology industry in China were characterised by a low level of skilled human resources, backward production capital stock, weak research and development-innovation-commercialisation systems and limited interlinkages among the economic input units. The types of household demand for information technology output faced by this industry were also reflective of the level of technology diffusion from the banking industry to the consumer segment. The lack of capability to afford information technology products and services, the low level of computer literacy and inadequate telecommunication infrastructure support were the reasons for the slow acceptance of information technology in households.

10.5D) The Role of the Agent in the Diffusion Process.

Generally, the agents found it extremely tedious to process payment settlement transactions through the POS system because of the highly manual process (Wang 1995a). The agent has to check the blacklist or 'hot card' list to ascertain the validity of the card, swipe the card, fill out the transaction form and check to verify the personal details of the payer. All these activities have to be carried out manually and the high staff turnover in these agent's outlets has rendered it difficult to maintain a consistent level of efficient service to the customers. In addition, the incoherent frame of reference governing card usage (prior to the 1996 legislation) and the non-unified POS system subjected the agent to different banks' operating systems. The lack of a supportive infrastructure and coherent operating system, and the difficulty in recruiting staff with the prior knowledge in processing card payment transactions, all caused the manual method of processing to involve a high volume of work, a low level of productivity and a high degree of human error.

Bank charges on the agent for each card payment transaction are between 1% to 4%, depending on the type of transaction involved. For transactions denominated in RMB or yuan, the bank charges are between 1% to 3%, whereas a 4% bank charge is imposed on transactions that involve foreign exchange currency payment. In terms of affordability, these charges tend to be more within the affordable range for the economically better-off cities than for the less developed cities like in Guangxi.

The potential agent demands convenience, low costs and wide consumer acceptance from this innovation. The agent's unfamiliarity with the POS system and the weak telecommunication infrastructure contributed to the inconvenience and high risk factors in card usage for the consumers. Although the monetary cost of adopting the POS system varies among the different agents, there is often a higher level of perceived risk than of perceived benefit when the inconvenience and risk factors are taken into account.

10.5E) The Acceptance of ATM and POS Technologies by the Consumers.

The level of consumers' acceptance of the payment technologies plays a central role in determining the effective rate of return and the payback period on technology investment for the banks. The socio-attributes and decision attributes of the targeted consumer market segment have a bearing on their potential level of acceptance. The banks focused on developed and urban regions for potential personal cardholders. The urban dwellers represent a viable target market than the rural dwellers, as the 1995 data on the annual income per capital and average per capita annual expenditure of the urban and rural dwellers shown in Table 10.11 suggests:

Table 10.11 - The Annual Income Per Capita and Average Per Capita Annual Expenditure of the Urban and Rural Dwellers in China

<u>Urban :</u>	
Annual income per capital	4,288.09 yuan
Average per capita annual expenditure	3,537.57 yuan
<u>Rural :</u>	
Annual income per capital	2,337.87 yuan
Average per capita annual expenditure	2,138.33 yuan
<u>Cost of bank card payment :</u>	
Annual membership	20 yuan
Deposit requirement	1,000 yuan
Urban : 60 days interest on outstanding credit (assumed to be equivalent to the average per capita annual expenditure)	177 yuan
Rural : 60 days interest on outstanding credit (assumed to be equivalent to the average per capita annual expenditure)	107 yuan

Source: Statistical Yearbook of China (1996) and Fu and Wang (1993).

In aggregate, the deposit requirement, membership fee and interest charges are within the average urban dweller's annual income per capital but not the rural dweller's. The high and middle income earners were largely located in the cities. The majority of the rural dwellers earned between 800 to 1,500 yuan per annum, for which the basic cost of the bank card is beyond range. The majority of the cardholders recruited from the developed and urban regions are employed by the government or state-owned sector, and are at medium income earning capacity.

The issuance of a debit card to a personal cardholder requires guarantorship in case of payment default, which may be either undertaken by an enterprise, an individual (must be unrelated to the applicant) or in monetary terms (high amount of fund deposit and collateral). The majority of the cardholders relied on their employing enterprises to act as guarantor for their bank card application. An application for a bank card on an personal basis without a guarantor, which is to be substituted with funds and collateral, would be beyond the means of many of the potential cardholders. This is because of the requirement¹⁴ that collateral be pledged at a value that is at least 10 times of the deposit value in the escrow account, as a substitute for guarantorship (Fu and Wang 1993). From a survey undertaken by a major bank in early 1990s, it was shown that about 80% of the cardholder's guarantors were enterprises that were employing the cardholders; about 10% of the cardholder's guarantors were individuals or personal friends of the cardholders, and the remaining group involved guarantorship in monetary terms, represented by additional funds and collateral (Fu and Wang 1993). Hence, the enterprises constitute one of the significant forces in realising the availability of bank card to the population. The role of the state-owned enterprises in the diffusion of the savings card to its employees is also evident in their adoption of new wage payment system, in which the latter's wages are credited into their bank account. The employees of these enterprises are each issued with a ATM or savings card for claiming their wages in their bank account.

While the urban cardholders are still not used to the concept of being charged on the new form of payment, the preference to use cash to settle payment transactions in the

¹⁴ Industrial and Commercial Bank of China required a deposit amount of 5,000 yuan in lieu of guarantorship (1994(2)).

economy is still very high. Most consumption expenditures are on basic essentials and are of small transaction value. The cardholders' unfamiliarity with the use of technological payment facilities and the unreliability of the electronic support system have instilled a considerable level of diffidence in the system. The ignorance of the operating framework was also reflected in overspending, exceeding the stipulated limit, and delay in repaying the overspent amount. On average, the problem of card overspending by the cardholders is commonly at least 5% of the total deposit value received in the bank card business. The process involved in collecting the overdue amounts and the relevant interest from the delinquent cardholders has been heavy in terms of cost, time and effort, and this weighed on the availability of limited resources in the banks for business development.

The cardholders are sensitive to the costs involved in the form of new behaviour and need to be absolutely convinced of the worth of adjustment before adopting it. Opportunities for trial of the innovation are limited for the cardholders, and the weak telecommunications support creates substantial inconvenience and risk for the cardholders. The unreliable system of operation, and the reluctance of agents to support the use of the payment system, established and reinforced the negative impact of the innovation. Overall, the adoption of the system of using a bank card as a payment instrument among these customers is very slow, because there is more perceived advantage in cash usage than in the new form of payment.

10.6 CONCLUSION: EXPLAINING THE DIFFICULTIES IN THE DIFFUSION ROLE OF THE STATE-OWNED BANKS.

The objective of this chapter is to explain the difficulties encountered by the state-owned banks in their technology diffusion role to the consumer sector, by examining the factors which influence that diffusion process. In addition, these factors also account for the limited success in the diffusion of ATM and POS technologies within the national financial system.

Some of these factors, such as infrastructure, are beyond the control of the banks and indeed the efforts of the banks to seek alternative routes to overcome the rudimentary

nature of the communications infrastructure has imposed high investment costs relative to their financial capability. The main influencing factors which have had a significant impact on the diffusion role of the banks are summarised below.

10.6A) Organisational Factors.

The organisational factors that influence the adoption of technology within the state-owned banks, which have been analysed in Chapter 9, have also had similar effects on their efforts in the diffusion of the ATM and POS technologies to the consumer sectors. Although the adoption of information technology has extended from the internal organisation to the customer sector, the incompatible technologies and the pockets of computerised activity areas within and between banks has resulted in the absence of a national electronic payment network. This is reflected in the fact that the processing of a POS transaction tended to involve a number of manual processing points, while the ATM system was not sufficiently networked to form an integrated payment system. In addition, the operational staff involved in supporting the electronic payment system were unfamiliar with the framework governing transaction authorisation and processing. The shortage of information technology staff resulted in the inability of the banks to ensure reliable performance of equipment and this aggravated the distrust of the customers towards the ATM and POS technologies.

10.6B) Limited Acceptance from the Consumer and Agents.

The pre-requisite conditions for the acceptance of the bank card technology by the consumers are that the new bank card system should be more convenient, secure and reliable than the traditional cash system. However, the essential attributes sought by the consumers were not delivered. In addition, the latter's unfamiliarity with the new technological system also caused them to prefer the use of cash and to conduct transactions at the traditional banking outlets. This preferred mode allowed human interaction for the consumers to clarify and seek rectification on the spot. Therefore, consumers have had limited incentive to use the card system and, as a result, the diffusion of this technology has been inhibited.

Agents (in the POS system), on the other hand, want convenience, low cost (affordability) and widespread consumer acceptance of the bank card system. However, the applications of the POS technology have not been capable of being a convenient, secure and cost-effective choice to deliver financial payment services. The reluctance of the agents to use POS technologies for payment transactions have, in fact, discouraged consumers who were willing to use or try the system. This has had cumulative and dynamic effects in shrinking the technologies' diffusion potential.

10.6C) Inadequate Infrastructure.

The inadequate Chinese infrastructure imposed constraints on the diffusion of electronic payment systems in the banking industry, which in turn influenced the range of possible products or technologies that could be adopted. In particular, the undeveloped telecommunications infrastructure in the Chinese economy constituted a major inhibitor to the adoption and acceptance of banking technology. The information technologies in question involve the convergence of computer and telecommunication technologies. The inadequacy of telecommunication technology will lead to a stand alone or limited network application of the computer technology. This inadequacy in China is significant in the inability to support financial liquidity in the card payment system in real time. As obvious in the plans (Golden Card project, CNAPS and CNFN), the pattern of the banking technology adoption and diffusion in the country is defined mainly by the geographical coverage of the telecommunication infrastructure. It is largely confined to the developed areas and to areas classified as at the national level and the first level of the national geographic segmentation structure. Specifically, this has resulted in a higher level of technology diffusion in the major cities. A balanced coverage of technology diffusion must be achieved across the economy, because the formation of a technology enabled network has development potential for the region involved. Regions that lag behind in electronic network coverage run the risk of being left out in reaping the positive network externalities, and may even end up with a wider development disparity gap.

The lag in telecommunications infrastructure development has affected the Chinese banking industry's capabilities in the adoption and diffusion of information

technology, which is a concern to the Chinese government over the ability of the Chinese banks in matching the foreign banks' stronger position in the use of banking technology for scale economies and competitiveness.

10.6D) Inadequate Policy and Support Framework.

Despite the government aggressive promulgation of the Golden Card project, the parties found themselves operating the electronic payment system within an inadequate policy and support framework. There are barriers that need to be overcome before the new technology is fully embraced. The information technology industry, for example, has not been able to respond and develop product and services closely related to market demand and requirements and to ensure that they remain relevant into the future. The legislative structure had been inadequate to govern the proper use and operation of the electronic payment system. The People's Bank of China has not been able to exercise its authority to ensure appropriate behaviour compliance and adherence, in instilling security and confidence in the new electronic payment system. In 1996, a legislation that endorsed stringent penalties was enacted. In fact, this legislation addresses many of the loopholes that existed in the past system. It was considered necessary for the People's Bank of China to consolidate its power as a strong enforcement force via the 1996 legislation, in order to curb malpractices.

It is noted that because of the undeveloped condition of many related industries, resources and operating frameworks, it became crucial for the government to provide incentives to build a strong domestic information technology industry and to create the relevant institutions to foster support and acceptance for the new electronic payment system within the country. Besides cultivating a strong supply side to support technology diffusion, a significant government role and influence is also needed to build up the demand side of the technology diffusion equation. The state-owned enterprises serve as an important facilitator or change agent in the payment practices of consumers. This is done through their role as a wage payer using the electronic banking system for wage payment, and as guarantor for their employee's bank card application. The potential of the state-owned enterprises as a significant

channel for introducing and enabling the adoption and diffusion of the payment technologies also stems from the fact that it is a major employing sector in the economy. The state-owned enterprises, which constitute about 48% of the companies established in China, employed about 74% of the labour force in 1995 (Statistical Yearbook of China 1996). A strong commitment by the state-owned enterprises to the new payment technologies would greatly facilitate the technology diffusion role of the state-owned banks.

PART FIVE
TECHNOLOGICAL LEAPFROGGING AND
IMPLICATIONS FOR POLICIES

CHAPTER 11 : SOME IMPLICATIONS - TECHNOLOGICAL LEAPFROGGING AND POLICY IMPLICATIONS

The body of existing literature reveals that there are many different factors that have a bearing on the information technology adoption and diffusion process. In addition, the diverse findings of studies for different countries shows that there are big variations in the factors influencing such processes in different countries. The literature review also highlighted the fact that there exists a research vacuum in the area of technology adoption and diffusion in emerging market economies.

The thesis seeks to contribute to filling a gap in the research area. In this thesis, the factors influencing information technology adoption and diffusion are explored in the context of the banking industry in the emerging market economy of the People's Republic of China.

Chapters 6, 7 and 8 revealed an overall slow and shallow information technology adoption and diffusion process in the Chinese banking system. The adoption of information technology in the state-owned banks has been determined slow, both relative to official plans and to global trends, and shallow, in the sense that information technology usage tends to be concentrated in a few branches, and is not widely spread through the operations of the banks. Chapter 9 examined the nature of the internal organisation factors that influenced the technology adoption process within the Chinese state-owned banks. It concluded that the lack of clear business structure and strategy, funding constraints, technology application deficiencies, lack of a total management approach, failure to adopt business process re-engineering, insufficient learning from external experience about conditions of technology adoption and skill shortages were the critical factors that retarded the technology adoption process within the state-owned specialised banks. Another conclusion of Chapters 6, 7 and 8 was that, despite the fact that technology adoption within these banks was lagging behind what was planned, the pace of technology adoption was ahead of that in the other state-owned enterprises. The latter outcome was attributed

to government involvement in targeting adoption in the state-owned banks. Chapter 10 investigated the technology diffusion role of the state-owned banks in relation to the consumer sector, in light of the findings in Chapter 9, the external operating environment and the profile of consumers. The ATM (Automatic Teller Machine) and POS (Point-of-Sale) technologies were the focused technologies for this study into the banks' diffusion role. Chapter 10 demonstrated that the state-owned specialised banks have been experiencing difficulties in the diffusion of banking technology to the consumer sector. Besides being plagued with the problem of inadequate internal resources, these banks were constrained by the rudimentary and rigid infrastructure and by a weak policy and support framework, both of which were largely beyond their control. In turn, all these factors hindered the acceptance of the new technologies by both the consumers and agents.

The literature review in Chapter 2 identified the set of factors which may influence information technology adoption and diffusion. In addition, it also noted that these factors varied in their nature and intensity of influence on the adoption and diffusion process in different countries. In the case of China, the popular notion that pursuit of improved economic returns and the benefits of adoption in large, monopolistic market structures are major factors influencing technology adoption and diffusion has less relevance than may have been anticipated, especially in the case of the state-owned specialised banks. They turned out not to be the prime forces in influencing technology adoption and diffusion in these financial units. Instead, the directives of government stand out as a stronger force in this process.

In Chapter 2 doubts were cast on the relevance of the domestic capability of the information technology industry for effective technology adoption and diffusion in a particular country. The analyses in Chapters 9 and 10 confirmed that the extent of support from the domestic information technology industry was very important to the pace of both the technology adoption and diffusion processes in the Chinese banking system. This became apparent when China had a controllable technology gap since the mid-1980s, when it was free from COCOM's hi-tech import and transfer restrictions, as laid out in Chapter 3. The weak indigenous capability of the information technology industry was reflected in the banks' inadequate support for internally applied technology for work processing and for externally applied

technology for customer service, even after China was not subjected to technology procurement restrictions.

In the area of foreign direct investment, which is widely believed to be an effective channel for technology transfer to developing countries, this was not the case for the Chinese banking industry. Despite the growing presence of foreign banks in the Chinese domestic industry (as tracked in Chapter 5), Chapter 8 showed that they have played a very weak role in foreign technology transfer and diffusion in China. Instead, the state-owned specialised banks have played a much greater role than the foreign banks in this area. This is because the restricted business scope imposed on foreign banks has discouraged aggressive adoption and diffusion of technology among these banks, such as has been common in deregulated and competitive banking industries overseas. The foreign banks, in the Chinese banking industry, did not turn out to be the potential technology transfer and diffusion agents intended by the Chinese government. The restricted scope for foreign banks was one reason that the regulated Chinese banking industry did not engender strong competitive pressure on the local domestic banks to apply information technology for strategic market purposes. Their focus was mainly on internal applications for transactional and informational purposes.

The findings summarised also offer insight into the dangers of the simplistic view that there is a universal model for the adoption and diffusion of information technology. It may be possible to imitate the structural features of a developed country's successful model for the adoption and diffusion of information technology, but it is a great challenge to emulate the efficiency and effectiveness achieved in such countries, and the attempt may have consequences which are viewed as adverse. For example, market liberalisation may stimulate technology adoption and diffusion, but may have to be achieved at the expense of losing control of the market (refer to Chapter 5 on the Chinese government's stand between market liberalisation and market control of the financial industry).

In addition, the findings in Chapters 6, 7 and 8 also offer some insights into the possibility of technological leapfrogging for the state-owned specialised banks. Although the level of information technology adoption and diffusion was considered slow and shallow in the Chinese banking system, the learning paradigm of most users

in the state-owned specialised banks involved advanced technology (that is, technological leapfrogging). However, the analyses in Chapters 9 and 10 question the value and viability of technological leapfrogging for the Chinese state-owned banks, in view of their capability to exploit advanced technology fully. From this point of view, it may seem appropriate for these state-owned specialised banks to adopt intermediate technology rather than to leapfrog to advanced technology. The possibility of technological leapfrogging for the state-owned specialised banks in China is addressed further in the next section (Section 11.1) of this chapter.

Another issue emerging from the analyses in Chapters 9 and 10 is that, in contemporary circumstances in China, the government is evidently a necessary force to propel an effective rate of technology adoption and diffusion. The effectiveness of the government role has been evident in some of the projects implemented in the banking industry. For example, the initial focus on major prospering cities like Shanghai, Guangzhou and Beijing, showed that the level of banking technology adoption and diffusion is much richer in these areas than in others. Based on the data available, it is clear that the conditions for technology adoption and diffusion in these major cities are more favourable than other regions at a lower economic level. Therefore, the strategy laid out in the CNFN project and in the Golden Card Project by the government was appropriate. A step-wise approach was used for the construction of a electronic network, and this deliberately concentrated scarce financial resources into developing the well-endowed areas, which had the potential for faster returns on investment. These areas also served as models of development for the suburban and county areas. The institutional change which has occurred in the banking system has created the necessary environment for technology adoption and diffusion to begin and to spread, but continued institutional change is necessary to ensure this movement continues on the right path. This is especially so for the rural areas, where a stronger commitment from the government is necessary for directing a consistent spread of the technology to these less well-endowed areas, towards achieving a well-connected national inter-bank electronic network. The government role is highly critical in those areas where factors not within the control of the technology adopting entities are especially important. Section 11.2, following the discussion on technological leapfrogging, highlights some of the policy issues

involved in fostering an efficient and faster rate of information technology adoption and diffusion within the state-owned specialised banks.

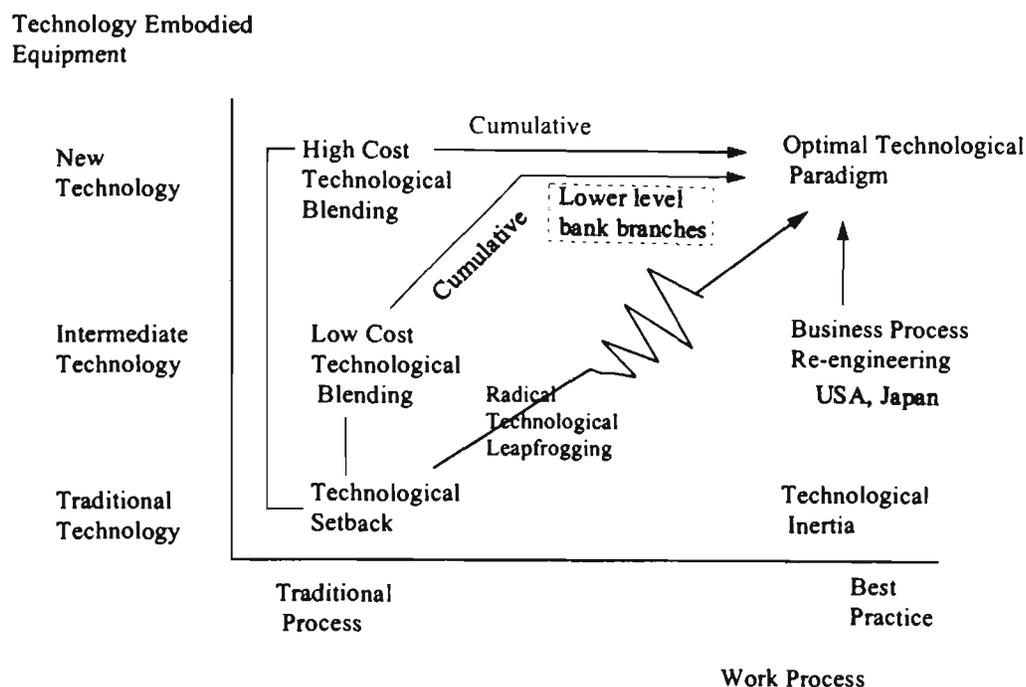
11.1 TECHNOLOGICAL LEAPFROGGING

The findings of the analyses in the previous chapters provide some insights into the study of technological leapfrogging in information technology, in the case of China. These are explored below.

11.1A) The Grid

The value of technological leapfrogging in information technology for China must be evaluated in light of its domestic banking capability to do so, and also of the characteristics of advanced information technology versus other intermediate information technology available for adoption. In assessing the domestic capability of the Chinese banking system in technological leapfrogging, the relevant features of the Chinese experience in technology adoption are reviewed. The rationale for technological leapfrogging is also examined in this section. To facilitate analysis of the technological leapfrogging situation in China, information technology adoption in the banking context is viewed from the perspective of the technology embodied in equipment and of the exploitation of its potential benefits for the work process. There are several ways of complementing technology and work process as reflected in the grid below, which was explained in detail in Chapter 2.

Figure 11.1 - Technological Leapfrogging Grid



11.1B) Relevant Features of the Chinese Experience

A major feature of the adoption and diffusion processes in China is that the learning paradigm of most users in the banking system is largely based on advanced technologies (at least late 1980s generation technologies). That is, by and large the Chinese state-owned banks have jumped straight to advanced information technology products. There were a few cases where the lower level bank branches adopted intermediate technologies during the Eighth Five-Year-Plan. These intermediate technologies were the then advanced technology adopted by the higher level bank branches in the early 1980s, and were subsequently handed down to the lower level bank branches in the rural areas for learning purposes. These technologies were largely standalone computers. However, it was arranged by the banking headquarters that these lower level bank branches will adopt new technology during the Ninth Five-Year-Plan period, whereby sophisticated communication systems would linked to the applications of the new technologies. The technological usage paradigm differed, to a limited extent, in these two situations. The higher level bank branches were involved in the use of newly emerged technology at their initial point of technology adoption

and, thus, traced a cumulative learning trajectory within an advanced technology paradigm. On the other hand, those lower level bank branches, where their initial adoption experience involved intermediate technology, adopted intermediate technology in the form of standalone computers that were many years behind the newly emerged technology in the marketplace at that time. In this sense, when these lower level bank branches came to adopt newly emerged technology in the Ninth Five-Year-Plan period, the whole adoption process became a process of blended technology usage. This, however, has had less disruption to their learning experience than might have been the case, because the initial application with the intermediate technology was largely confined to standalone computers for basic learning purposes. As mentioned in Chapter 2, there are two possible extreme outcomes from radical technological leapfrogging. Technological leapfrogging has the potential of bestowing unprecedented technological possibilities on the banking system and on the other hand, it also has the possibility of adverse impacts, by shocking the traditional system through a sudden technological transplantation. Despite technological leapfrogging in the technical sense, the advanced technologies adopted in the Chinese banking system were underutilised and underexploited (as identified in Chapters 6, 7 and 8). This was due to factors such as the limited capability of the human resources, systems and infrastructure to immediately and fully exploit the advanced technological potential (as detailed in Chapters 9 and 10). Among these factors, a significant technical attribute that hindered the full exploitation of the technological leapfrogging concept was the prolonged usage life span of the adopted technology. When the usage life span of those information technology products is taken into consideration on an aggregate basis, it was evident that a pattern of widespread technology incompatibility and of different stages of technology adoption was common within the different banks (Chapter 7). The technology adopted initially may have been newly emerged technology at that time, but because of prolonged and variable usage life spans, a mixture of often inconsistent new and intermediate technologies were being employed at any time. This meant that, despite the general occurrence of technology leapfrogging in the adoption process, the lack of coherent standards in usage life span for information technology prevented the full technical exploitation of the potential of new technology across different banking systems.

The gap between the potential benefits from technology leapfrogging and that achieved from actual technology usage was further aggravated by the absence of deliberate coordinating efforts to achieve technology unification and standardisation, at both the organisation and national levels. In addition, the Chinese method of innovation adoption normally involves a trial period confined to a specific geographical venue, before implementation is carried out on a wider scale. This, together with the inherent intricacies in the transitional system, led to the new technology permeating the system on a gradual basis. Hence, the potential adverse impact of technology leapfrogging did not materialise to drastically affect all levels of the organisation within a short period of time.

11.1C) Relevant Features of Information Technology

While the extensive use of intermediate technologies is clearly possible, but when the following features of the advanced information technology are contrasted against the intermediate information technology, technological leapfrogging qualified as an inevitable move in information technology adoption in the Chinese banking system.

i) Open Systems. Operating systems that are established under open systems standards can be easily integrated for network formation. In other words, the technical choices of such systems for network establishment are not constrained by vendor, type or vintage, and this provides a high level of communication flexibility. Early information technology had been dominated by proprietary system standards, and the incompatibility among the different manufacturers' equipment and software resulted in incomplete and inconsistent exchange of information.

Adopting intermediate technology would mean re-living the problem of technical inflexibility that the advanced countries are experiencing in the 1990s, and which these countries are trying to overcome through open system in advanced technology adoption. The inability of these advanced countries to advance rapidly to new technology adoption is reflective of the inflexible technology infrastructure inherent in the intermediate technology design, due to the earlier pursuit of the proprietary concept in technology development. The new technology, on the other hand, had

provided a greater degree of infrastructure flexibility¹, in which consideration is given to the incorporation of future emerging technologies and migration to future technologies without incurring exorbitant costs in technology replacement. In the long run, this flexibility means a lower cost in investment. The adoption of new technology therefore seems to be the most economic alternative, from a wider and longer term in perspective.

ii) Demand on Users. Although the potential of advanced technology would not be fully utilised or exploited in the Chinese banking system, the learning paradigm offered by the advanced technology framework has more benefits than that of intermediate technology. Closely related to the advancement in technology is its reduced demand on the prior knowledge and experience of users in technology usage, which is known as the increasingly 'user-friendly' feature of systems. One obvious attribute of this phenomenon is the human-computer interface factor in technology development, which is a rapidly developing area of focus in technology innovating countries. This emphasis is highly evident in funding criteria for technology R&D, training, design development and market demand (Australian Science and Technology Council 1990). Research studies show that an effective human-computer interface has a strong influence on learning curve, performance speed, rate of error and user satisfaction (Shneiderman 1992). It tends to share a strong positive correlation coefficient with the mentioned user-related variables.

iii) Globalisation. The development of information technology applications and the revolutionary potential of information technology also do not suggest that intermediate technology is the ideal choice for adoption. The successful applications of advanced information technology in the developed countries and the NICs, such as the Internet, trade networks and banking networks, strongly project a future world economy where globalisation is underpinned by electronic global networks and an electronic global marketplace. This point is also related to the inherent open system characteristic of advanced information technology. The adoption of intermediate information technology by developing countries would involve the heavy price of being excluded from integrating into the global market, especially when the concept of the GII (Global Information Infrastructure) is fully realised. Thus, these

¹ The result of movement towards open systems and standards for system interoperability.

developing countries would be in the position of a perpetually technologically backward country, while the developed countries are advancing their vision of a global integration for economic development, through the displacement of intermediate technology for advanced technology.

Thus in comparing the technical attributes of the advanced technology to intermediate technology, there are strong reasons to leapfrog to advanced technology adoption than to adopt intermediate technology in the Chinese banking system. However, consideration must be given to the factors which made up the work process that complements the adoption of the advanced technology.

11.1D) Technological Leapfrogging in China

In the technological leapfrogging approach, the immediate transformation of work process to complement or exploit the new technology would introduce 'shocks' into the banking system at both the micro and macro level. In the context of the Chinese banking system, radical technological leapfrogging, in terms of advanced technology equipment and complementary best practice work process, could upset the functioning of a market economy that is still in transition and that is still rudimentary in coping with the impact of technology. The transitional Chinese economy would have considerable difficulties in coping with socio-economic repercussions, such as unemployment and the demand for skills, which would be likely to result from the radical approach. However, it is noted that advanced technology does not necessarily bring only hardship to the adopting entities. Advanced technology may not present the same challenges to organisations from different social environments, its unprecedented potential may benefit the social condition of the technology adopting entities. The social context of a developing country may turn out to favour radical technological leapfrogging. For example, the status symbol associated with owning a mobile phone has not only led to a quick diffusion of the mobile phone technology in China, but the social consciousness of being seen with the latest mobile phone model has driven technology leapfrogging in this area in China. On similar ground, the pattern of mobile phone adoption fits the Chinese business and organisation environment well. This is because most managers of local Chinese companies do not

often have the privilege to work in clean and nice offices. The mobile phone technology provides a mobile office environment for them to conduct businesses in more appropriate settings with their clients. Thus, the social condition and environment of the Chinese banks in the adoption of information technology warrant further investigation in future study.

Overall, technological leapfrogging should be adapted to local conditions. In the case of the Chinese state-owned banks, their technology adoption process thus far can best be described as the high cost technology blending approach, with some elements of the low cost technology blending approach (Figure 11.1). The high cost technology blending approach involves an advanced technology paradigm for usage and learning to take place on a gradual basis. Given the open system features of the advanced technology, the applications from such technology will remain relevant for a considerable period of time and will thus provide undisrupted continuity in the learning process. In addition, the ease of usage features also represent positive benefits to the learning process. Although the high cost technology blending approach has its attractions, it does involve an initial high set-up cost and low returns on investment for a considerable period. The high cost technology blending approach requires a high degree of tolerance towards technological capability underutilisation, while the work process is being reformed or restructured on an evolutionary or transitional basis. Despite the falling cost of information technology (Braga 1996 and Wallis Report 1996), the Chinese banks have been unable to fully enjoy this advantage because of the weak condition of their organisational factors and resources. It is envisaged that when these factors and resources have achieved a reasonable level of capability in exploiting advanced technology that the Chinese banks may then be able to enjoy the falling cost of collecting, storing and analysing information. Perhaps, at that point of time, the resistance to the cost of new technology adoption within the Chinese banks may be eroded by the improvement in this capability.

The eventual achievement from the high cost technology blending approach should be the optimal technological paradigm, where new technology is complemented by best practice in the work process. As at the end of 1995, the type of technology adopted and nature of the complementary work process transition in most of the state-owned banks show signs of resembling the high cost blending approach, although

considerable effort is needed to reform the work process to exploit the applied advanced technology fully.

As noted above, in some cases the lower level branches in the rural areas started off using intermediate technology before progressing to advanced technology. The approach in these cases involved the initial adoption of the low cost technology blending approach and eventually, a move to a high cost technology blending approach. The realisation of the optimal technological paradigm has to be achieved not only through the adoption of new technology, but it requires work process to be reformed to complement the new technology.

In both the technology blending approaches (high cost and low cost) for the Chinese banking system, the progression towards the optimal technological paradigm requires capability issues to be resolved. The capability issues involved are those identified in Chapters 9 and 10: clearer business structures and strategies, increased funds availability, technology efficiency, adoption of a total management approach, thoroughgoing business process re-engineering, increased skill availability, and development of a transparent operating environment and reliable infrastructure. Government support is once again crucial for realising the movement of the banks towards the optimal technological paradigm. The Chinese government's role constitutes an essential element in assisting to remedy the deficiencies in the system.

11.1E) Conclusion

From the above discussion, it is clear that leapfrogging of information technology to advanced products and systems is inevitable in the late twentieth century for the Chinese banking system, but has to be adapted to the respective local conditions of the industry and the country. The high cost and low cost technology blending approaches appear to be the appropriate strategy for advanced technology adoption for the banks. However, reforms on the identified capability issues have to be consistently undertaken, to remove the negative factors in the work process that impede the full exploitation of the potential of advanced technology.

From the case study undertaken in this thesis, it appears likely that technological leapfrogging is an inevitable move in information technology adoption for most industries and most developing countries in the late twentieth century, based on the increasingly powerful characteristics of emerging technologies. But this must be implemented in accordance with the local conditions of the technology adopting entity and having regard to the capabilities, traditions and objectives of both businesses and consumers. Nevertheless, the above discussion on technology leapfrogging invites further crystallisation by future research work, since this topic is only a subsidiary aim in this thesis. On the whole, technology leapfrogging in information technology constitutes a field of study which deserves future research attention. This is especially pertinent to the technologically backward developing countries.

11.2 IMPLICATIONS FOR POLICY

It finally remains to explore briefly the potential role which government might play in supporting the state-owned specialised banks in the information technology adoption and diffusion process. Several points must be taken into consideration when reading this section. Firstly, it must be noted that the thesis perspective on the possible policy implications is based on the research analyses conducted for the period between 1979 to 1995. The Chinese banking system operates in the very dynamic environment of an emerging market economy. It is possible that some of the policy implications suggested here may be rendered invalid either by developments since 1995 or by changes in the direction of the economy, in which a different course of development emerges. To be definitive about the nature and structure of policies necessary to shape the adoption and diffusion of advanced information technology in the Chinese banking system requires a detailed study of the Chinese polity and its institutional development. This is, however, beyond the scope of the thesis. Thus this section serves only to highlight the need for government's support for the state-owned specialised banks in their adoption and diffusion of advanced technology, and to make some suggestions about the nature of that support.

Although the widely held presumption in many Western countries is that sound policy is established upon the basis of the competitive marketplace allocating resources in the optimal way, there is no one universal model for success especially in managing a transitional economy. What matters is the existence of a viable combination of efficient market mechanisms, a clear government role and a stable institutional framework. Government intervention would seem relevant in situations where market imperfections or externalities make it unlikely that private participation can fulfill the required role, and where action to set up market conforming institutions and structures is necessary.

China's institutional change in the post-1978 economy has been predominantly state-led and has been supported by a decentralised structure of local government administering the regional system and local government bureaus operating with a high degree of jurisdiction. As a result, the economic and administrative system constitutes an elaborate network that extends to all levels of the bureaucratic structure. Unlike its former socialist counterparts in Eastern Europe, China proceeded with its transformation of the pre-1978 economy on a gradual basis, without immediately embracing privatisation, a full commitment to private property or full foreign participation. Thus, a competent governance role is very important in directing efficient institutional change in the economy, at both the local and the central government level. A high level of central government capability is required to ensure consistency and coherence among the different local approaches to attaining their overall economic goals.

Based on the findings outlined in this thesis, four major areas are identified below where government's role may have high leverage on the adoption and diffusion movement in banking technologies.

11.2A) Tax Policies To Encourage Rate Of Capital Formation.

The analyses in earlier chapters have pointed out that the availability of financial capital is an essential element in the technology adoption process within the banking system. The state-owned banks, which are the adopters of information technology

and the potential diffusion agents for the financial system, face severe financial constraints in this area. Unfortunately, they are prohibited by their ownership structure from raising capital to finance their adoption of technology through market listing. Their dependence on the government's assistance for their working capital and asset investment capacity is marked. The reform era, which decentralised much of the administration of the economic system to the local government area of responsibility, means the process of seeking development support has shifted mainly to the local level. The local governments are, nonetheless, also faced with limited supplies of capital. Since neither the central nor the local governments are able to provide grants and subsidies for technology adoption and diffusion within the state-owned specialised banks, tax policy may be employed as a mean to encourage capital formation by the banks by treating such investment as tax deductible. This would help to lower the cost of capital for these banks. It was identified in Chapter 9 section 9.2D that the state-owned banks were not satisfied with the support provided by tax policy for their information technology adoption and diffusion process. The treatment of such investment as tax deductible would alleviate the financial burden on the state-owned banks in the adoption and diffusion of advanced technology.

11.2B) Human Resource Policy.

Besides financial resource limitations, the shortage of appropriately qualified human resources is one of the most pertinent issues facing the state-owned specialised banks in their adoption and diffusion of information technology.

Towards the end of the Eighth Five-Year-Plan period, external facilities specialised in training people for information services remained relatively scarce. The average skill level of the information technology personnel in China remained low. There was also a lack of individuals with a knowledge of both the technical applications of information technology and the business value systems of the banks. Such individuals are in high demand for their potential in enhancing business value through the exploitation of technological capability. Between 1979 to 1995, it has been the responsibility of these banks to create a pool of information technology talent to support the technology adoption and diffusion process. This has weighed on the

already tight financial position of the banks. Although the government's support for computers courses in primary and secondary education level is growing, basic education takes years. Support from the government in the area of providing external training facilities is needed. This would not only alleviate the constraint faced by the banks, but also may serve as a coherent national strategy to incorporate the concentration of scarce resources into developing indigenous technological capabilities. This is necessary to meet the immediate and pressing demand for talents in those economic systems that are already involved in information technology adoption. The consolidation of the different learning paradigms by establishing responsive and nationally coordinated training centres², for example, might not only alleviate the financial burden on the technology adopters but also have an impact on the adoption of consistent standards in technology operations and management.

11.2C) The State-Owned Enterprises as Beachheads for Information Technology Adoption.

As discussed in Chapter 10 of the thesis, the government sector could serve as a significant force behind the initiation of information technology applications within the banking system and within the country. After all, the current structure of the economy is predominantly state-owned. The government could carry this out through its influence on the state-owned enterprises, driving them to adopt technology for electronic linkage to the banking network (as customers of the banks) or to diffuse payment technologies in their role in paying wages. The Golden Projects are representative of the government direction in using its state-owned enterprises as the initiating point of technology adoption and as the channel of technology diffusion. In fact, the government agenda of the Ninth Five-Year-Plan period spelt its commitment in this sector - it endorsed the plan to invest US\$29 billion to boost information systems infrastructure in this sector.

It is important to note that many of the problems encountered by the banking system in the local Chinese context are also shared by the other technology adopting units

² Similar to the joint-venture training institutions established between the Singapore government and foreign institutions (Japanese and German).

(for example, other beachheads as represented by the other Golden Projects). Thus, it is also imperative for the government to ensure that the information infrastructure is relevant to the economy.

11.2D) Infrastructure.

Infrastructure is beneficial to the economy *only when it provides services that respond to effective demand and do so efficiently* (The International Bank for Reconstruction and Development 1994). China is still involved in trying to overcome the problem of inadequate basic infrastructure and has yet to reach a level that is fully beneficial to the economy. The Chinese telecommunication and power supplies infrastructure impose direct constraints on potential delivery systems in the banking industry, and this in turn influences the range of possible products or technologies that can be adopted. The institutional frameworks of these two infrastructures (telecommunications and power) share many similarities. The technical and particularly institutional constraints imposed by the infrastructure, especially the telecommunication infrastructure³, have been impeding the ability of the Chinese banking industry in its adoption of information technology to realise benefits such as:

- Cost-effectiveness in linking the Chinese banking units,
- Extensive coverage of all provinces,
- International standards for open access,
- Secure and reliable transmission of financial data and information,
- Rapid payment settlement without information transmission delay,
- Flexible structure for creation and further support of financial products and services.

From the perspective of information technology adoption in the banking system, two aspects of the infrastructural and deficiencies seem to be of particularly importance.

³ Telecommunication infrastructure is a social overhead capital which has a macro influence on firm's pattern of information technology adoption and diffusion. It constitutes telephone lines, satellite communications, broadband communications, institutions and policies, et cetera, that made up a nation's telecommunication framework which determines a firm's internal and external connection with other entities.

i) Inadequate Institutional Mechanism. The organisational and structural complexities, and related policy indeterminacy, are key blockages in the path of infrastructure development necessary to support information technology adoption and diffusion. Institutional reform will continue to be a slow process in view of these complexities. Genuine government effort is needed to inject credibility into the system and to extract conforming behaviour from the participants. It has been argued that private and foreign financial investment constitutes a solution to infrastructure bottlenecks and should be given serious consideration. However, the involvement of these investors is unlikely to occur efficiently even if the industry is liberalised unless the Chinese government takes serious initiatives to instill credibility and incentives into the institutional and regulatory framework.

The lack of a institutional and regulatory frame of reference is also the most serious impediment to efficient adoption and diffusion of information technology. The status of the Golden Card and CNFN/CNAPS projects as laid out in Chapters 7 and 10, has shown the reason why the pre-existing PSTN communications infrastructure could not be relied upon, so that a separate financial communications network infrastructure had to be built without total reliance on MPT's undertaking. Nonetheless, it is imperative that the existing telecommunication infrastructure be made efficient, because of the necessity of network linkage in achieving a sophisticated national banking system. For example, home banking service would require the link between the public communications infrastructure and the dedicated financial communications infrastructure, for public accessibility to the service.

ii) Inequity in Coverage. Another significant issue pertaining to the development of infrastructure is that, if the infrastructural development rate is not accelerated in the rural areas, the gap between the 'haves and have-nots' will be greatly aggravated by the effort to establish a national electronic banking system, this is because the nature of the projects to focus on the well endowed areas first. The construction of the electronic banking system might not continue to move rapidly when the focus is extended to the rural areas. The analyses in Chapter 9 and 10 substantiate the slow adoption and diffusion of information technology in these areas. This is because the development of the infrastructure in the rural areas would be aggravated by the inadequate local conditions (Zhang 1995a). The development of the north-eastern

region (largely rural and remote areas) of the country has been a major problem to the government. The profile of the absolute poor reveals that most of them live in this region. The north-eastern region holds 64% of the total population in the China and covers 89% of the geographical landscape. About 87% of those Chinese who live below poverty line are located in this region. Developing this region involves major infrastructural costs, with unduly long payback periods, and indeed poses a major problem to the government in soliciting foreign investment interest. Thus, it is imperative that greater central government support be given to the local government in the less developed regions, to prevent the widening of the economic and educational disparities traditionally suffered by them.

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