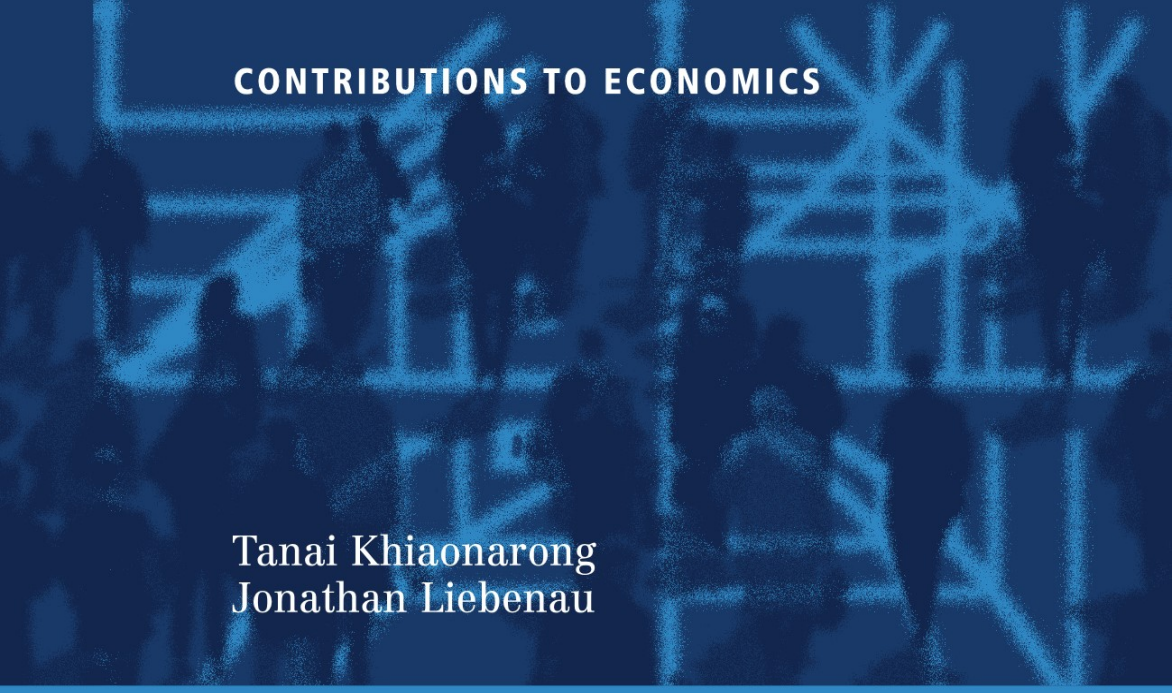

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Tanai Khiaonarong
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Banking on Innovation

Modernisation of Payment Systems

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Dr. Tanai Khiaonarong
University of Westminster and
Bank of Thailand
273 Samsen Road
Pranakhon, Bangkok 10200
Thailand
tanaik@bot.or.th

Dr. Jonathan Liebenau
London School of Economics
and Political Science
Department of Management
Information Systems and Innovation Group
Houghton Street
London WC2A 1AE
UK
j.m.liebenau@lse.ac.uk

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To Boonchuey Karnjanauksorn

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The views expressed in this book are those of the authors and do not represent the official views of the Bank of Thailand, the London School of Economics and Political Science or the University of Westminster. Any errors or omissions are attributed to the authors.

Preface

This book is being published during yet another period of dismay, and indeed disdain, for banking worldwide. Previous episodes of banking failures are associated with the mendacity of a few large bankers, or the mismanagement of a national treasury, or the knock-on effects of a major depression, or the failure of key regulators, and sometimes a combination of these and other factors. All these factors play a part in the explanation of the current banking failure, but there are at least two unusual factors that lie at the heart and have massively amplified these conditions. One is the abandonment of sensible risk analysis as financial instruments have been repackaged and sold on in ways that disguise, or at least camouflage, their riskiness. Another is the role of information and communication technologies in assisting in the computational processes that extend these practices using the tools of financial engineering and then extend and accelerate the knock-on effects of bad decisions.

The technologies that we focus on in this book were designed to have something of the opposite effect of those that accentuated the current malady in that they were designed to make more transparent the movement of money through the banking system. They were designed to ensure that debts are properly accounted for, that credits are paid out in an orderly fashion, that the parties involved are properly identified. They have been built and implemented such that the movement of money between organisations and among individuals can be scaled up without the system being highly sensitive to overload or congestion. They are supposed to be tools that promote efficiency, accountability, and above all, transparency.

We began this study shortly before the Asian financial crisis of 1997 and conducted studies initially among banks and central banks that were directly affected by it. We were concerned then and in the aftermath about the role that technology might have played in extending that crisis, but we were even more concerned about what financial institutions could do for themselves, apart from large scale geopolitical disruptions, to foster better practices. We were concerned to understand how banking systems could become more modern in the sense that they might move from practices that tended to isolate them from the benefits of more integrated, international financial systems. The risks of greater integration have long been clear, but the process of modernisation brought with it the opportunity to rid organisations of expensive practices that were long entrenched and directly contributed to low productivity.

No such technological artefact remains neutral for long. Its designers build into it features that emphasise their own priorities and biases. They are designed to ensure that those in charge of the systems benefit, sometimes at the expense of those whom the system is otherwise supposed to serve. We are assessing a large and intricate system, one that of course encounters resistance as it is implemented. That resistance is typical of the lifecycle of most innovations and originates in one form or another from locations throughout the institutions involved. Some stakeholders simply want no change of any kind, as they perceive (often quite correctly) that it will damage their vested interests. Sometimes participants would be willing to accept such innovations of product, method and practice, but are uneasy about their ability to adjust as users. Sometimes people would wish to champion alternative or contrary approaches, or value the supposed overall efficacy of a new system less than the anticipated costs at one particular point.

In this book we present a story of the introduction of payment systems. Early systems of this sort date from the last quarter of the twentieth century but the large scale standardisation of systems and the boost in participation such that the vast majority of banks worldwide now use such systems occurred in the last years of the twentieth century and the first years of this. This is the story of how this innovation took hold. It is also a study of how our understanding of innovation processes can teach us about processes of this sort, and of what this particular case of widespread innovation reveals about our understanding of innovation.

The common convenience of ATM machines, the widespread use of cashless payments, the rapid dissemination of smartcard payment systems and the facility for mobile payment, all rest on modern payment systems. How these innovations disseminated beyond the leading banking countries in northern Europe and North America so that they are available almost throughout the world is something that we have investigated in considerable detail by studying Asian banking systems in comparison with other regions. It is in this way that we are able to comment on the detailed mechanisms by which institutions acquired capabilities and adapted their practices to cope with the changes that they were undergoing.

The lessons from this story are far reaching. They extend to management practices and the implementation of new technologies. Although they may have most resonance for bankers and central bankers, those who are looking for ways to apply concepts of change to financial services and other large-scale systems should also see the extent to which clear thinking about innovation can bring better understanding.

Contents

Abbreviations

ACDES	Australian Cash Distribution and Exchange System
ACH	Automated Clearing House
ACSS	Automated Clearing Settlement System (Canada)
AFT	Automated Funds Transfer
APACS	Association of Payment Clearing Services (UK)
APCA	Australian Payments Clearing Association Limited
APCS	Australian Paper Clearing System
ASEAN	Association of South East Asian Nations
ATM	Automated Teller Machine
BACS	Bankers' Automated Clearing Services (UK)
BAHTNET	Bank of Thailand Automated High-Value Transfer Network
BCBS	Basel Committee on Banking Supervision
BECS	Bulk Electronic Clearing System (Australia)
BI-RTGS	Bank Indonesia Real Time Gross Settlement
BIS	Bank for International Settlements
BoF-RTGS	Bank of Finland Real-Time Gross Settlement
BOK-Wire	Bank of Korea Financial Wire Network
CECS	Consumer Electronic Clearing System (Australia)
CHAPS	Clearing House Automated Payment System (UK)
CHIPS	Clearing House Interbank Payments System (US)
CIFS	CBC (Central Bank of the Republic of China) Interbank Funds Transfer System (Taiwan)
CNS	Continuous Net Settlement
CPA	Canadian Payments Association
CPSS	Committee on Payment and Settlement Systems
DNS	Deferred Net Settlement
ECB	European Central Bank
ECS	Electronic Cheque Clearing System (Thailand)
EDI	Electronic Data Interchange
EFT	Electronic Funds Transfer

EMEAP	Executives' Meeting of East Asia-Pacific Central Bank and Monetary Authorities
EU	European Union
FBA	Finnish Bankers' Association
FSAP	Financial Sector Assessment Program (IMF)
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariff and Trade
GDP	Gross Domestic Product
HVCS	High-Value Clearing System (Australia)
IMF	International Monetary Fund
IT	Information Technology
ITMX	Interbank Transaction Management and Exchange (Thailand)
LVTS	Large-Value Transfer System (Canada)
MEPS	MAS (Monetary Authority of Singapore) Electronic Payment System
NECTEC	National Electronics and Computer Technology Centre (Thailand)
NPC	National Payments Council
NSTDA	National Science and Technology Development Agency (Thailand)
PACS	Planning and Control System
PEACH	Pan-European Automated Clearing House
PhilPaSS	Philippine Payments and Settlements System
PMJ	Finnish retail payment system
POPS	Finnish large-value netting system for express transfers and cheques (Pankkien on-line pikasiirrot ja sekit)
PSAF	Private Sector Adjustment Factor
PSC	Payment Systems Committee
R&D	Research and Development
RENTAS	Real-Time Transfer of Funds and Securities (Malaysia)
RITS	Reserve Bank Information and Transfer System (Australia)
ROSC	Reports on the Observance of Standards and Codes (IMF)
RTA	Regional Trade Agreement
RTGS	Real-Time Gross Settlement
SCL	Siam Commercial Link
SEACEN	South East Asian Central Banks Research and Training Centre
SEPA	Single Euro Payments Area
SET	Stock Exchange of Thailand
SIPCO	Siam Information and Processing Company Limited
SMART	System for Managing Automated Retail Funds Transfer (Thailand)

SNPC	Sub-Committee on National Payment Co-operation (Thailand)
SPICK	Sistem Penjelasan Imej Cek Kebangsaan (Malaysia)
TBA	Thai Bankers' Association
WATCH	Worldwide Automated Transaction Clearing House
WTO	World Trade Organization

Chapter 1
Introduction

Abstract Modern payment systems have transformed both the technology of banking and made possible numerous changes in the strategy and structure of financial services organisations, including central banks. By applying innovation theory to this study of payment systems, we can show how such a broad change, replete with intricacies, could be conceptualised, designed, implemented and disseminated. In this book, we examine the relevant theories of innovation and provide a review of the strategic approaches to establishing efficient payment systems. We set up the story of the diffusion of payment innovations, the building of capabilities in banking, and consider future challenges.

In his *Theory of Economic Development*, Joseph Schumpeter observed that 'economic logic prevails over the technological and in consequence we see all around us in real life faulty ropes instead of steel hawsers, a clumsy money economy instead of a cheque circulation'. Over half a century on, his views on how radical innovations drive gales of creative destruction remain valid in many modern banking systems where paper-based payment economies now face substitution challenges by more efficient electronic payment methods to achieve speedier and safer payments.

The process of payment systems modernisation presents a major challenge to both policy makers and practitioners alike, involving tasks that range from the formulation of high-level strategic plans, the drafting of new legislation, and the development of common standards and state-of-the-art technology among others. Payment systems form a core group of strategic information systems which contribute towards economic development, and often constitute the foundation for financial sector and national information infrastructure developments (Listfield and Montes-Negret 1994; Talero 1997; BIS 2006). They operate as the plumbing system for financial markets and help improve macroeconomic management, releasing funds from the clearing and settlement functions for more productive use, reducing float levels, and improving the control of monetary aggregates.

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The principles of payment systems involve the discharge of financial obligations between two or more payment participants (Humphrey 1995). This mainly aims to provide financial markets promptness and certainty in the payment and settlement of borrowed and invested funds. In addition, it provides consumers the convenience of time and location, the choice of payment options, and the privacy and low cost of making payments.

Consumers, businesses, financial service providers, and government agencies transfer funds among each other in a matrix of different payment environments and payment methods. This ranges from making simple cash payments between a consumer and business in a retail purchase on the high street to a more sophisticated setting whereby a central bank or monetary authority uses electronic credit transfers in a real-time gross settlement (RTGS) system to inject liquidity into a financial institution faced with intraday liquidity shortages to ensure that the payment system runs smoothly, and more importantly, to maintain financial and monetary stability (Haldane et al. 2008; Johnson 1998).

Schumpeter's early observation was echoed in a major competition review in one of the world's most modern banking systems – the United Kingdom – which stated: 'The rhythm of the UK payment system often seems to reflect the nineteenth century more than the twenty first. It takes three to four working days for a customer of an internet current account provider to transfer money electronically through BACS to an account held with another supplier, for example. Other aspects of the payments cycle still bear witness to the work habits of a nineteenth century bank clerk. Weekends and bank holidays add further unnecessary delays to what are now largely automated processes. Internet retailers are frustrated at the credit and debit card systems' lack of flexibility in adapting to an e-commerce world (HM Treasury 2000).

The UK Faster Payments Service was introduced in May 2008 to meet this twenty first century catch up challenge by revolutionising the automated payments infrastructure with the development of a central infrastructure that served as Schumpeter's 'steel hawser' (APACS 2008). It envisaged the speeding up of phone, internet and standing order payments from several days to only a few hours with an initial phased rollout approach by 13 banks and building societies who were founding members. The very first money transmission transaction made a global impact; a charity donation of £10,000 by the 13 founding members to Oxfam for the disasters emergency committee's Burma cyclone appeal to deliver aid relief to people affected by Cyclone Nargis.

Schumpeter's ideas on innovation are also at the heart of the Lisbon Strategy which seeks to transform the European Union (EU) into the most competitive economic area in the world with innovation serving as the motor of economic change. This has led to the formulation of the European Commission's Financial Services Action Plan in 1999 which includes measures to further modernise and integrate payment and securities settlement systems in the EU area (Koskenkylä 2004).

The study of global payment systems has been largely well researched and documented since 1980 when the governors of the central banks of the Group of Ten (G10) countries set up a Group of Experts on Payment Systems, which later

evolved into the establishment of the Committee on Payment and Settlement Systems (CPSS) under the auspices of the Bank for International Settlements (BIS) in 1990. The body of knowledge grew from the study of computer-related issues and preparation of descriptive country reports, also know as the 'Red Book', to a wider range of topical issues including interbank netting schemes, foreign exchange and settlement, securities and derivatives settlement, large-value payment systems, retail payment and electronic money, oversight, system interdependencies, and principles, recommendations and guidance (www.bis.org).

It is also interesting to note the extensive studies on the US payments system as the US Federal Reserve has been actively involved in providing payments processing services since its establishment in 1913, operating the cheque processing, automated clearinghouse, and large-dollar wire transfer systems (Humphrey 1984). These roles were reviewed in light of the *Depository Institutions Deregulation and Monetary Control Act of 1980*, which gave it a mandate to recover all direct and indirect costs in providing priced services. By the late-1990s, a comprehensive study on its role in the payments mechanism concluded that it should remain a provider of payment services and play a more active role in collaborating with both service providers and users (Federal Reserve System 1998). Moreover, the U.S. experience has played an important role in modernising payment systems in many emerging economies where U.S. Federal Reserve officials helped provide technical assistance, particularly to former socialist republic countries (Balino et al. 1994; Summers 1994; Zulu et al. 1994; Hook 1992).

Comparatively, the body of knowledge on payment systems in emerging economies is rather limited but growing. This is partly explained by the historical role the G10 governors played in responding to global currency and banking market disturbances, which led to foreign exchange settlement problems, and the subsequent failure of Bankhaus Herstatt in West Germany (Davies and Green 2008). During the crisis, most of the G10 central banks, which were dominated by advanced economies in Europe, served as banking supervisors in their jurisdiction. Thus, the G10 governors pushed forward the establishment of a committee on banking regulations and supervisory practices in 1974 (later renamed as the Basel Committee on Banking Supervision), which was followed by the mandate to start overseeing payment systems efficiency and stability in the 1980s.

One of the earliest studies to examine global payment system developments focused on central banks in the Bank of England Group (Fry et al. 1999). The study found that the level of payment systems modernisation varied across countries around the world. In industrial, transitional, and developing economies, countries have faced a range of obstacles including their existing legal framework, technical infrastructure, and maturity of banking systems. Payment system strategies undertaken in these countries often have the involvement of the central bank and commercial banks in devising evolutionary or leapfrogging strategies. In particular, the majority of developing country central banks have experienced payment system reforms since 1975. Indeed, 16 central banks in the study initiated them with developments concentrated on technical change, such as in the automation of cheque clearing houses.

The International Monetary Fund (IMF) and World Bank have also played an important role in increasing the understanding of payment systems in emerging economies through their financial and technical assistance programmes. In particular, this has included the assessment of major payment and securities settlement systems against the BIS core principles for systemically important payment systems, which are conducted under Financial Sector Assessment Programs (FSAP) and Reports on the Observance of Standards and Codes (ROSCs) (www.imf.org). Assessments aim to spot vulnerabilities in the payment systems and their potential to undermine monetary or financial stability, and their negative impacts on the liquidity situation in financial markets. Predictably, early assessments for developing countries noted: 'a significant majority of the systems suffered shortcomings of various importance in their design and operation that may expose them to risks in the event of a problem' (IMF and World Bank 2002).

Davies and Green (2008) observe that major developing countries have been left out of key decision-making forums that shape global financial regulation, and in particular propose that Asia-Pacific countries such as China, India and Singapore, should be more involved due to the growing significance of their financial markets and overseas bank operations. In the area of payment systems, 3 of 15 CPSS members are currently Asian (Japan, Hong Kong, Singapore), while 3 of 42 countries assessed under the IMF/World Bank FSAP from 1999 to 2001 were Asian (India, the Philippines and Sri Lanka).[1] And although Asia-Pacific countries have initiated regional collaboration in forums such as the Executives' Meeting of East Asia-Pacific Central Banks and Monetary Authorities (EMEAP) and the South East Asian Central Banks (SEACEN) Research and Training Centre, these meetings have been mainly focused on information sharing, research and capacity-building efforts rather than serving as a regional decision-making body that shapes global payments reforms.[2]

This book examines the process of payment systems modernisation from an innovation perspective. To fully understand the dynamics of the development process, it first discusses the evolution of innovation theory and proceeds with a review of the strategic approaches to achieving payment systems efficiency and innovations, the economic analysis of efficiency, the diffusion of payment innovations, capability development in the banking sector and in commercial banks, and finally considers the future challenges.

In Chapter 2, we discuss the analysis of payment systems modernisation from an innovation perspective. We first review the different models of innovation starting from the diffusion model and progress with a detailed discussion of more recent

[1]The number of Asian countries that have participated in the IMF/World Bank FSAP have increased since 2001. The inclusion and disclosure of assessment results of payment and securities settlement systems are subjected to the consent of member economies. See http://www.imf.org

[2]EMEAP members include Australia, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore and Thailand. SEACEN members include Brunei Darussalam, Cambodia, Fiji, Indonesia, Korea, Malaysia, Mongolia, Myanmar, Nepal, Papua New Guinea, the Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam.

approaches from evolutionary economics and resource-based perspectives that have influenced the concept of national systems of innovation, which have been adopted in the context of modernising financial services, and in particular payment systems.

In Chapter 3, we discuss the strategic approaches to promoting payment systems efficiency and innovations. We present the different policy approaches - minimalist, competitive, and public service – that have been pursued in the context of advanced and emerging banking systems. We then discuss how technological, regulatory and financial innovations can promote payment systems efficiency.

Chapter 4 discusses the analytical frameworks for examining payment systems efficiency with a summary review of selected studies. To illustrate how countries are catching up on the efficiency frontier, we discuss the use of cash and cashless payment instruments and their implications in Asia. This is followed by an economic analysis of central bank payment services.

Chapter 5 further examines the diffusion of electronic payment innovations with a discussion on the cross-country use of cash and electronic payments and the costs of using different payment instruments. We then forecast the shares of electronic and cash payments in Asia and discuss their future implications for monetary policy going forward.

Chapter 6 provides an analysis of capability development in the banking sector. We present survey results on innovation in the banking sector, which took place in the context of financial services liberalisation and later a financial crisis. We examine IT awareness and usage, the level of computerisation of payment services, sources of learning, and sources of technological capabilities. Chapter 7 provides a firm-level analysis of capability development in selected commercial banks. We examine their background, use of IT, and sources of innovation, and discuss how innovation has helped them gain competitive advantage and maintain their market leadership positions. Finally, in Chapter 8, we consider the future challenges facing the modernisation of payment systems. We particularly examine the challenges from maintaining financial stability, fostering financial integration, liberalising financial services trade, and promoting technological innovation.

Chapter 2
Payment Systems: An Innovation Perspective

Abstract Innovation concepts underpin the growth and development strategies of the European Union and have been adapted to drive the integration of the Lisbon Strategy with the Financial Services Action Plan. They are at the core of practices to introduce measures promoting the efficiency, stability and reliability of payment systems. European financial integration, particularly the integration of payment clearing and settlement systems, can be seen as a sub-set of Europe's broader national system of innovation, which is based on a system of social and institutional factors influencing innovation and interactive learning processes. In this chapter we link these goals with the study of innovation beyond technology embodied in products and processes. We show that in studying firm capabilities, competencies, and the distinct resources that contribute towards innovation, we can extend the approach to study new ways of doing things in the services industry. We link this to the ability of firms and industries to increase their competitiveness and to promoting national economic development. As part of this, in this chapter we show how different innovation models contribute to our understanding of these innovation processes.

As we discussed in Chapter 1, the concept of innovation underpins the growth and development strategies of the European Union and drives the integration of the Lisbon Strategy with the Financial Services Action Plan and the introduction of necessary measures promoting the efficiency, stability and reliability of payment systems. European financial integration, particularly the integration of payment clearing and settlement systems, can be seen as a sub-set of Europe's broader national system of innovation, which is based on a system of social and institutional factors influencing innovation and interactive learning processes (Freeman 1982; Lundvall 1992; Nelson and Winter 1982).

As an illustration, the European Commission's Payment Services Directive adopted in 2007 paved the way for further entrepreneurship and innovation in the European payments market by introducing a new authorisation regime for so-called 'payment institutions' that are neither banks, building societies, nor e-money issuers. This seeks to 'enhance competition, efficiency and innovation in the European payments market by removing barriers to entry and ensuring fair market access, and

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establish a set of rules on the information requirements, and the rights and obligations which would be applicable to all payment service providers and end-users in the European Union.' As a result, the unleashing of this 'creative gale of destruction' would promote more innovation and competition on the part of payment service providers, and create more flexible payment choice for consumers.

While this concept is clearly evident in Europe, its variants are also present in many national development plans, and in particular payment system reform plans around the world where innovation plays a key role in driving development. We illustrate this below. But before that we consider how Schumpeter's early ideas on innovation evolved into the concept of a national system of innovation. We then consider how payment service providers capitalise on innovation to compete successfully. To address this, it helps to review the major models of innovation that have influenced economic, technological and managerial thinking.

2.1 Models of Innovation

The definition of innovation is in itself diverse. Schumpeter (1934) viewed innovation as the carrying out of old and new combinations, 'employing existing resources in a different way, in doing new things with them, irrespective of whether those resources increase or not'. Innovation is also seen as the combination of invention and commercialisation which forms the foundation of firm competitiveness (Freeman 1982; Porter 1990). From the organisational standpoint, innovations are defined as 'the adoption of ideas that are new to the adopting organisation' (Rogers 1983). Moreover, the types of innovations may include technical, administrative, product, and process innovations (Damanpour 1991; Utterback 1994).

Apart from studying innovations as 'technological innovations' that are embodied in products and processes, it is important for us to account in the services industry for new ways of doing things. This view considers how firm capabilities, competencies, and distinct resources contribute towards innovation, which, in turn, determines the sustaining of competitive advantage of firms, industries, and countries. The development of different innovation models helps illustrate the major contributions and shortcomings in understanding the innovation process.

2.1.1 The Linear Model

The linear model views innovation as following a determined sequence of stages. The ideas that shaped the model were introduced as early as the seventeenth century in Francis Bacon's *The Advancement of Learning* (Bacon 1605). Bacon argued that government should fund and support academic research, contributing to advances in pure and applied sciences, technological progress, and economic growth, and such arguments were in favour of expanding knowledge through government involvement, particularly by the monarchical establishment (Kealey 1996).

Although Bacon's argument was convincing during his time, arguments against the model, particularly the role of government initiatives in supporting science, were presented by Adam Smith.

Smith's argument against the linear model was based on free trade principles and the role that technology played in promoting economic growth independent of government support. The sources of new technologies that Smith proposed were shaped by the development of pre-existing technologies and industrialists working outside academia also contributed (Kealey 1996).

These early arguments illustrated the limitations of the linear model and contemporary innovation research partly shaped past and present national policies in science and technological development. The linear model is widely discounted because it fails to capture the richness of the innovation process. Simple models are based on the assumption that the increase in the number of a given input would result in the relative increase in output. For example, an increased investment in research and development (R&D) would produce more patents. On the contrary, many now argue that the heart of innovation lies in the transformation process, whereby the inputs are processed into outputs mediated by a variety of institutional factors. Others stress that the free market approach, characterised by the combination of old and new science and technologies, has been by far the most successful model for innovation, as compared to the linear model which emphasises the role of government in funding science and technological development. Kline (1985) further argued that innovation was a non-linear process, and proposed a linked-chain model which illustrates the feedback and connection relationships among research, invention, innovation, and production. Rothwell (1992) reviewed the development of major innovation models, and suggest that there has been a shift from the simple linear 'technology push' and 'need pull' models of the 1960s to a more 'strategic integrated and networked' model in the 1990s.

2.1.2 The Diffusion Model

The linear model is commonly associated with the widely used innovation diffusion theory which defines diffusion as 'the process by which an innovation is communicated through channels over time among members of a social system' (Rogers 1983). This model explains how an innovation follows a particular path during diffusion, progressing in sequential stages. The model, although commonly criticised, has been widely used in different disciplines and suggests that innovation diffusion follows a linear direction. Four major factors influence innovation diffusion under this model – innovation characteristics, communication channels, time, and social systems. Moreover, the process of diffusing innovations involves two general stages, the adoption stage, involving knowledge acquisition, learning and decision-making; and the implementation stage, involving organisational changes and the support for technological deployment.

The strengths of the model are four-fold (Rogers 1983). Firstly, the model provides a common conceptual ground for researchers addressing a field of study that

has divergent methodologies and is multidisciplinary in nature. Secondly, the model provides a pragmatic approach that yields solutions that can be utilised by individuals and organisations and can also be used to address social problems. Thirdly, it allows researchers to accumulate empirical findings as they go along and this could be used as the basis for higher-level generalisations of a more theoretical nature. Lastly, diffusion research provides clarity and straightforwardness for the researcher in gathering and analysing data as these approaches are well established.

Rogers (1983) also raises four main limitations. Firstly, the model takes a pro-innovation bias, implying that innovations should be diffused and adopted rapidly by members of the social system, and not re-invented or rejected. Secondly, the model takes an individual-blame bias towards holding individuals responsible, rather than the social environment or institutional system to which the individual belongs. Thirdly, researching the model has faced a recall problem whereby respondents have provided inaccurate accounts of when they adopted a particular innovation. And lastly, the model raises the issue of equality for which the socio-economic gaps between members of a social system are widened as a result of introducing innovations. These limitations are partly explained by the linear-orientation of the model which focuses on the relationships between innovations, and their diffusion through a sequence of stages.

2.1.3 The Innovation Dynamics Model

The model of innovation dynamics analyses product-process relations of innovations (Utterback 1994; Abernathy and Townsend 1975; Abernathy and Utterback 1978). The main argument is that most innovations follow a general pattern over time, including three major phases – the fluid, transitional and specific phases. The fluid phase is characterised with high rates of product innovation in an industry, as firms compete in new product design development. However, there is a low rate of process innovation which increases in the transitional phase. In the transitional phase, the rate of process innovation overtakes product innovations, which slows down but contributes to the emergence of dominant designs of a particular product, prior to entering the specific phase, characterised by low product and process innovations. The role of dominant designs is important in this model because it is the product class

> 'that wins the allegiance of the marketplace, the one that competitors and innovators must adhere to if they hope to command significant market following. The dominant design usually takes the form of a new product synthesised from individual technological innovations introduced independently in prior product variants' (Utterback 1994).

The model suggests that as an organisation enters a particular phase, it will require a range of capabilities to profit from an innovation. This implies that a firm having strong competencies in the design and development of new product innovations is more competitive than firms lacking such strategic resources in the fluid phase of the model. The model successfully explains the entry and exit of firms in

an industry with regard to new product-process innovation development. However, it does not address how organisations can create the necessary competencies to compete, how they can develop dominant designs, and most importantly, how organisations might compete on the base of unique resources.

2.1.4 Teece's Model

In a seminal article that still defines his influential approach, David Teece identified two major factors influencing innovation in firms (Teece 1986). Firstly, the 'appropriability regime' of a firm can protect it from competitors imitating its technologies, particularly through the provision of intellectual property (patents, copyrights, trademarks and trade secrets) and the protection of technology. Secondly, the 'complementary assets' of a firm contributes to the creation of capabilities required in innovation which also influences the development of an integrated research organisation (Teece 1988). These assets include a firm's unique characteristics in manufacturing, marketing, distribution, services, reputation, and brand name.

In extending this approach, for example, Abernathy and Clark (1985) argue that a firm's marketing capabilities are equally important in influencing innovation, as compared to its technological capabilities. Patel and Pavitt (1997) also argue that the technological competencies of large firms are influenced by complexity and path-dependency, suggesting that there is multiple product innovation development, but based on and limited to the principle products of the firm. Teece and Pisano (1994) and Teece et al. (1997) support this view, arguing that the dynamic capabilities of firms are related to their routines and history, represented in processes, positions, and paths.

The implications of the model are two-fold. First, organisations have a higher potential to profit from innovations that have high 'appropriability regimes', implying that the ability of competitors to imitate innovations are limited and constrained by their strategic boundaries. And second, the competition between firms in innovation is largely based on whether 'complementary assets' are specialised or not, which, in turn, influences the ability to imitate innovations.

2.1.5 The People Perspective

Individuals also influence innovation in organisations, mainly because they are in a position to identify and promote the potential of technological innovations. This may include, for example, the idea generator, the gatekeeper, the champion, and consultants. Idea generators are individuals who possess a mix of specific and general skills, characterised by a depth of knowledge in a particular discipline combined with the ability to integrate a breadth of knowledge in a wide range of areas, for example in the development of new products between different functions of a firm (Iansiti 1993).

The gatekeeper serves as a bridge between a firm and its environment, identifying external sources of information and translating them into a language the organisation could understand (Allen 1984; Tushman and Nadler 1986). The champion is characterised by an individual who transforms his vision or an idea generator's suggestion of a particular innovation into reality, and this is usually supported with an organisation's resources and commitment (Schön 1963; Roberts and Fusfeld 1981; Howell and Higgins 1990; Beath 1991; McKenney et al. 1995). Consultants also play an important role in the transfer of technology, particularly in bridging the 'managerial gap' which is required to absorb and assimilate new technology inputs (Bessant and Rush 1995).

The Bank of America provides one illustration (McKenney et al. 1997; Mason et al. 1997). The case study, adopting an historical approach to the analysis of major technological innovations, identified three major types of individuals who played key roles in introducing dominant designs for banking operations during 1958–1964. This included a non-technological 'leader' who possessed a vision to introduce technological innovations, a 'maestro' who fully understood the technological and business aspects of the company, and the 'supertech' who are team members who work on the detailed managerial and technological tasks to fulfil the leader's vision. The importance of people under the resource-based perspective is primary, as human resources are unique, and a major source of innovation, and sustained competitive advantage.

2.1.6 The Profit Chain

The profit chain model attempts to integrate major innovation concepts in explaining how firms can profit from innovation. The model considers a range of factors that contribute towards the generation of company profits, including the characteristics of competencies, endowments, knowledge, environment internals, and the nature of innovations (Afuah 1998). One of the key factors in this model is knowledge, which forms the foundation for developing low cost or differentiated product innovations, and is largely influenced by a company's competencies and endowments.

The competencies of a company are similar to its skills. For example, this may include capabilities in new product design and development. The endowments of a company ranges from non-skill-related factors which strengthen existing competencies, such as brand names, patents, reputation, geographic location, client relations, and distribution channels. The competencies and endowments of a company are in turn reinforced by its underlying marketing and technological knowledge, which together contribute to the development of new products and services. Moreover, Afuah and Bahram (1995) argue in their 'hypercube of innovation' model that a firm's learning and innovation process influences, and is in turn influenced by its customers, suppliers and complementary innovators. These views support the resource-based perspective, as they emphasise competencies and endowments in furthering innovation in firms.

2.1.7 The Services Model

One of the common shortcomings in the previous models is that they are oriented towards product innovations and provide relatively weak analyses of innovation in services. Guile and Quinn (1988a, b), for example, suggest that although services have become the largest and fastest growing sector in the United States economy, it remained understudied, as compared to the manufacturing sector. There have been attempts to develop theories which interpret innovation processes in the service sector by the conceptualisation of 'products' as encompassing both manufacturing and services (Lancaster 1966). Gallouj and Weinstein (1997), for example, argue that innovation in services can be analysed from a product's final, technical, and process characteristics, which reconciles the 'science-push' and 'demand-pull' perspective in innovation studies.

The reverse product cycle also attempts to provide an innovation model in services (Barras 1986). The model mirrors the product cycle theory, which explains the development of new products based on new technology, but operates in opposite directions in three major phases. These phases include the use of new technology to increase efficiency in existing services, the use of new technology to improve the quality of services, and lastly, the use of new technology to develop new services. The three phases interact with the innovation process in the product cycle and reinforces each other in the transformation and generation of new products and services.

The study of financial services innovation suggest that it represents a vanguard economic sector, characterised by retail banks using new technology to increase efficiency through back-office computerisation, the application of automated teller machines (ATM) to improve customer services, and the use of new technology to develop new network services (Barras 1990). Buzzacchi et al. (1995) also developed a conceptual model to analyse innovation in electronic payment services in banking, and argued that demand-pull factors stimulated innovative behaviours in 'smart automation' regimes, as contrasted to innovation in 'mass automation' regimes, which was limited by cumulative and learning-by-doing effects in back-office automation. These views also support the resource-based perspective, as they attempt to distinguish between behaviours in innovation in the manufacturing and services sectors.

2.1.8 The Developing Country Model

There are also limitations to the generalisation of the previous innovation models, as they were developed in the context of advanced industrialised nations, disregarding the context of developing countries which possess distinct characteristics. Several early studies have suggested that the processes of technological development in such countries proceed differently, and many such studies are

guided by simplistic stage-development models (Enos 1962; Lall 1980). However, technological innovations do not follow sequential stages and require further elaboration through dynamic innovation models (Fransman and King 1984; Fransman 1985, 1986). The key innovation concepts, as discussed in previous innovation models, have been applied and adapted by some authors, contributing to the development of integrated analytical frameworks (Lee et al. 1988; Kim and Dahlman 1992; Hobday 1995; Wei 1995; Kim 1997).

Kim (1997), for example, introduced four analytical frameworks to examine the dynamic learning process from imitation to innovation in industries. This includes the global technology framework, the institutional environment framework, the firm dynamic learning framework, and the technology transfer framework. The first framework extends the innovation dynamics model by incorporating a three-stage model – acquisition, assimilation, and improvement – to examine technological trajectories in advanced and catching-up countries, and the accumulation of indigenous technological capabilities by firms in an industry (Kim 1980). The second framework argues that three major mechanisms influence the creation of technological capabilities in firms; interactions with the international community, interactions with the domestic community, and in-house efforts. These three mechanisms interact and reinforce each other, and are influenced by five factors – the market/technology environment, formal education, socio-culture, organisational structure, and public policy. Other frameworks emphasise the importance of individual and organisational learning processes in the firm which is influenced by absorptive capacities, discontinuous learning patterns, and the nature of the knowledge being either tacit or explicit (Grant and Liebenau 1997). Moreover, firms can strengthen existing capabilities through formal and informal technology transfer channels from foreign suppliers. This may include foreign direct investment, foreign licenses, and turnkey plants through the former, and printed information and observation of foreign plants in the latter channel.

In sum, the previous discussion illustrates how different models of innovation were developed to address the dynamic nature of innovations. These models further support the argument that innovation research is shifting away from the linear oriented view of innovation towards more integrated and networked approaches. This shift partly reflects the increase in understanding of innovations as being dynamic and embodied in product and process innovations. It must be emphasised, however, that the selected models are not exhaustive, and only represent some of the major developments in studying innovation.

This review suggests a shift in innovation models from a linear oriented view towards a more integrated, networked, and strategic perspective. Moreover, this shift also reflects an increased understanding of innovation as being dynamic, as contrasted by earlier views, which viewed innovation as only products and processes. One alternative approach in studying the dynamic nature of innovation focuses on their behavioural characteristics, which is represented by the evolutionary and resource-based perspectives.

2.2 Evolutionary and Resource-Based Models

The evolutionary and resource-based views of innovation are mainly oriented towards the economic or strategic management literature and have common and contrasting characteristics. These models, however, are not exclusively categorised as evolutionary or resource-based models, partly because the major innovation concepts are related and are widely applied between both perspectives.

2.2.1 Evolutionary Perspectives

A few early economists were interested in the importance of innovation. Marx (1999) argued that innovations created markets, which was a key factor in economic growth, while Hicks (1932) argued that innovation reduced factor of production prices, creating shifts among them accordingly. These early studies, however, were limited to explaining initial choices of innovations based on factor price models, and they failed to discuss the dynamic nature of the innovation process.

2.2.2 Schumpeter

One of the earliest economists to use evolutionary approaches to study innovation was Joseph Schumpeter who made two major arguments (Schumpeter 1934). Firstly, there is a positive relationship between entrepreneurs and innovation. Secondly, there is a higher potential for larger firms to innovate. These propositions suggested that there was a strong relationship between the size of a firm and its ability to innovate, implying that the greater the control a firm has over the means of production would influence its innovative capabilities in industry. These propositions also suggest that monopoly furthered innovation, creating a 'gale of creative destruction' during the process (Swedberg 1991). Such arguments also assume a stronger tendency for innovation to be more frequent in monopolistic industries than in competitive ones.

These arguments, however, did not amplify the process of 'creative destruction'. This process, involving new firms entering and old firms exiting an industry in the presence of new technological innovations, inspired the work of economists in the demand-pull vs. the technology-push perspectives (Schmookler 1966; Scherer 1984; Elam 1993; Stoneman 1995). The first perspective argues that innovations are based on economic opportunities, while the latter view focuses on the role of strong technical bases in influencing innovation. Furthermore, some economists have attempted to understand the relationship between both perspectives through the study of key social and institutional factors influencing the innovation process in a broader national system of innovation (Freeman 1982; Lundvall 1992; Nelson and Winter 1982).

2.2.3 Freeman

Christopher Freeman introduced a taxonomy of technical change, pointing to the role of the techno-economic paradigm which requires an understanding of the social and institutional factors influencing innovation processes and national systems of innovation (Freeman 1982, 1987; Freeman and Perez 1988). This taxonomy distinguishes four categories of innovation: incremental innovations, radical innovations, changes in technology systems, and changes in the techno-economic paradigm. Comparatively, these innovations differ in their intensity and impact on economies.

The implications toward innovation studies are two-fold. Firstly, Freeman (1987) identified a rationale that influences innovation, in addition to the conception of innovations based on rational choices and cumulative small modifications. This is based on new combinations of radical innovations, linking major advances in S&T with organisational and social innovations. This rationale is particularly important as it addresses the intangible factors in technological learning activities and their linkages among institutions which have been ignored in earlier models of innovation (Patel and Pavitt 1994). The techno-economic paradigm also addresses both continuous and discontinuous technical changes which include the interplay among scientific advances, economic factors, and institutional variables (Dosi 1982). These changes influence the innovation process, including the formation of firm innovation strategies which may be characterised as offensive, defensive, imitative, dependent, traditional, and opportunist (Freeman 1982).

Secondly, these factors played important parts in a national system of innovation. This system is defined as 'the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies' (Freeman 1987). This suggests that the rate of technical change in a country does not simply depend on the magnitude of R&D or other technical activities, and the competitiveness of firms should not depend on such factors.

Alternatively, technical change also depends on the appropriate manner whereby a country's resources are well managed and organised at the enterprise and national levels. Thus, Freeman (1987) concludes by arguing that 'the national system of innovation may enable a country with rather limited resources, nevertheless, to make very rapid progress through appropriate combinations of imported technology and local adaptation and development'. These arguments, for example, have been applied to show how the Japanese Ministry of International Trade and Industry accelerated technical change, influenced industrial policy, and supported the IT industry with subsidies and tax incentives to stimulate R&D (Freeman 1987; Johnson 1982; English and Brown 1984).

National innovation systems, however, are far from ideal. There is no perfect model of national innovation systems, partly because different institutions in different countries do not follow a fixed set of policies in promoting technological innovation. Nevertheless, there have been attempts in modelling national innovation systems, for example from regional, industrial, and enterprise perspectives

(Padmore et al. 1998; Padmore and Gibson 1998; Cooke et al. 1997). Therefore, there is a need to understand the range of factors influencing the ability of institutions to innovate, particularly at the sector and firm levels.

2.2.4 Lundvall

Bengt-Åke Lundvall developed the argument for national innovation systems, focusing on the relationship between innovation and interactive learning (Lundvall 1992). This theoretical approach is based on two fundamental assumptions. First, knowledge is the most important resource in a modern economy, while learning is the most important process. Second, learning is largely interactive, being a socially embedded process which addresses both institutional and cultural contexts.

The main argument is that interactive knowledge is embedded in organisational routines. Innovation is viewed as a cumulative process, implying that the 'most important forms of learning may fundamentally be regarded as interactive processes, and that together the economic structure and the institutional set-up form the framework for, and strongly affect, processes of interactive learning, sometimes resulting in innovations' (Lundvall 1992). This argument also implies that learning processes are discontinuous and non-linear in nature (Meyers 1990), and requires an organisation to develop an absorptive capacity to further innovation (Cohen and Levinthal 1990).

Lundvall also argued that technical change does not solely depend on the scale of R&D functions of firms. Alternatively, learning is acquired from workers through the production structures, and innovations arise from routine activities such as in the process of production, distribution, and consumption. Such workers, who are in direct contact with these processes, interactively learn from them, further producing new knowledge for innovations. This argument is supported by the concepts of 'learning-by-doing' (Arrow 1962) and 'learning-by-using' (Rosenberg 1981).

This approach suggests that institutions provide some stability to uncertainty in a national innovation system which reflects the argument advanced by North (1990) that institutions provide a guidepost for action and change, and also serve as routines. This routine reinforces learning in the production structure, covering the production, distribution, and consumption processes. In addition to the learning process, the processes of searching and exploring are also creative inputs into the innovation system, pointing to the importance of institutions in a national system of innovation.

There is a distinction between a system of innovation in the narrow sense and a system of innovation in the broad sense. The narrow definition would include organisations and institutions involved in searching and exploring – such as R&D departments, technological institutes and universities. The broad definition which follows from the theoretical perspective includes all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring – the production system, the marketing system and the

system of finance present themselves as sub-systems in which learning takes place. (Lundvall 1992).

Lundvall's (1992) theoretical approach analyses what constitutes the social and institutional factors that influence innovation. This mainly focuses on routines existing in both production structures and institutional set-ups. The role of routines provides workers with the basis to learn, use, search, and explore creative inputs into the innovation process. Nelson and Winter (1982) also support and extend this argument by viewing routines as similar to genes that can be transferred across organisations.

This form of analysis addresses sub-systems, social institutions, and their linkages within a broader national innovation system. For example, such studies have focused on the past and potential roles of the public sector in influencing national systems of innovation (Gregersen 1992), the relationship between finance and innovation (Christensen 1992), and the sectoral patterns of technical change (Pavitt 1984). Klevorick et al. (1995) also argue that inter-industry differences in innovation are based on three major sources of technological opportunities: advances in scientific knowledge and technique, advances in industry and private-governmental institutions, and feedback from industry.

The limitation of the approach is the abstractness of learning. The approach makes an important assumption that knowledge and the learning process are very important for innovation, and this can be assessed through the focus on routines. However, the interactive learning of these routines, which contribute to innovation, are constrained by the explicit and tacit characteristics of knowledge. Such limitations partly determine whether knowledge can be transferred between individuals accordingly.

2.2.5 Nelson and Winter

Richard Nelson and Sidney Winter further analysed the key role of routines in innovation which were characterised as genes that are transmittable across organisations (Nelson and Winter 1977, 1982; Nelson 1979). This biological analogy of organisational routines, or organisational genetics, is analogous to individual skills, implying that the study of routines in innovation requires the analysis of these traits or individual skills which can be characterised into two main areas.

First, individual skills are analogous to computer programmes, including programmes functioning as a unit, being serial, operating automatically, and performing efficiently and accurately. In this respect, human skills function as units in various levels of the organisation. Moreover, its serial organisation reflects its structure, determining the order in which skills should be executed and carried out automatically.

Second, individual skills are tied to tacit knowledge (Polanyi 1973). This holds that although a very skilful individual may carry out a work performance efficiently, this does not imply that she can articulate it clearly. In harnessing such

knowledge to strengthen organisational capabilities, determining the degree of tacitness, or the limits of articulation of different situations, is primarily important. Moreover, this involves a 'never-ending spiral' process of converting both individual and organisational knowledge that are tacit and explicit by nature (Nonaka 1994; Nonaka and Takeuchi 1995). For example, the role of tacit knowledge in a particular performance may be high, provided that the situation is non-standardised, uncontrolled, or complex.

Institutions play a central role between individuals and innovations. Organisational routines are analogous to individual skills and reflect its capabilities. Such routines, originating from individuals, provide a potential source of innovation. This creates diversity among firms which develop different strategies, structures, and core capabilities (Nelson 1991). Therefore, the role of routines in innovation in this theory is particularly important and involves two major roles.

The first role of routines in innovation is in organisational memory. This serves as storage for an organisation's knowledge or the location of its capabilities. Nelson and Winter (1982) define this as the process of 'remember by doing' on the part of an organisation. A typical routine operation in an organisation would involve, for example, the interpretation of incoming tasks by individuals who respond with an appropriate performance from their 'repertoires'. These repertoires are defined as 'a set of skills or routines that a particular member in an organisation could perform in some appropriate environment' (Nelson and Winter 1982). This operation would generate successive messages for other individuals in the organisation for interpretation and performance accordingly.

There are several conditions or capabilities, however, that organisations must satisfy to carry out routines productively. This includes the character of individual member's repertoires, the ability of such members to operate plant and equipment, and the exercise of member's capabilities. It is important to stress the latter point that through the exercise of skills, an individual can remember by doing. This is in contrast to increasing productivity solely through the co-ordination of operations because individual skills, once exercised, are maintained, and in turn, refreshes organisational memory.

The second role of routines in innovation is through its use as a target for control, replication, and imitation. The first target states that an organisation faces difficulties in maintaining control of its routines that is subject to new inputs, for example, new recruits or new computer equipment. It may attempt to counter this through the processes of selection, modification, monitoring or adaptation. However, this applies only to a certain extent, as the changing environment may be dynamic, calling for non-standardised routines. Consequently, organisational routines undergo mutation, which may foster productivity and innovation, or vice versa.

The second target states that an organisation attempting to replicate or improve its template based on a more successful routine from another organisation does so imperfectly. This may be problematic, taking into consideration the extent that knowledge can be transferred despite its tacit nature, and potentially leading to the mutation of routines. Nevertheless, the primary objective behind replication should be to strive to acquire an overall efficiency that is parallel to the original routine.

The last target states that an organisation that aims to imitate the routines from another source does so based on economic criteria. In contrast to replication, the process of imitation does not involve the use of templates. This makes the mutation of routines increasingly substantive, not considering the transfer of knowledge. However, the practice of acquiring such skills may be non-conventional, such as in the hiring away of skilled personnel from a competitor or the seeking of inside information.

This theoretical approach advances the analysis of routines in innovation. However, the definition and interpretation of routines remains problematic (Cohen et al. 1996). For example, Winter (1987) points to the ambiguity of 'assets' and argues that this encompasses the knowledge and competence of organisations which are strategic assets. Comparatively, routines may be defined as 'an executable capability for repeated performance in some context that has been learned by an organisation in response to selective pressures' (Cohen et al. 1996).

In sum, the use of evolutionary economic perspectives provides an established theoretical standpoint in the analysis of dynamic innovation processes. However, this is also a shortcoming, as it is macro-oriented, which needs to be supplemented with further micro-level analysis of firm-specific sources of innovation. In this respect, resource-based innovation models help amplify the analysis of internal and external firm-specific factors influencing innovation.

2.3 Resource-Based Perspectives

The resource-based perspective is a relatively recent view of studying how a firm's unique set of resources influences its growth (Foss 1997). This view argues that firm competitive advantage is sustained through a set of unique resources. Penrose (1959) was one of the earliest proponents of this view, arguing that 'it is never resources themselves that are the inputs in the production process, but only the services that the resources can render'. This implies that firms are conceptualised as a 'bundle of resources' and differ in their innovative capabilities, while they transform resources into potential services, making them distinct and influencing their growth. Itami (1987) illustrates these resources as 'invisible assets', including the knowledge, skills, and experience of committed people.

The importance of resources has also been emphasised in strategic management studies. For example, Chandler (1962) argues that the structure of firms follows its strategy, suggesting that entrepreneurial decisions and actions affect operating decisions, particularly in the allocation and reallocation of resources. Andrews (1987) points to the central role of resources in corporate strategy in converting distinctive competence into competitive advantage. Kay (1993) introduces the term distinctive capabilities, which represents a firm's source of competitive advantage including architecture, reputation, innovation, and strategic assets.

Although the role of resources has been identified as important, there has been less emphasis on the analysis of their attributes. For example, Porter (1990) argues

that a nation's competitive advantage is determined by four major attributes in his 'diamond' framework, including factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. This structural view of resources, however, overlooks their underlying behavioural attributes (Nonaka and Takeuchi 1995). Prahalad and Hamel's (1990) core competence argument acknowledges the importance of behavioural aspects in collective learning in firms, but does not analyse the acquisition of competence. Stalk et al. (1992) further argue that core competence has a strong orientation towards the production and technological aspects of the firm along specific points in the value chain, and suggests that the concept of capabilities complement this with a more visible and broadly-based analysis in the whole value chain.

The shortcomings of the resource-based view are a lack of a comprehensive theoretical framework and empirical research. For example, Nonaka and Takeuchi (1995) argue that the resource-based approach does not address how different parts in a firm interact over time to influence innovation, and introduce an analytical framework based on examining explicit and implicit knowledge. Robins and Wiersema (1995) suggest that empirical research in the resource-based view has been relatively difficult due to the concepts of capabilities and tacit knowledge which resists direct measurement.

However, proponents of the resource-based view suggest that the approach contribute to a new theory of the firm, incorporating a range of related theoretical perspectives (Conner 1991; Mahoney and Pandian 1992). There has also been the development of theoretical frameworks in support of such arguments. Wernerfelt (1984) developed an economic analysis approach, focusing on the relationship between resource-product matrices. Barney (1991) introduced a firm resource model which analysed the potential of firm resources based on their value, rareness, imitability, and substitutability attributes. Grant (1991) developed a framework to analyse the relationship among firm resources, capabilities, competitive advantage, and strategy.

2.4 Comparison of Views

Evolutionary and resource-based perspectives share some characteristics, and there have been attempts to synthesise the two views (Foss et al. 1995; Montgomery 1995). Nevertheless, both perspectives have their strengths and weaknesses, and it is important to understand their limitations, particularly when used in any analytical framework. These issues are better understood by briefly reviewing three main relationships between these theoretical perspectives.

Firstly, the two views are grounded in economic theory. The evolutionary perspective has its historical roots from *The Theory of Economic Development* (Schumpeter 1934) and articulated in *The Evolutionary Theory of Economic Change* (Nelson and Winter 1982). Comparatively, the resource-based perspective originated from the *Theory of the Growth of the Firm* (Penrose 1959) and advanced

by numerous theorists (Wernerfelt 1984; Barney 1991; Peteraf 1993). Their applications, however, have been relatively mixed, with the evolutionary view being macro-oriented, and the resource-based view firm-specific. Moreover, the evolutionary view focuses on the environment and innovation processes in industry, whereas the resource-based view is dynamic, process-based, and analyses how firms can compete on unique resources to sustain competitive advantage.

Secondly, the two views share similar terminology. There has been diversity in the use of terms which basically reflect the same concept. This has included assets, capabilities, competencies, knowledge, know-how, resources, routines, and skills. For example, Wernerfelt (1984) has defined resources as 'anything which could be thought of as a strength or weakness of a given firm…(tangible and intangible) assets which are tied semi-permanently to the firm'. One of the most important issues, however, is in determining their 'strategic state description' which is in identifying and characterising organisational behavioural patterns that are sources of long-term success in firms (Winter 1987). Furthermore, Winter (1995) examines the interrelationships among the concepts of rent, resources, routine, and replication. This is amplified below.

Lastly, the two views are converging. For example, Conner (1991) has suggested that the resource-based view is reaching for a new theory of the firm, based on a critical review of five theoretical traditions in industrial organisation economics. Similarly, Knudsen (1995) reviews the major theories of the firm and argues for the integration between the evolutionary, the resource-based, and the transaction cost theories. However, there remain outstanding issues in integrating the two views, particularly in linking the industry-firm interrelationship. Levinthal (1995) suggest that the evolutionary and resource-based views should be bridged through the analysis of interrelationships between industry-firm forces influencing diversity and innovation. Foss and Eriksen (1995) support this argument by emphasising the need to study industry capabilities which are 'non-proprietary capabilities that are shared among a group of firms, and may yield rents'. Wernerfelt (1995) suggests a stochastic model approach in integrating the two views.

The two views may also be compared by the '4 Rs' relationship (Winter 1995). This includes the links among rents, resources, routines, and replication which influence innovation. For example, routines may be considered as a web of resources which may be replicated among firms to generate rent. Firms earn Ricardian rents when they are the owners of unique factors (Montgomery and Wernerfelt 1988). However, the rate of resource-routines replication among firms is influenced by behavioural conditions. The process of innovation, in turn, contributes towards profitability and the sustaining of competitive advantage (Afuah 1998).

In sum, the two views provide a complementary analytical approach. This is particularly important in innovation research, as the understanding of industry-specific and firm-specific factors are equally important in identifying the sources of innovation that contribute towards sustained competitive advantage. Foss (1997) summarises and supports this point very well with the following argument.

There are many other important similarities between the two approaches, and the resource-based perspective in particular may benefit from being infused with a dose

of evolutionary economics. For example, evolutionary economists have cultivated an advanced understanding of the mechanisms of technological change - insights that may both help develop a more refined resource-based analysis of the environment and help understanding the process of creation of new resources through innovation. Thus, one attractive way ahead for the resource-based perspective is to strike a closer intellectual strategic alliance with evolutionary theorists, most importantly because evolutionary economics adds a dynamic dimension and does so in a rather precise and formal way (Foss 1997).

2.5 Analytical Framework

Our next step is to produce an analytical framework which integrates the key concepts from these major theoretical perspectives. This integration of innovation models reinforces the strengths in the two approaches, providing a macro and micro level analysis of the dynamic innovation process. The unifying theme in these models is characterised by behavioural factors influencing innovation which is largely reflected in evolutionary and resource-based perspectives (Nelson and Winter 1982; Barney 1991).

These two theoretical perspectives treat the innovation process as a dynamic rather than a static and structural process which is represented by the competitive-forces framework (Porter 1990). For example, this dynamism is represented by the change of routines in evolutionary economic theory (Nelson and Winter 1982), and the services rendered by resources in resource-based theory (Penrose 1959; Barney 1991). Our approach also addresses the inadequacies of diffusion models, which are basically static and assume that innovations are adopted, diffused and implemented along a predetermined set of stages.

2.5.1 Types of Resources-Routines

The framework treats resources and routines dependently. Firm resources may be tangible and intangible in nature. The tangible form of resources may include human, financial, physical, technological, and organisational resources. The intangible form of resources may include ‘invisible assets’ or ‘strategic assets’, including consumer trust, brand image, control of distribution, corporate culture, reputation, knowledge, know-how, capabilities, competencies, management skills, and technical skills (Itami 1987; Winter 1987).

The role of strategic regulation, for example, can be a resource, and as a source of sustained competitive advantage, as suggested by its stimulation of demand and protection of rent-producing resources in the audit industry (Maijoor and Witteloostuijn 1996). The ability of firms, sectors, and nations to compete rests on acquiring, adapting, and advancing such resources which are the sources of innovation.

For example, one firm may replicate the technological resources from another firm through technology transfer and imitation to gain or sustain their competitive advantage in the same sector.

The firm, however, faces difficulties in the replication of resources. The difficulty in resource replication, or the transfer and imitation of resources, is partly due to their homogeneity and mobility characteristics. The rate of resource replication is relatively low when the resource is heterogeneous and immobile. For example, a firm may have a unique set of resources, resulting from the set-up of strategic boundaries or 'appropriability regimes' which may include intellectual property rights provisions (Teece 1986). Therefore, these resources are not widely available to other competing firms in the market and difficult to imitate. Amit and Schoemaker (1993) suggest that the differences in the range of resources controlled by firms may be related to resource-market imperfections and discretionary managerial decision in developing and deploying resources. Zander and Kogut (1995) developed an empirical test of knowledge transfer, suggesting that the codification and the teachability of capabilities influence the speed of transfer and imitation of knowledge among organisations.

Alternatively, the rate of resource replication is relatively high when the resource is homogenous and mobile. For example, a firm may compete with a rival company through the purchase of a similar software programme used by their competitor, provided that the software is widely available in the market and relatively simple to imitate. The mobility of the resources also determines the difficulty of transfer. For example, the transfer of a single software programme is much simpler than transferring the complete information system, which includes the computer software, computer hardware, and the people who operate them. The importance of IT as a resource, and the differences in rates of resource replication, provides a further illustration to the analytical framework.

2.5.2 IT Resources

IT may be seen as a type of strategic resource which is a source of sustained competitive advantage to firms, sectors and countries (Clemons 1991; Clemons and Row 1991; Mata et al. 1995). However, the resources related to IT are not exclusively embodied in computer hardware and software components. For example, Ross et al. (1996) argue that there are three IT assets that have an interdependent relationship, including human assets, technology assets, and relationship assets. Powell and Dent-Micallef (1997) also suggest that IT was not a sole source of sustained competitive advantage, but rather its use in leveraging intangible and complementary human and business resources, including culture, strategic technology planning, and supplier relationships. Such IT assets may also be viewed as a firm's physical, organisational, and human resources.

Firstly, physical resources include the IT infrastructure. This includes investments in IT projects, particularly in computer hardware, computer software

and telecommunications equipment, aimed to increase efficiency in internal working processes and to improve the delivery of customer services. Keen (1991) views this infrastructure as the 'IT platform' which is a shared information service delivery base, influencing a firm's 'reach' in linking computer systems locally and internationally, and its 'range' in determining what information can be shared across systems and services. Ross et al. (1996) suggest two distinguishing characteristics of technology assets, a sharable well-defined technology architecture, and data and platform standards.

Secondly, organisational resources include firm-specific strategies influencing IT investments. For example, Weill and Lucas (1992) proposed a 'pyramid' of IT investment, arguing that firms have four major types of management objectives which influence technological investments - strategic, informational, transactional, and infrastructure. Broadbent et al. (1994) further examined this 'pyramid' through the relationship among business process redesign, strategic context, and the role and capabilities of the IT infrastructure. Firms may formulate a strategy specifically aimed at acquiring the necessary IT resources, for example through joint ventures and company cooperation. In the case of financial services, Hopper (1987) suggests the integration of IT resources into a company's broader strategy. Nevertheless, Pennings (1998) suggests that there are delayed benefits in IT investments by organisations, as they require time, approximately over 10 years, to absorb and learn the technology.

Lastly, human resources include managerial-technical skills specific to IT. The case of Citicorp provides one illustration (Glaser 1988). Early attempts by the bank to develop the ATM were unsuccessful, although the company's senior management provided full support. Notwithstanding such failures, the bank formed a subsidiary company, following an agreement with another computer firm, which involved the transfer of 30 technical staff from the latter to the former firm. This created the necessary human resource capabilities and technical skills required for ATM development.

Mata et al. (1995) further distinguished between managerial and technical IT skills in a company, and argued that the former type of human resource is the sole source of sustained competitive advantage, as compared to other firm resources, including capital, proprietary technology, and technical skill resources. Henderson (1990) also suggested the critical need to create a connection between line managers and IS managers through partnerships, although this strategy may be difficult to implement or inappropriate in individual cases.

Several survey studies also support the need for managerial-technical skills. For example, Boynton et al. (1994) study IT use in large organisations and suggest that usage of technology was largely influenced by managerial IT knowledge, apart from the technology management climate. Lee et al. (1995) studied the skills and knowledge required by IS professionals and show the need for multi-dimensional staff who are trained in technical, managerial, and interpersonal skills.

Keltner and Finegold (1996) argue that human resource innovations, particularly in service firms, should shift from the tendency towards transactions-oriented to a more relationship-oriented approach through the development of competence-based

strategies, modularised training, internal recruitment and promotion, and cooperation with education providers. Scarbrough (1998) suggested that the strategic use of IT depended on the interaction between IS expertise and senior management knowledge, including political and learning process influences. These arguments commonly suggest that human resources, particularly managerial IT skills, are incorporating the need for non-technical skills, and may be the most important but difficult resource to acquire.

The rate of resource replication is central in the analytical framework. This rate does not imply direct measurement in the replication of resources but represents the difficulty of transfer. This is because the replication of tangible resources is relatively less difficult than the replication of intangible resources when represented by the 'invisible assets' embodied in human resources. The replication of 'intermediate' organisational resources is moderately difficult. The reasons influencing resource replication can be further explained by their attributes, which determine the sources of innovation and sustained competitive advantage.

2.5.3 Source of Innovation

The analytical framework includes four major attributes influencing the replication of resources. These attributes influence innovation through their behavioral characteristics, and are the major sources of sustained competitive advantage.

The first attribute is the value of resources. Resources are valuable if they improve firm efficiency and effectiveness, and reduce costs and increase revenues. However, a resource is only considered valuable provided that it exploits opportunities and neutralises threats in the firm environment (Barney 1991). For example, a firm's installation of a strategic information system, which it has imitated from a competitor, may help it gain competitive parity or competitive advantage over other companies, but may not contribute towards innovation and sustaining that advantage in the long-term. Alternatively, if the firm does not implement such a system, it is likely to have a competitive disadvantage to firms that have installed the system.

The second attribute is the rareness of resources. Resources are rare if they are unique in character. The scarcity of resources among firms determines their competitive position with one another. If all firms share the same resources or the ability to acquire homogenous resources that are widely available in the market, they are in a competitive parity position. However, if the resources are heterogeneously distributed across firms, there is a potential for a firm to gain a temporary competitive advantage or a sustained competitive advantage, provided that the resource is mobile (Mata et al. 1995).

The third attribute is the imitability of resources. The imitation of resources depends on their tacitness which determines the possibilities in teaching and articulating them (Polanyi 1973). For example, Nonaka and Takeuchi (1995) distinguishes between the tacit and explicit knowledge in individuals and organisations, suggesting that there are four modes of knowledge conversion among

these different dimensions - socialisation, externalisation, internalisation, and combination.

The replication of resources is influenced by their imperfect imitability. For example, this includes differences in individual memory repertoires such as skills to operate computer equipment. Moreover, although an organisation can increase capabilities through the replication and imitation of resources from competitors, these mechanisms are constrained through their mutation and the inherently tacit nature of knowledge. This imperfect imitability of resources, which is a potential source of innovation and sustained competitive advantage, is influenced by three main factors.

The first factor is the role of historical conditions. The history of a firm can be a source of imperfect imitability, provided that the firm experiences unique opportunities during a particular period in time. This implies that historical conditions contributed to the firm's competitive position and are relatively costly to recreate or imitate. This source of competitive advantage can be described as the 'accumulation of asset stocks' (Dierickx and Cool 1989) and the path-dependency nature of technological change (Rosenberg 1994). The second factor is causal ambiguity. This source of imperfect imitability is based on a firm's incomplete understanding of how a particular resource can be used for innovation to gain competitive advantage. For example, this causal ambiguity may result from the 'invisible' nature of assets which are difficult to imitate (Itami 1987). The third factor is social complexity. This source of imperfect imitability is based on resources that are related to complex social phenomena. For example, this may include a firm's corporate culture, reputation, and close customer relationships that are difficult for competitors to imitate.

The last attribute is the substitutability of resources. The substitution of resource may be achieved through the use of similar and different resources. The use of similar resources may involve, for example, the duplication of a technology policy team of one firm from another one. Similarly, the use of different resources may involve the establishment of a formal planning system within a firm which formulates its technology strategies. These substitutions of resources, however, vary among firms and may be a potential source of innovation, provided that they are unique.

In sum, these four attributes influence the replication of resources. They have behavioural characteristics and represent the dynamic processes involved in innovation, which influences the three types of resources in the analytical framework – physical, organisational, and human. Moreover, these attributes are the conditions that influence the competitiveness of firms, sectors, and countries.

In the next chapter, we apply our analysis at the macro level by assessing how payment system strategies can be formulated within a national system of innovation. In the later chapters, we further examine the micro aspects of efficiency, innovation diffusion, and capability development within the banking sector and banks.

Chapter 3
Strategic Approaches to Payment Efficiency and Innovation

Abstract We discuss the strategic approaches for promoting payment efficiency and innovations, including the minimalist, competitive and public service approaches. The cases show how strategies are developed under unique environments of advanced and emerging banking systems and compare the involvement of the central bank and the private sector in payment operations by illustrating how ownership, pricing policies, and cost recovery may vary, and how such factors may influence efficiency and innovation in terms of changes in paper-based and electronic payment market shares.

The level of payment systems modernisation varies across countries around the world. In industrial, transitional, and developing economies, countries have faced a range of obstacles including their existing legal framework, technical infrastructure, and maturity of banking systems. Payment system strategies undertaken in these countries often have the involvement of the central bank and commercial banks in devising evolutionary or leapfrogging strategies (Fry et al. 1999; BIS 2006).

Listfield and Montes-Negret (1994), for example, discuss the World Bank's two-phase approach to payment systems development. This includes conducting a situation analysis to take stock of a country's infrastructure, financial system, current payment system and incentives, which is followed by the development of a vision of how the payment system should evolve over the long-term. Moreover, many countries have developed visions that help fulfil the mandates of promoting efficient and secure payment systems that observe the BIS Core Principles of Systemically Important Payment Systems (BIS 2001). These ten international principles cover the following: legal basis, understanding financial risks, management of financial risks, prompt final settlement, settlement in multilateral netting systems, settlement assets, security and operational reliability, efficiency, access criteria, and governance.

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Listfield and Montes-Negret (1994) also note the particular importance of establishing an organisational structure, in the form of a National Payments Council (NPC), to serve as a forum for major stakeholders such as the central bank and commercial banks, and to facilitate capacity building efforts. In practice, different variants of the NPC have been established around the world to suit unique banking structures and capabilities. This may range from payment associations, payment system development committees chaired by the central bank, and the establishment of the NPC itself.

Some recent examples of payment systems modernisation efforts include the 'Payment Systems in India – Vision 2005–2008' document that sets a mission for 'the establishment of safe, secure, sound and efficient payment and settlement systems for the country' (Reserve Bank of India 2005); the Zambian 'National Payment System Vision and Strategy 2007–2011' that seeks to 'uphold a world class payment system that meets domestic, regional and international requirements (Bank of Zambia 2007, p. 14); and Namibia's payment system reform initiative (Shiimi 2008). The World Bank (2008a, b) provides a more comprehensive and in-depth survey of payment systems worldwide covering topics as follows: (1) legal and regulatory framework; (2) large-value funds transfer systems; (3) retail payment systems; (4) foreign exchange settlement systems; (5) cross-border payments and remittances; (6) securities settlement systems; (7) payment system oversight function and cooperation; and, (8) planned and on-going reforms to the national payments system.

In what follows, we discuss the strategic approaches for promoting payment efficiency and innovations, including the minimalist, competitive and public service approaches. The cases show how strategies are developed under unique environments of advanced and emerging banking systems and compare the involvement of the central bank and the private sector in payment operations by illustrating how ownership, pricing policies, and cost recovery may vary, and how such factors may influence efficiency and innovation in terms of changes in paper-based and electronic payment market shares.

3.1 The Minimalist Approach: Australia, Canada, Finland, United Kingdom

The private sector takes precedence in promoting payment systems efficiency under the minimalist approach. The central bank plays a minor role in payment operations, which may be limited to providing settlement account services, collateral services and liquidity facilities. Others may own and operate the core large-value inter-bank funds transfer system. The private sector plays a larger role in payment clearing and settlement. This may take the form of joint-ownership and operations of a centralised or decentralised payments system, which may be self-managed by banks or administered by an association. The central bank is involved in such associations as a board member, shareholder, or participant. It may also take part in their

establishment. Such practices may be illustrated with the approach adopted in Australia, Canada, Finland and the United Kingdom.[1]

3.1.1 Australia

In Australia, the central bank owns and operates a core inter-bank RTGS system - the Reserve Bank Information and Transfer System (RITS). RITS supports the settlement of obligations for both high-value and low-value payment transactions between financial institutions through Exchange Settlement Accounts. RITS originally served as the central depository for Commonwealth government securities until early-2002, when it was transferred to the Austraclear System, a private depository and settlement system for debt securities. The central bank promotes safe and efficient payment systems by formulating policy guided by a high-level Payment Systems Board that is chaired by the central bank governor. It also benefits from the *Payment Systems (Regulation) Act of 1998*, which gives power to the central bank to regulate designated systems and purchased payment facilities.

The annual settlement costs associated with operating RITS is approximately 15% of the central bank's underlying operating cost (Reserve Bank of Australia 2002). The share of settlement cost gradually increased from 6 to 15% between 1997 and 1999, reflecting the high development costs incurred before and during the introduction of the system in mid-1998, while levelling off during 1999-2002. Other underlying operating costs include functions relating to monetary policy, financial system surveillance, note distribution, and banking and registry. This excludes notes printing.

The central bank explicitly charges for its banking services and also supports cost-based and the transparent pricing of payment transactions by industry. RITS operates with a full cost recovery principle with a pricing structure as follows: joining fee, annual fees, and per item fees (debit, credit, and cash transfer instructions). While joining and annual fees are generally used, it is waived for a majority of Austraclear participants, which uses the same proprietary network for RITS.

The Australian Payments Clearing Association Limited (APCA) plays a major role in managing, developing and operating payment systems in Australia. APCA was first conceived by the Australian Bankers' Association in 1988, while the reform process was later guided by a central bank representative in an industrywide Reform of the Clearing System Steering Committee, which eventually led to the establishment of APCA in 1992. APCA shareholders include the RBA, commercial banks and the building society and credit union industry bodies. It operates five

[1] See Berg (1999) for a discussion of the minimalist approach in Nordic countries. For full details of country cases, see Executives' Meeting of East Asia-Pacific Central Banks and Monetary Authorities (2002) for Australia; Goodlet (2001) and Anvari (1990) for Canada; and European Central Bank (2001) for Finland and the United Kingdom.

clearing systems as follows: the Australian Paper Clearing System (APCS); the Bulk Electronic Clearing System (BECS); the Consumer Electronic Clearing System (CECS); the High-Value Clearing System (HVCS); and the Australian Cash Distribution and Exchange System (ACDES).

APCA costs are associated with its general administration and the development and operation of its five clearing streams. Members share these costs in proportion to their importance in the payments system, and their category of membership would also determine the extent to which types of fees are paid. Such fees may include entrance fees, operational change fees, operating fees, and annual membership fees.[2] The pricing policies for the four clearing systems are not based on transaction fees, but are determined independently by individual financial institutions. For ACDES, members share operational costs based on their share of national activity.

3.1.2 Canada

In Canada, the central bank does not own or operate payment clearing or settlement systems. The central bank maintains settlement accounts and provides the final settlement of payment obligations among the participants in these systems. Although not directly involved in payment operations, the central bank has taken a keen interest in promoting their safety and soundness through its oversight role, which has been clearly mandated under the *Payment Clearing and Settlement Act of 1996* (Goodlet 1997, 2001). Strong links have also been maintained with the Canadian Payments Association (CPA), where a central bank representative serves as a chairperson on the Board of Directors.

The CPA is a "not-for-profit" organisation established in 1980 based on amendments to the *Bank Act of 1980*. Members are from deposit-taking institutions. The *Canadian Payments Act* came into effect in the fall of 2001, replacing the former *Canadian Payments Association Act*. This expanded the types of organisations that are eligible for membership beyond deposit-taking institutions to include three new groups: life insurance companies, securities dealers and money market mutual funds. As of July 2008, CPA membership numbered 125 and included the following: 64 banks, 16 centrals, 28 trust companies and loan companies, one securities dealer, and 16 other financial institutions. Its mandates are threefold: "to establish and operate national systems for the clearing and settlement of payments and other arrangements for the making or exchange of payments; to facilitate the interaction of its clearing and settlement systems and related arrangements with other systems

[2] See Regulations for Australian Paper Clearing System (APCA 1993), Regulations for Bulk Electronic Clearing System (APCA 1994), Regulations for Consumer Electronic Clearing Stream (APCA 2000), and Regulations for High-Value Clearing System (APCA 1997).

or arrangements involved in the exchange, clearing or settlement of payments; and to facilitate the development of new payment methods and technologies". It operates two major national clearing and settlement systems: Automated Clearing Settlement System (ACSS) and Large-Value Transfer System (LVTS). In 2001, ACSS handled over 99% of the total number of payment instructions and 15% of total transaction values in Canada. Comparatively, LVTS handled less than one percent of the total number of payment instructions but 85% of total transaction values. Payment values handled by LVTS were expected to rise due to the planned introduction of a CAD 25 million ceiling in early-2003 for paper-based transactions such as cheques and bank drafts that are currently cleared by ACSS. This migration of value would seek to reduce the potential systemic risks in ACSS.

The CPA recovers operating costs through its membership fee structure.

According to the *Canadian Payments Act* the CPA Board is required to prepare an operating and capital budget for each fiscal year and to seek approval from members. If a budget surplus exists in a given year, it is applied to reduce membership dues in the following year. Members are required by the association's by-laws to pay dues, which take two forms: individual member general dues and LVTS dues.[3]

Individual member general dues are based on a member's proportionate share of the ACSS payment items. This is the difference between the total number of transactions that a member has sent and received from other members through the ACSS, and the total number of transactions it has sent and received, through the ACSS, on behalf of another member. Comparatively, the CPA Board also determines LVTS dues through the preparation of an operating and capital budget for each fiscal year. Dues take into account LVTS development costs and are also volume-based, where a participant pays dues in proportion to the total number of payment items it sends and receives to other participants though the LVTS.

Gradual unit cost reductions were achieved for the ACSS over the 1990–2001 period with volume increases. These operating costs focus on the centralised cost shared by members but do not account for other costs that would have been incurred by individual institutions. Unit cost reductions largely stem from the large number of payment instructions and the economies of scope of the system. The ACSS handles a wide range of paper-based and electronic transactions. This includes, large- and small-value paper items, paper bill payment remittances, automated funds transfer (AFT) debits and credits, shared cash dispensing via ABM networks, point-of-sale transactions, EDI transactions, and electronic bill payment remittances. With strong scale and scope economies, relatively low unit costs, and a concentrated banking structure, the Canadian payment system, particularly ACSS, has been regarded as one of the most efficient in the world (Anvari 1990).

[3] See Department of Finance, By-law No. 2 Respecting Finance. Changes to the Financial By-law, and the structure of dues, would take effect on January 1, 2003. See http://www.cdnpay.ca for the Canadian Payments Act (revised 2001) and the new By-law.

3.1.3 Finland

In Finland, the central bank owns and operates a core inter-bank RTGS system (BoF-RTGS). The central bank maintains accounts for settling financial obligations between participants in the financial market. BoF-RTGS operates on a full cost recovery principle and cost is recovered through the following fees: joining fees (to open an account), monthly fees (account maintenance) and per item fees. Other fees include charges for applications and their monthly maintenance fees, which is required by account holders to establish and secure connection to the central system.

The banking industry develops, owns and operates two major payment systems: a retail payments system (PMJ) for batch processing, and an on-line netting system that handles large and small valued express transfers and cheques (POPS). In 2000, the BoF-RTGS and POPS systems each handled less than one percent of the total number of payment instructions in Finland, but 90% and 7% of the total transaction values, respectively. Comparatively, the PMJ system handled over 99% of the total number of payment instructions but approximately three percent of total transaction values.

The PMJ and POPS systems operate on a decentralised basis, where payment information is sent bilaterally between participants and settlement is made across their accounts in the BoF-RTGS system. In contrast to the payment associations established in Australia, Canada and the United Kingdom, the Finnish Bankers' Association (FBA) has a limited role in the management and operation of payment systems. Instead, its role has been in coordinating the development of payment services and banking technology for the joint use by its members, along with contract administration between participants. Thus, there are no membership dues or contributions that are required for operating both systems.

Costs relating to investing, developing and operating the POPS and PMJ networks are incurred by member banks and not the FBA. General administration cost of the FBA are paid by members on an annual basis, and this is based on a budget prepared by the FBA and accepted by its Board of Directors. Cost relating to the POPS and PMJ networks are solely administrative and not operational, and are allocated to the Banking Technology Department of the FBA. General administration cost is allocated among members based on their share of total deposit balances, while the policy is kept under review. Members have equal voting rights, regardless of the proportion of their share to the total general administration cost, while resolutions are usually based on the consensus of members.

As the PMJ and POPS systems are decentralised and network-based, there are no administrative or central operating costs that are charged to members by the FBA. New participants, however, are charged an entry fee to help cover initial investment costs relating to systems design and implementation, along with costs for making subsequent changes. The unit cost incurred by participants is estimated to be relatively minimal and relate to their investment and the costs for operating data processing centres. This mainly arises from the sending of bilateral payment information, where financial obligations are later settled across accounts at the central bank.

3.1.4 United Kingdom

In the United Kingdom, the central bank does not own the core inter-bank RTGS system – the Clearing House Automated Payment System (CHAPS). It partly operates the CHAPS processor, maintains settlement accounts, and processes multilateral settlement across them. Annual budgeted settlement costs is 7% of all other major central bank functions, which include monetary policy, note issue, banking, financial stability, and services for the government (Bank of England 2002). CHAPS operates on a full cost recovery principle and include the following fees: annual fee (account maintenance), annual fee (terminal connection to the Enquiry Link function), and per-item tariff (sterling transfers).

The central bank played a constructive role in establishing the Association of Payment Clearing Services (APACS) back in the early-1980s (APACS 1984). APACS serves as an umbrella industry payment body that manages three major payment systems. Additionally, the association carries out work on the forecasts of payment trends, market research, compilation and maintenance of a large base of statistics, and the formulation of industry payment standards. While APACS membership is largely from clearing banks, the governance structure has been changed to allow in non-banks such as the Post Office. Moreover, other non-bank players may be represented in various interest groups, such as the Cards Group, under a predetermined set of criteria.

CHAPS ownership belongs to banks, while it is operated under a company structure and managed by APACS. APACS manages two other major retail payment systems that also operate under a company structure: the Bankers' Automated Clearing Services (BACS) and Cheque and Credit Clearing.

APACS members share the costs of major payment clearing operations (APACS 2002). This source of funding serves the purpose of recovering costs. Its interest groups and clearing companies formulate their own budget, while costs are allocated among members based on a formula. This is based on the level of activity a member is involved with or their share of the total number of transactions handled in a given clearing system. Thus, members with a higher share of transaction volumes are required to pay a larger share for the cost of clearing operations, and vice versa.

For example, CHAPS settlement member banks are required to pay entry and annual fees, which is determined by their respective shares of the total volume of transactions handled by the system. Charges made by settlement banks to other participants or members are based on commercial negotiations and independent fee setting. In BACS, the central company applies tariffs to sponsoring banks for incoming and outgoing messages, while independent negotiations between the bank and users and other customers are made to determine the charges. As for Cheque and Credit Clearings, settlement members share operating costs through direct contributions, while payment charges to corporate customers are also based on commercial negotiations. Fees for personal customers are waived.

3.2 The Competitive Approach: United States

The public and private sectors take competing roles in promoting payment systems efficiency under the competitive approach. The central bank plays a major role in owning and operating inter-bank funds transfer systems and competes directly with commercial banks. In doing so, its pricing policy is formulated to recover fully all real resource costs, but more importantly, the imputed costs, which account for the costs that would have been incurred by a private firm providing similar services. This practice can be best illustrated with the case of the United States (Humphrey 1984).

The US Federal Reserve has been actively involved in providing payments processing services since its establishment in 1913, including the operation of cheque processing, the automated clearinghouse, and a large-dollar wire transfer system. These roles have been reviewed in light of the *Depository Institutions Deregulation and Monetary Control Act of 1980*, which gave it a mandate to recover all direct and indirect costs in providing priced services (Humphrey 1984). By the late-1990s, a comprehensive study on its role in the payments mechanism concluded that it should remain a provider of payment services and play a more active role in collaborating with both service providers and users (Federal Reserve System 1998).

The US Federal Reserve's pricing policy is guided by the *Monetary Control Act*. The law "requires the Federal System to establish fees that, over the long run, recover all direct and indirect costs of providing services to depository institutions, as well as imputed costs, such as income taxes that would have been paid and the pretax return on equity that would have been earned had the services been provided by a private firm" (Board of Governors of the Federal Reserve System 1995). This is the basis for pursuing full cost recovery where an annual pricing process projects volumes, revenues, expenses, the private sector adjustment factor (PSAF), and net income in major service areas. Fee schedules undergo an approval process by product directors, the Financial Services Policy Committee, and finally, by the Board of Governors.

Federal Reserve priced services includes the following: commercial cheque collection, funds transfer and settlement, commercial ACH, book-entry securities, non-cash collection, and cash services. Among them, the first three services are directly related to payment and settlement services, and are areas where the central bank is most active in terms of the number of items handled and the revenues received from operations.

Fee-based revenues originate from the following sources (www.frbservices.org). Commercial cheque collection fees vary across the different districts where Federal Reserve offices operate. Generally, per item fees are applied to cheque forward collection, cheque return item, and electronic cheques. Fees for electronic cheques are comparatively lower than cheque forward collection, while higher fees are charged for returned items.

Funds transfer and settlement fees originate from the following. For funds transfer, fees are largely based on volume-based pricing for origination and receipt services. Fees per transfer are set at three levels, with fee reductions applied when

volumes reach a predetermined level of volume per month. Other charges include comparatively higher fees for off-line transfers (origination and receipt) and additional fees for the delivery of reports. For settlement, basic fees include per entry and settlement file charges. In addition, there is a minimum monthly fee. Other charges include comparatively higher off-line origination fees per file in exceptional cases.

Commercial ACH fees originate from providing origination, receipt, international ACH, and non-electronic input/output services. Usually only per item charges apply for most of the commercial ACH services. Lower fees are applied for items in large files in the origination service. Comparatively, higher fees are charged for smaller origination files and for the use of non-electronic input/output services, which are limited to contingency situations. Per monthly charges are specifically applied for miscellaneous services such as account servicing, settlement, and information extracting.

Non fee-based revenue originates from the net income on clearing balances. The investment income on clearing balances is equal to the average coupon equivalent yield on 3-month treasury bills applied to the total clearing balance maintained net of earnings credits, and adjusted for the effect of reserve requirements on clearing balances (Board of Governors of the Federal Reserve System 1995).

The total cost for priced services takes into account both resource and imputed costs. Resource costs relate to operating expenses. This includes direct, indirect, and other general administrative expenses of the Reserve Banks for priced services plus the expenses for staff members of the Board of Governors working directly on the development of priced services (Board of Governors of the Federal Reserve System 1995). Such resource costs are also called total activity costs and are comprised of fixed and variable expenses for personnel, equipment, shipping, travel, communications, and detailed support costs (computer operations, data systems support, motor vehicles, building operations, house-keeping, stock of supplies, printing and duplicating, graphics, and planning). Costs stemming from district projects, which are defined as 'planned efforts at the District level that focus on broad areas with specific, generally long-range objectives or anticipated end results', are also included in the calculation of service costs (see Federal Reserve Planning and Control System).

Imputed costs, also known as the private sector adjustment factor (PSAF), serve as a 'profit' element in direct competition with correspondent banks. The PSAF is added to the real resource costs required for producing payment services, and includes three major components as follows: tax rates, capital structure (debt–equity ratio) and return on capital (the weighted average of debt costs and return on equity). To arrive at the PSAF, a set of commercial banks is used for comparative basis, while adjustments are made prior to calculating the final PSAF.

Efficiency improvements in the US payments system have been largely attributed to the role of the US Federal Reserve. Although past studies found scale diseconomies in US Federal Reserve cheque processing services, this was attributed to the lack of competition, only to be improved with the introduction of the *Monetary Control Act* (Humphrey 1984). Further efficiency improvements were

reported in empirical studies of specific services. Bauer and Hancock (1993) examined the efficiency and productivity of 47 cheque processing offices of the Federal Reserve System over the period 1979–1990 and found that no offices were operating with scale diseconomies. This confirmed scale efficiency improvements after a new pricing policy was introduced in the early 1980s. Bauer and Hancock (1995) further examined and found scale economies in 38 ACH payment processing sites over the period 1979–1994, while noting that further cost savings may be achieved through the consolidation of processing sites. Bauer and Ferrier (1996) carried out a comprehensive cost function study on cheque processing, ACH and Fedwire funds transfer over the period 1990–1994 to estimate their marginal costs, scale economies, cost efficiency, and technological change. The study found scale economies for all but the twelve smallest cheque processing sites, suggesting the possibility to further reduce costs through consolidation. ACH and Fedwire services also experienced scale economies. Using a more general and analytical approach, Gilbert (1999, 1998) applies the risk-cost frontier framework and notes that the US Federal Reserve's founding did improve the efficiency of the payment system, where lower ratios of cash to total assets were experienced.

3.3 The Public Service Approach: Thailand

The public sector plays a major role in promoting payment systems efficiency under the public service approach. This is characterised by the major role that central banks play in payment operations. The central bank owns and operates a majority, if not all, inter-bank funds transfer systems. This includes large-value funds transfers and settlement, cheque clearing and ACH clearing. The monopoly of payment networks, and their pricing method, is aimed to encourage economies of scale. A 'non-profit' and subsidised pricing policy is adopted to promote payment systems efficiency, and has a strong influence on the setting of fees that commercial banks charge their customers. This practice can be illustrated with the case of Thailand.[4]

Since the founding of the Central Bank of Thailand in 1942, one of the main central banking businesses has been the administration of the bank clearing system. The formulation of a national payment system strategy, however, did not start until the 1990s. This can be organised under three major strategic plans: Payment Systems Master Plan, Payment 2004, and Payment 2010.

The first plan was named the Payment Systems Master Plan. This coincided with the country's economic expansion, which started in the late-1980s but unexpectedly ended in the late-1990s. It led to the development of three major payment systems.

[4] See Johnson (1998, pp 131–140) for a description of the Thai payments system and Jitsuchon and Khiaonarong (2000) for an analysis of their cost, pricing and income.

The central bank played a leading role, in the absence of private sector initiative, in investing, developing, enhancing and managing these systems. This included the introduction of a RTGS system, which was one of the most advanced large-value funds transfer systems in the world at its launch date in 1995.

While foreign trade, foreign direct investment, and tourism drove the country's economic activity from the early-1980s to the mid-1990s, they were also generating large numbers of financial and trading transactions which required a modern, efficient and effective payments infrastructure. Thus, payment systems reform became one key component of two major 3-year financial development plans from 1990 to 1995.

The first plan, covering the period 1990–1992, addressed four main areas of financial development. The first area was the deregulation and liberalisation of financial markets. Such measures included the liberalisation of interest rates, the relaxation of foreign exchange control, the expansion of financial institutions' scope of activities, and the improvement of portfolio management efficiency. The second area was the improvement of financial institution supervision. The objectives of this plan were to promote the transparency of financial institutions conditions, to increase consumer protection, and to increase the stability of the financial system. Such universal measures adopted included the BIS capital adequacy requirements which was raised to 8% in 1995. The third area was the development of financial instruments and services which was aimed at finding alternative sources of funding to support the credit needs of businesses. Such instruments included debentures, convertible instruments, multi-Asian currency notes, securitised instruments, unit trusts, warrants, and financial derivatives. The fourth area was the development of the payment system. Such reforms provided the necessary infrastructure to integrate financial institutions and instruments. The objective was to provide a more systematic, efficient, and secured approach in the clearing and settlement of financial transactions.

The second plan, covering the period 1993–1995, addressed three main areas of financial development. The first area was the mobilisation of savings. This was to ensure an adequate level of savings to support the long-term growth of the country's economy. Such measures included the expansion of provincial branch network of commercial banks and finance companies. The second area was the extension of financial services to rural areas. The objective was to increase the availability of credit and financial services to the provincial regions of the country. This included the promotion of capital market development in the regions, as an effort to avoid concentration in the country's capital. The third area was the development of the country's capital into a financial centre. This plan capitalised on the geographical proximity of Thailand to the Indo-Chinese countries, supporting the country's potential to develop itself into a funding centre for international trade and investment, including three major stages.

The first stage involved the development of the country's capital into a regional centre of funds. Early developments have been in the form of permitting both domestic and foreign commercial banks based in Bangkok to provide international banking facilities. This included the mobilisation of funds from abroad for re-lending to Thailand or Indo-Chinese countries. The second and third stages were

more evolutionary, including the development of the funding centre into a restricted financial centre, providing a range of specialisation of services, and then further developing it into a full-service centre.

One important part of the financial development plans was the modernisation of the Thai payment system, aimed to create an efficient financial infrastructure to support the growth of financial transactions (Watanagase 1994). Thailand's payment system, however, is highly cash-oriented. And the introduction of electronic payment systems was aimed to reduce the country's cash dependency ratio. Like many developing countries, Thailand's payment system was characterised by labour-intensive operations. Such constraints on economic development prompted the central bank to devise a master plan for the payment system. It was designed around three core systems.

The first core system was the Electronic Cheque Clearing System (ECS). The Bangkok Clearinghouse, established in 1945, provided commercial banks with the convenience in cheque clearing. This service, however, was limited to a certain extent and posed several problems. First, its geographic coverage was limited. Cheque clearing was made available only to commercial banks operating in Bangkok and its environs, Thonburi. This implied that in the clearing of cheques across provinces, the branches of commercial banks sent a cheque to its headquarters in Bangkok for verification and for further clearing at the Bangkok Clearinghouse.

Second, existing clearing routines delayed the availability of funds. This stems from the requirement that commercial banks needed to forward cheques, in physical form, to the clearinghouse to calculate its net debit or credit positions with other banks. As a result of this requirement, certain time restrictions were imposed. Customers presented cheques to banks by 10.00 a.m. in order to accommodate time for cheque delivery to the clearinghouse by 1.00 p.m. Thereafter, settlement of reserve accounts is effected at 3.30 p.m. on the same working day. Thus, funds are unavailable to a customer if a cheque is presented after 10.00 a.m. thereby losing interest earned on that sum accordingly.

Lastly, the system maintenance cost was very high. This includes the use of manual labour to collect, sort and deliver cheques. For example, the delivery of cheques by messengers from banks to the clearinghouse for settlement is subject to road traffic that may be very unpredictable. The process was also error prone. For example, the use of un-standardised cheques was sometimes mishandled by a magnetic-ink character recognition machine and created system errors.

The ECS was developed to resolve the problems. Information technology was used to improve three basic procedures. First, a cheque encoder reader captures information written on cheques. Second, the information is sent and received through telecommunications links between front-end processor machines located at both commercial banks and the central bank. Lastly, cheque information in original physical form is delivered and matched with their electronic versions for verification and settlement in the evening.

The ECS has two advantages. First, new requirements created by the improved system extend the time restrictions imposed on bank customers presenting cheques.

As a result, funds become available to bank customers the next working day and they can also benefit from gaining interest on that sum. Second, labour-intensive procedures are replaced by IT, hence minimising costs and increasing productivity.

The second core system was built to facilitate small-value funds transfers, which is involves the exchange of financial transactions that are low in value but high in volume. Thai commercial banks have provided various small-value funds transfer or retail payment services. This mainly includes recurring payments, for example, debit transfers for utilities payment or credit transfers for employee salaries. Such payment practices have often been conducted on a bilateral basis, where the payment initiator and receiver maintained accounts at a common commercial bank. However, this posed the problem of decentralisation. Bank customers maintained multiple bank accounts to conduct payments with different utilities companies holding different bank accounts. The delivery of this information recorded on magnetic tape and transported by messengers was subject to traffic congestion. The overall impact is increased inefficiency in the payment system.

A more centralised approach was introduced. The provision of the Media Clearing System (renamed "System for Managing Automated Retail Funds Transfer or SMART" in July 2002), which utilised existing facilities of the Electronic Clearinghouse, facilitated the transfer of retail payments. This procedure included the preparation of customers' recurring payment information on magnetic disk by commercial banks and is conducted off-line. Thereafter, the payment medium is delivered to the Electronic Clearing House for further sorting and settlement.

SMART provides one key improvement. As the payment media is received by the system, EFT settles the net debit or credit positions of each commercial bank in the payment system. This is connected to a large-value fund transfer system created by the central bank called the Bank of Thailand Automated High-Value Transfer Network (BAHTNET).

The third core system was developed to support large-value funds transfers, which is characterised by the exchange of financial transactions that are high in value but low in volume. Transactions originating from financial market transactions are common in this category. Prior to the use of IT to facilitate the transfer of funds, these transactions were conducted by the use of cheques, being delivered to the ECS or deposited with the central bank. Disregarding the payment method, this was subject to payment risks. When one bank faced liquidity risks, it may fail to fulfil financial obligations to another bank, which poses systemic risks in the payment system.

BAHTNET, a large-value funds transfer system, was developed in response to this perceived need. The range of services that was provided was beyond its main function of electronic interbank funds transfer originating from interbank loans and foreign exchange transactions. This also covered third-party funds transfer, account inquiry, bilateral communication, and message broadcasting.

BAHTNET provides convenience to both commercial banks and other payment participants. EFT carries out the payment instructions through computer terminals

and telecommunication lines located at the payment initiator and recipient's premises. This reduced the use of cheques. Moreover, this involves an RTGS feature, reducing the possibility of liquidity and systemic risks accordingly.

The second payment strategic plan was named 'Payment 2004'. With the successful development and operation of new payment systems, this 3-year development roadmap focused on five major areas (Bank of Thailand 2002). The first area focused on the need to establish an industry payment body to create a channel for co-operation among banks and non-bank payment participants in the market. The establishment of the Thailand Payments Association (TPA) was proposed which included committees overlooking regulation, standards and security, card payments, global payments, and strategy and electronic commerce. The second area focused on the need to collect national payment data to support decision making by market participants and policy making for the central bank. The third area focused on the need to introduce a new Payment Systems Act to reduce risks and promote efficiency in the payments system, contributing towards the safeguarding of financial stability. The fourth area focused on the need to develop an electronic payment infrastructure based on interoperable payment standards. This particularly concerns the use of common data formats and the development of complete straight through processing for payments. And the fifth area focused on the need to study and consider making cross-border connections for both large-value and small-value payments.

Three lead institutions, including the Thai Bankers' Association (TBA), the National Electronics and Computer Technology Centre (NECTEC) and the Bank of Thailand, helped push forward the action plans in this roadmap. And as a result, this collective effort contributed to the following: (1) the establishment of a subcommittee on national payment co-operation; (2) the systematic collection and dissemination of payment system statistics; and (3) the establishment of the National Interbank Transaction Management Exchange (ITMX) to serve as a central payments infrastructure to support electronic commerce (Bank of Thailand 2006).

The third strategic plan was a follow up to the previous plan and named 'Payment 2010' (Bank of Thailand 2007). Launched in 2006, this 4-year development plan envisaged 'collaboration among public and private institutions in driving the use of efficient and secured electronic payment services with fair fees supported by an adequate legal foundation with effective enforcement'. The plan focused on seven strategic objectives as follows (www.bot.or.th):

- Extend the usage of electronic payment services for all user groups
- Establish measures to reduce cash usage
- Establish fair and appropriate service fees structure and promote electronic payment services
- Implement supporting laws for electronic payment systems
- Establish standards and guidelines for the observance of applicable laws to reduce payment providers' operation costs

- Develop payment systems which promote international trade and investment between Thailand and its neighboring countries, and
- Establish oversight to ensure safe, sound, and efficient, payment systems that comply with international standards and promote public confidence in the financial systems and financial institutions systems

Driving these developments forward includes the establishment of eleven working groups, advisory groups, steering committees, or technical committees tasked with issues relating to consumer electronic payments, corporate electronic payments, commercial bank payment costs and fees, standards and operating guidelines, payments legislation, BAHTNET, cross-border connection to the Association of South East Asian Nations (ASEAN) and selected Asian countries, and payment systems development to support trade and investment with neighboring countries.

The organisational structure for payment systems modernisation started with a more informal structure that later evolved into legislation. Early stakeholder consultations between the central bank, commercial banks and other major players were evident as early as the formulation of the first payment systems master plan. Co-operation was achieved through the establishment of working committees and expert working groups. This later evolved into the establishment of a high-level Payment Systems Committee (PSC) in August 2001 that was chaired by the Governor of the Bank of Thailand and included twelve members of whom three were external members who represented qualified experts on economic, technology and legal matters (Bank of Thailand 2003). As of June 2008, the PSC was comprised of eight members (including the chairperson), with four external members representing the Thai Bankers' Association, the Board of Trade of Thailand, the Thailand Development Research Institute Foundation, and the National Electronics and Computer Technology Centre (Bank of Thailand 2007).

This governance structure was tasked with four major mandates as follows: (1) controlling associated risks in the payment system, (2) adopting common standards, including security and efficiency, in addition to technology requirements, rules and procedures, (3) promoting competition among payment service providers, and (4) fostering cooperation among major stakeholders in the payment industry.

Following the fourth amendment of the *Bank of Thailand Act* B.E. 2551 (2008), the Bank of Thailand was legally authorised to maintain payment systems stability, including establishing, or playing a facilitating role to establish, payment systems. The PSC also received legal powers to formulate and follow up national payment system development directions and the oversight of inter-bank clearing systems.

The establishment of the Sub-Committee on National Payment Co-operation (SNPC) in December 2002 is also an interesting aspect of the payments organisational structure in Thailand (Bank of Thailand 2003). Its formation served as a precedent to the planned establishment of the TPA as envisaged under Payment 2004. When the concept of establishing a payments association did not prove feasible among the major stakeholders initially, this was resolved with the establishment of a sub-committee whose work feeds into the higher-level PSC.

The early membership structure was chaired by a major Thai commercial bank and comprised of nine members of which one member, the Communications Authority of Thailand, represented a non-bank player. As of June 2008, the SNPC comprised of eleven members (including the chairperson) and tasked with three major responsibilities as follows: (1) to establish the code of conduct for payment systems including technical standards and fair competition, (2) to formulate relevant policies relating to payment interoperability, payment media and technologies, cross-border connections, and data collection and research, and (3) to consider the establishment of a multiparty organisation for payment service providers (Bank of Thailand 2007).

One of the SNPC's major achievements has been the establishment of the National ITMX which serves as a central payments infrastructure that functions as a switching centre for members to support electronic commerce. Furthermore, as the Bank of Thailand gradually shifts its role in the payment system from that of operator to regulator, it has started, as of October 2007, to migrate the processing and settlement of automated retail funds transfer transactions in SMART to the National ITMX.

Some of the challenges facing the modernisation of payment systems in a developing country like Thailand are related to legal, governance and pricing issues. Firstly, legal reforms would need to catch up with rapid technological developments and the international principles for speedy and secure payment systems. The amendment of the central bank law is a good first step as it strengthens the legal foundation for the oversight of payment systems and empowering the central bank with a clear mandate in maintaining payment system stability through the PSC. As of December 2008, the Royal Decree Regulating Electronic Payment Service Businesses, which was initiated in July 2004 and gives the central bank supervisory and licensing powers, was due for enforcement on January 14, 2009 (Bank of Thailand 2008).

Secondly, governance reforms for the payments industry would need to continue. Under review would be the evolution of the SNPC into a more formal body for the payments industry, which may take the form of a National Payments Council or possibly a trade association like the APACS in the United Kingdom. Of particular importance would be the inclusion of both financial and non-financial institutions that provide payment services.

Thirdly, payment pricing policies would need to be continually reviewed and changed if necessary to avoid any market distortion through the subsidisation of services and to promote the use of electronic payments, hence reducing cash and cheque usage. Jitsuchon and Khiaonarong (2000) found that the Thai payments system was characterised by the high costs of paper-based payments, cross-subsidisation among payment services, and direct payment fees that made up less than half of total variable cost. They further argue for price changes by introducing cost-based pricing with fee reductions for electronic payments to encourage their usage, and fee increase for cheques to better reflect their cost.

3.4 Comparison of Strategic Approaches

The choice of policy approach largely depends on the unique characteristics of a country. Historical, structural and economic differences influence the role played by both the public and private sectors, the ownership and operations of payment systems, and the pricing policies that are adopted to achieve efficiency.

Under the minimalist approach, ownership and operations of inter-bank funds transfer systems are largely by the private sector. Where the central bank is involved, this is focused on either the ownership and/or operation, or in some cases solely oversight, of the core inter-bank funds transfer system. Costs are fully recovered in principle. Cost recovery of private sector payment systems is achieved through cost sharing by member institutions generally under a not-for profit banking or payments association. Full investment and operating costs are allocated among members based on their share of total transaction volumes or their level of involvement in the association's activities. Costs are generally paid as membership dues or contributions on an annual basis, while per-item charges may also be levied. In cases where payment systems are decentralised and with no central clearing house, operating cost is incurred by individual members that participate in the system. Pricing structures and fees of private sector payment systems are set independently by member institutions, which may vary from carrying out commercial negotiations with corporate customers to providing free of-charge services to personal customers.

Under the competitive approach, ownership and operations of inter-bank funds transfer systems are by both public and private sectors. Cost recovery of both public and private payment systems are fully accounted, including both real resource and imputed costs. Pricing structure and fees of central bank payment services follow the two-part pricing principle accounting for both fixed and variable costs, and is reflected in volume-based fee structures and monthly charges. This encourages economies of scale. Central bank fee structures undergo an annual pricing process, where fees are adjusted, if necessary, based on the future projections of expenses, revenues, volumes, the PSAF and other incomes. This is aimed at direct competition with private operators. A major issue, however, is the central bank's conflicting role as regulator and service provider.

Under the public service approach, ownership and operations of major interbank funds transfer systems are solely by the central bank. Cost recovery is based on subsidisation, where a large share of fixed costs is absorbed by the central bank. Pricing structures and fees are determined based on the non-profit principle, and are targeted at per item charges to recover variable cost from financial institutions. In addition, the central bank sets price ceilings for fees that the private sector charges its customers. This latter point also raises the issue of conflicts of interest between the central bank and the private sector.

Table 3.1 illustrates changes in domestic payment market shares for the selected country cases. This compares the percentage changes in the volumes and values of payment instructions handled in selected inter-bank funds transfer systems to total market shares in each country in 1996 and 2000.

Table 3.1 shows cheque volume reductions in each country as follows: United Kingdom (48–38%), United States (82–76%), and Thailand (99–94%). The largest market share reductions for cheques were in the United Kingdom. The share of cheque operation cost to total operating cost was highest as compared to the selected major inter-bank funds transfer systems, and is as follows: United States (86%), United Kingdom (71%), and Thailand (55%).[5]

Migration of volumes to ACHs were also evident as follows: United Kingdom (51–62%), United States (15–20% for Fed ACH; 2–3% for private ACH), and to a lesser extent Thailand (0.29–5%). The United Kingdom, once again, experienced

Table 3.1 Changes in payment market share in Canada, Finland, Thailand, United Kingdom, and United States, 1996 and 2000

Country	% Share of Volume		% Share of Value	
	1996	2000	1996	2000
Canada				
ACSS	99.90	99.92	38.14	17.03
LVTS	0.10[a]	0.08	61.86	82.97
Finland				
BOF-RTGS	0.04	0.12	73.55	90.11
PMJ	99.88	99.62	21.08	2.78
POPS	0.08	0.26	5.38	7.11
Thailand				
Cheque Clearing[b]	99.60	93.79	93.77	30.29
BAHTNET	0.11	0.84	6.22	69.57
Media Clearing	0.29[c]	5.37	0.01	0.13
United Kingdom				
CHAPS	0.30	0.47	91.58	95.66
BACS	51.24	61.71	3.96	2.47
Cheque and Credit Clearing	48.46	37.82	4.46	1.87
United States[d]				
CHIPS	0.27	0.26	54.92	41.59
Fedwire	0.42	0.47	41.27	54.06
Fed Cheque Clearing	82.37	76.29	2.00	2.02
Private ACH	1.63	2.68	0.23	0.34
Fed ACH	15.31	20.29	1.58	2.00

Sources: Bank for International Settlements (2002), European Central Bank (2002a), and EMEAP (2002)

Notes: [a]1999 figures; [b]ECS and provincial cheques; [c]1997 figures; [d]1996 figures are unavailable for private cheque clearing houses and direct exchanges. Annual figures are unavailable for Australia

[5]Total operating costs are based on cheque, ACH and funds transfer and settlement systems in each country. U.S. figures are based on the total cost for Federal Reserve cheque collection, funds transfer and settlement, and commercial ACH services in 2001. Thailand figures are based on Bank of Thailand operating costs for cheque and electronic payment services (Jitsuchon and Khiaonarong 2000). U.K. figures are based on payment industry cost for cheques and automated payments in 1994 (APACS 1996).

the largest market share increases in ACH volumes. Comparatively higher market shares of over 90% were evident in both Canada and Finland, where payment systems operate with scope economies processing more than one type of payment instrument. The share of ACH operation cost to total operating cost is comparatively lower than cheques by 23% in the United Kingdom, 14% in Thailand, and 7% in the United States.

Migration of values to large-value payment systems were as follows: Thailand (6–70%), Finland (74–90%), Canada (62–83%), United States (41–54% for Fedwire; 55–42% for CHIPS), and United Kingdom (92–96%). Thailand experienced the largest migration of values, where regulatory measures were issued to move large-value cheques to an RTGS system. Volume changes for large-value systems were minimal when compared to retail payment operations. The share of operating cost for large-value payment systems to total operating cost is as follows: Thailand (30%), United States (6%), and United Kingdom (5%).

Changes in payment market shares imply the shifting of payment systems on the risk–cost tradeoff frontier as follows. Firstly, larger volume increases in ACH operations enhances efficiency as cost-saving payment means are promoted. As illustrated, the share of operating cost for cheques was highest among all types of inter-bank funds transfer systems. ACH unit cost was comparatively lowest. ACH or ACH-like operations that handle a high share of volumes of total payment instructions were found in Canada (ACSS, 99.9% of total volumes in 2000), Finland (PMJ, 99.6% of total volumes in 2000), and the United Kingdom (BACS, 62% of total volumes in 2000). All countries adopt the minimalist approach.

Secondly, value migration to RTGS reduces risks in the payments system, although volume increases may not appear to be significant. This comes at a higher cost. Unit costs were found to be higher in large-value than retail payment systems, due to the lower number of payment transactions handled. Unit cost may also increase if opportunity cost are added when system participants are faced with costly intraday credit in maintaining liquidity or in the posting of collateral as a prudential requirement by the central bank. Many of the countries reviewed were relatively successful in migrating values to RTGS systems.

Finally, and perhaps most importantly, payment market failures existed in countries where there was a divergence between private cost and social cost. In other words, the price paid for versus the costs consumed to produce a payment service is distorted. A divergence remains even if low unit cost were achieved in an efficient payment service. Humphrey and Berger (1990) argue that this divergence stems from two sources – subsidies and taxes – which ‘distort incentives and misallocate resources, so that from a social viewpoint some payment instruments are underused and others are overused’. Payment market failures can be found in cheque and large-value payment transfers. Cheque subsidies may be in the form of par clearance in cheque collection. Large-value payment transfers use quantity constraints rather than explicit pricing to reduce risk (Faulhaber et al. 1990). Cheque operations with a high share of volumes were found in Thailand (Cheque Clearing, 94% in 2000) and the United States (Fed Cheque Clearing,

76% in 2000). These countries are under the public service and competitive approaches, respectively.

In sum, the minimalist approach was found to be more efficiency enhancing than the competitive and public service approaches, due to higher cost-reducing effects, stronger private sector involvement, and the avoidance of the central bank's conflicting role as regulator and service provider in the payments system. Subsidisation, if any, distorted prices and caused potential payment market failures in cases where the central bank has a monopoly on payment services or is a main competitor to the private sector.

3.5 The Role of the Central Bank in Promoting Innovation

This section discusses the common types of innovations that have been adopted, or proposed, in improving payment systems efficiency and some of the key policy issues faced by central banks. Three major types of efficiency enhancing innovations are drawn from a survey of international developments and the comparison of policy approaches, and are as follows: technological, regulatory, and financial innovations. The central bank's conflicting role of regulator and service provider, and their implications to improving efficiency, is later discussed.

3.5.1 Technological Innovations

Technological innovations are perhaps the most direct means in improving payment systems efficiency and include the following: consolidation of payment processing facilities, hybrid systems, outsourcing of operations, cheque modernisation, multiple net settlement, and decentralised payment systems.

Consolidation of payment processing sites reduces the number of facilities to achieve economies of scale and cost reductions. This applies equally to ACH, cheque and funds transfer operations. In the United States, the central bank consolidated many of its payments processing facilities provided by district office and branches nationwide in direct competition with private operators. In Italy, the central bank replaced the Ingrosso and Electronic Memoranda retail payment systems with BI-REL as from 1998 (European Central Bank 2001). In Spain, the National Electronic Clearing System, owned by the central bank, gradually replaced all traditional provincial clearinghouses by 1996 (European Central Bank 2001). The European Central Bank (ECB) has also prepared evolutionary plans for TARGET based on the voluntary use of central banks of a shared platform with the objective of guaranteeing cost efficiency (European Central Bank 2002b).

Hybrid systems seek to achieve lower settlement risks and lower liquidity costs in large-value payment systems. This may include use of optimising and gridlock

solving features (Leinonen and Soramäki 1999). McAndrews and Trundle (2001) classify hybrid systems into two types: continuous net settlement (CNS) and 'queue-augmented RTGS' systems. CNS systems are slightly similar to deferred net settlement (DNS) systems, but use a computer algorithm to check if a participant's net debit amount is within their settlement account balance and if conditions are met, releases payments for real-time settlement. The latter also involves a computer algorithm but searches a queue for simultaneous payments that are also offsetting. Examples of hybrid systems include the Paris Net Settlement, the New Clearing House Interbank Payment System in the United States, and the RTGS plus system in Germany.

Outsourcing of operations or facilities management by an external entity have also been reviewed by some central banks. The objectives of outsourcing may be to reduce cost, to gain outside expertise, or to phase out selected non-core functions of the central bank. Policy reviews initiated by some central banks to outsource large-value and retail payment operations are cases in point, although there may be no immediate plans (Sveriges Riksbank 2002). Comparatively, a large number of central banks see their continuing role in operating core inter-bank RTGS systems to ensure financial stability and market confidence. Others have considered long-term outsourcing options, such as in the movement of inter-bank settlement system hardware to an overseas site, as in New Zealand (Reserve Bank of New Zealand 2001).

Cheque modernisation has been introduced in many countries to increase the operating efficiency of cheque processing. In principle, cheque information is captured electronically at processing sites, and sent for further clearing and settlement. In the United States, a 5-year cheque modernisation programme, costing $250 million, was initiated to develop common standards, cheque imaging, and an Internet-based delivery channel for cheques (Board of Governors of the Federal Reserve System 2000). Cheque information, in electronic form, may be processed at a common ACH facility that also handles other types of payment instruments. This provides economies of scope and lower unit cost with output expansion.

Multiple net settlement was also found in some retail payment operations. This improves efficiency by increasing the overall processing time and providing real-time information of payments in a net settlement system. In the Netherlands, this has included the clearing of retail payments every 30 minutes in the Interpay system before they are sent for settlement at the central bank. In Spain, the central bank provides up to 30 RTGS operations for the daily settlement of the net position for all sub-systems operating under the SNCE retail payment system.

Decentralised payment systems were found in a few countries where there was an absence of a centralised ACH. Payment participants send bilateral messages to each other, while settlement takes effect across their accounts at the central bank. This was illustrated with the PMJ and POPS systems in Finland, while more recent proposals include interbank funds transfer systems that are network-based payment infrastructures that fully integrate with bank payment systems (Leinonen et al. 2002; Leinonen 2000).

3.5.2 Regulatory Innovations

Regulatory innovations focus on creating an overall policy framework to improve payment systems efficiency. This includes the following: legislation, transparent pricing policy, cost accounting applications, payment associations, and value migration measures.

Legislation can empower the central bank to pursue payment systems efficiency. This may be either explicit or implicit. Explicit legislation clearly defines the role of the central bank in the payments system, and this may broadly cover the objectives of promoting efficiency, reducing risk, and protecting consumers. Australia, Canada, Norway, and the United States, for example, have explicit legislation on payment systems. Implicit legislation may be found in the main central bank act or related laws. In promoting efficiency, legislation may address competitive issues such as the fair access and pricing of payment systems. The central bank may have powers to designate a payment system as systemically important, and therefore, putting it under strict oversight. In addition, it may also have data collection powers such as in the case of gathering cost data.

Transparent pricing policies help in resource allocation and management. The pricing policy of a central bank may range from being transparent to implicit. In the United States, a transparent pricing policy is mandated under law, while fee structures undergo an annual pricing process, which may result in new fees that better reflect the central bank's forecast of changes in costs, volumes and other variables. Cross-subsidisation of services are also not permitted. Danmarks Nationalbank discloses information on the development costs, monthly operating costs, and transaction prices for KRONOS, the country's RTGS system. Operating costs and transaction prices are also subject to an annual review to ensure full cost recovery, while cost distribution among participants are also considered yearly when new working capital figures are published by the Danish Financial Supervisory Authority. The Bank of England and the Reserve Bank of Australia report settlement cost in annual reports. The Sveriges Riksbank reports fees and commission figures. Transparent pricing policies, where both cost and prices are disclosed, and annual pricing reviews, were absent in a majority of central banks surveyed, however. Two-part pricing has been successfully demonstrated in achieving full cost recovery, particularly by the US central bank, which did not have an appropriate pricing regime until 1980. Such practices have also been adopted in many large-value payment systems through volume-based pricing, but full cost recovery was not always achieved by some of the central banks surveyed.

Cost accounting applications to payment services contribute to improved resource allocation and management. A transparent pricing policy is supported by a good cost accounting system. This applies to all types of central bank priced services, including payment and settlement services. Costing practices vary across central banks, where this may be on a systematic or an ad hoc basis. A systematic approach is the US Federal Reserve System's Planning and Control System (PACS) developed since the mid-1970s. PACS serves three major purposes: to identify the full cost of output services on a uniform basis for all Reserve Banks; to integrate

expense accounting and budgeting; and to provide a consistent basis for measuring Reserve Bank performance. A conceptual framework is further used to create credible cost accounting information with the underlying principles of accountability, integrity, decision-making, and efficiency. In practice, expenses are reported by activity with cost breakdowns by office and district.

Payment associations help in cost sharing by industry and promote private sector led initiatives to improve efficiency. A payment association is generally set up with a not-for-profit objective where full cost recovery is met through annual membership dues or contributions that are in proportion with their level of activity. Members determine customer charges independently. The central bank's role may vary from being a non-member, founder, shareholder, system participant, or even chairperson or board member in the associations. In some countries, such as the United Kingdom, the central bank has played a constructive role in the establishment of the association. The benefits of the association is not solely on the cost sharing of payment clearing operations, but is also a channel for industry co-operation on matters of common interest. Payment associations exist in Australia, Canada, and the United Kingdom. Similar industry arrangements have also been adopted in Korea (Korea Financial Telecommunications and Clearings Institute), and more recently, in Ireland (Irish Payment Services Organisation), where four autonomous companies operate under the umbrella of IPSO (European Central Bank 2001).

Value migration measures involve the movement of large-value items from retail to large-value payment operations to achieve the reduction of potential systemic risk. This involves setting ceilings in retail payment systems, and requiring large value items that are above the limit and are currently processed by them, such as large value cheques, to be handled in an RTGS system. Such measures have been introduced by many central banks, foe example in Indonesia and Thailand, while other there have also been similar industry plans led by the payments association in Canada.

3.5.3 Financial Innovations

Financial innovations focus on liquidity-saving features in large-value payment and settlement systems. They may also include the potential use of private substitutes for central bank money for the settlement of transactions (Lahdenperä 2001). Liquidity management systems provide an illustration. In Canada, a collateral valuation and tracking system was developed by the central bank to efficiently and accurately monitor the value for the different types of assets used as collateral security by participants in the LVTS. In addition, interest-bearing special deposit accounts are provided for LVTS participants by the central bank, which can be used as a form of collateral and reduce the overall collateral cost of participants (Goodlet 1997). In Malaysia, a real-time surveillance system has been introduced by the central bank to monitor liquidity in the large-value interbank funds transfer system

RENTAS (Bank Negara Malaysia 2001). Hybrid systems, as mentioned, may also be viewed as a financial innovation.

3.5.4 Key Policy Issues

The conflicting role of the central bank in the payments system stems from it being both regulator and service provider. Such dual roles may not always be in the best interest of both the public and private sectors. Payment market failures may result from the subsidisation of payment services by the central bank. Private sector competition and innovations may also be stifled as a result of central bank pricing policies or regulations imposed on the pricing of payment services provided by the private sector. Central banks face four key policy issues.

Choice of policy approach is the first policy issue. Cost-reducing effects were found to be strongest under the minimalist approach, suggesting that efficiency may be best achieved with increased private sector involvement in owning and operating payment systems, with the central bank assuming a more limited role. Although the choice of policy approach would need to be suitable to specific country conditions, the key lesson that can be drawn is in allocating and managing resources between the public and private sectors in the interest of improving the overall payment systems efficiency. An excellent example of a central bank that reviewed its policy approach is the US Federal Reserve, which examined the impact of five scenarios as follows: liquidation, privatisation, continuity and access, promoting efficiency, leading to electronic payments (Federal Reserve System 1998).

Subsidisation of services is the second policy issue. The objective of subsidisation is usually based on welfare grounds. Subsidisation may seek to promote cost saving payment methods that are in the public's interest, and is reflected in a not-for-profit pricing structure. Subsidisation may also support a risk reduction policy by encouraging the migration of high-value items to risk-averse payment systems. Subsidisation is justified if it is proven to be efficiency enhancing, risk reducing, and is in the public's interest. If this is proven otherwise, the central bank may choose to review its current policies, such as in minimising subsidies or subsidising selected services rather than all services. The latter case is of particular concern when central banks provide subsidies during the initial life cycle stages of payment systems it has developed to encourage their use. This may benefit the public, but may institutionalise the concept of subsidisation in the long-run if the central bank's pricing policy does not undergo an annual pricing process to review current and future pricing structures based on forecasts of changes in volumes, costs or other variables.

Specialisation of services is the third policy issue. The objective of specialisation is to focus on core payment and settlement functions where the central bank has comparative advantage. Green and Todd (2001), for example, argue that the US Federal Reserve should specialise in providing interbank settlement services that offer economies of scope, while reviewing its policy to withdraw from direct service

provisions given the readiness of the private sector. Another example is the phasing out of operations related to central securities depositories originally handled by central banks in some countries. Of particular importance is the role of some central banks in retail payment operations. In many countries, this function is largely owned and operated by the private sector, partly due to the profit incentive arising from the scale and scope economies processed by such systems. The consolidation of the banking sector may also bring about further policy implications on services the central bank seeks to specialise, as the number of payment instructions shift from inter-bank to intra-bank transactions in bank mergers, resulting in lower volumes processed by a payment system and rising unit costs.

Balancing oversight and operational functions is the final policy issue. The oversight of payment systems has become an increasingly important role for many central banks. This covers three broad areas: inter-bank funds transfer and settlement systems, securities settlement systems, and foreign exchange settlement systems. Both oversight and operational functions demand considerable resources and effort on the part of the central bank. Oversight should not be compromised in cases where the central bank is the owner and operator of payment services due to its conflicting role as earlier argued. In addition, there needs to be a balance between focusing resources on operational and oversight functions, where the former function has often taken precedence in countries where the central bank has a major role in operating payment systems. In fact, this would require a major shift from an operational to an oversight mindset, and the possible reorganisation of payment functions under the monetary or financial stability areas, rather than in operations. Policy issues also arise in cases where alternative service providers can replace the role of the central bank in payment operations. As collective investment funds can provide payment services in addition to commercial banks, this raises the question of whether additional regulatory and supervisory arrangements are required by the central bank (Goodhart 1987). In this respect, the asset portfolios of banks are fixed in value, while collective-investment funds are dictated by the market, requiring central bank assistance in reducing risk. Although the central bank has regulatory and supervisory roles, it may not be required to undertake an operational role, provided that sufficient information with real-time monitoring are obtained (Goodhart and Schoenmaker 1995). Moreover, the future division of roles between the central bank and the private sector may be based upon the former providing a prudential and efficiency enhancing policy framework, where the latter focuses on the development and operation of payment systems (Pauli 2000).

Chapter 4
The Analysis of Payment Systems Efficiency

Abstract There are various policy approaches to payment systems efficiency. Here we consider some common analytical frameworks, namely the risk-cost frontier, settlement delay-liquidity usage, economies of scale, and product life-cycle approaches. We do this to examine the use of payment instruments and their implications for payment systems efficiency, to compare pricing policies of central bank payment services, and to focus on pricing methods, payment transactions, fees, costs and revenue, and measures to enhance efficiency.

Efficiency in payment systems has become a key policy issue shared by many central banks in developed and developing economies. This can be explained from two perspectives. Efficiency in private sector payment services is the first view. Regulatory authorities have been particularly concerned about the role of competition, banking consolidation, and financial sector liberalisation in enhancing, or inhibiting, the efficiency of private sector payment services. Competition issues in debit and credit card schemes, and money transmission markets have been topical in Australia and the United Kingdom, respectively (Reserve Bank of Australia and Australian Competition and Consumer Commission 2000; HM Treasury 2001, 2000a, 2000b). The role of consolidation and bank mergers in strengthening scale economies in electronic payments has received interest in the United States and the European Union (Humphrey and Vale 2004; Hancock et al. 1999). Free trade agreements in financial services, particularly opening the access of local payment networks to foreign competition, have also received wide debate in many emerging economies.

Efficiency in central bank payment services is the second view. Central banks are faced with a risk-cost trade-off where the payment service they provide are treated as a public good providing positive externalities aimed at reducing potential risks in the payments system. While the risk-reduction objective may be fulfilled, this may in some cases be at the expense of an efficiency-enhancing objective where the payment service may have been partially or fully subsidised. When actual resource costs are not fully accounted for, this may lead to price distortions and market failure. Scholarly studies on central bank and payment systems efficiency have recently emerged (Blix et al. 2003; Bergman 2003).

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4.1 Analytical Frameworks

4.1.1 The Risk-Cost Frontier Framework

Alternative theories and models for studying payment systems, including efficiency issues, are reviewed by Frankel and Marquardt (1983). Figure 4.1 illustrates the risk-cost frontier framework, an approach that examines efficiency, risks, costs and innovations in the payments system (Berger et al. 1996). The framework helps explain the efficiency of a payment system in terms of the risk and cost it absorbs along the efficiency frontier, and more importantly, how innovations may shift its position, in terms of efficiency improvements, along the frontier.

The framework is based on the risk-return trade-off of the capital asset pricing model used in finance, but adapts costs for return in examining risk-cost tradeoffs for payment systems efficiency. It has also been adopted to study the risks and efficiency of operating DNS vs. RTGS systems in large-value transfer systems in both developed and developing countries (Fry et al. 1999). Gilbert (1998) also uses this approach to analyse the efficiency of the US payments system. The efficiency frontier, indicated by the curve *FF*, shows the possible combinations of risks-cost tradeoffs. In other words, achieving lower risks in the payments system comes at a higher cost, while achieving lower costs comes with higher risks. This inverse relationship between settlement delays and liquidity usage is illustrated later.

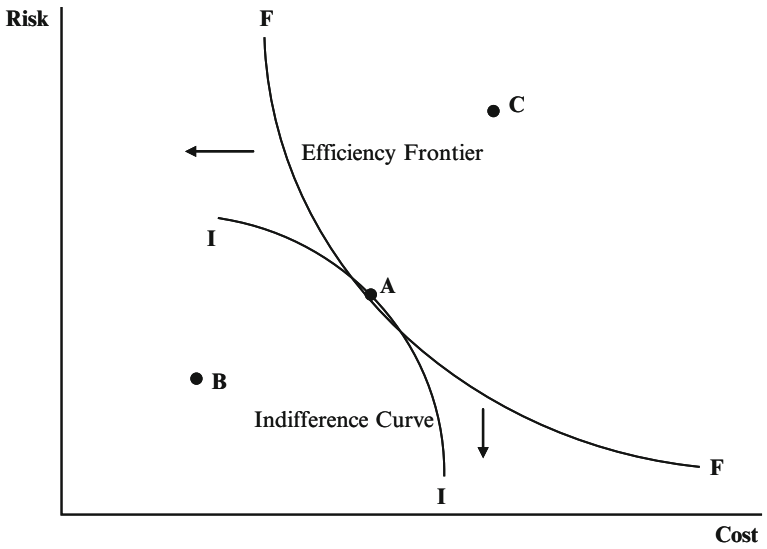


Fig. 4.1 The risk-cost frontier framework

The indifference curve, indicated by the curve *II*, shows how society prefers low-risk and low-cost payment services, while also being indifferent to lower risk and higher costs along the efficiency frontier. In other words, society is willing to incur a high cost for high-risk payments and vice versa. This can be illustrated with the transfer of large sums of money through electronic means rather than the withdrawal and carrying of cash. Social welfare is maximised at point A where the efficiency frontier curve *FF* meets the social indifference curve *II*. Point B represents technological change, where a new payment service has brought about lower risk and cost. Point C, however, indicates technical inefficiency, characterised by a high-risk and high-cost payment service. The challenge faced by central banks is shifting points along the efficiency frontier to achieve positions that are in close proximity to the origin, where the efficiency frontier and indifference curves are tangent, and where there can be greater social welfare.

Three types of innovations have potential to shift points on the efficiency frontier. Technological innovations include new payment services that have potential cost-savings arising from lower computer and communications costs, and may include examples such as on-line banking, telephone banking and other electronic financial services delivery channels. Regulatory innovations include changes in regulations or supervision rules that improve the oversight of payment systems. Such regulations may permit specific types of financial institutions to provide electronic money schemes, or in other cases, regulations that migrate the processing of large-value cheques from the cheque clearing house to a RTGS system to reduce potential systemic risks. Financial innovations may include risk evaluation techniques that enable better monitoring of risks, and may be illustrated with the use of modern liquidity management models by the central bank and commercial banks in managing intraday liquidity in RTGS systems.

4.1.2 The Settlement Delay-Liquidity Usage Framework

Financial costs, such as the cost of obtaining liquidity, the cost of settlement delays, and the cost of payment delays, influence the efficiency of payment systems. Understanding how liquidity usage and settlement speed is optimised helps in enhancing efficiency. Optimising liquidity usage and settlement speed involves introducing liquidity-saving mechanisms such as new settlement algorithms to improve efficiency (Kahn and Roberds 2001; Leinonen and Soramäki 1999; Koponen and Soramäki 1998; Angelini 1998).

Figure 4.2 shows the liquidity usage and settlement delay framework where there is a trade-off between the two in inter-bank settlement systems. An inter-bank settlement system with low settlement speed, like DNS systems, demands lesser liquidity than systems with shorter settlement cycles, in RTGS systems, which often require the immediacy of funds intraday. Figure 4.2, Point A represents an RTGS system facing no delays and queues, and requiring an upper bound of liquidity

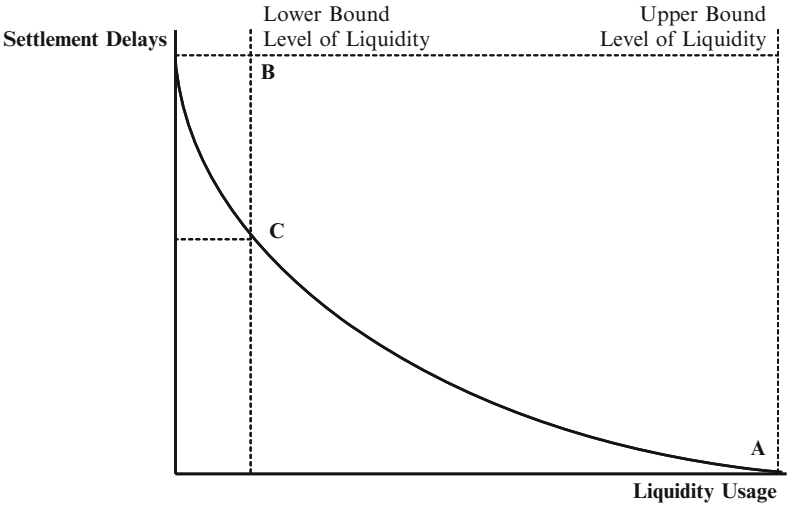


Fig. 4.2 The settlement delay-liquidity usage framework

or the amount of liquidity that must be available to the participants for immediate settlement during the day. Point B represents a DNS system facing delays and queues, requiring a lower bound of liquidity or the amount of liquidity required for participants at the end of the day. Point C represents an RTGS system, with optimisation and some queues and delays.

4.1.3 The Economies of Scale Framework

Real resource costs in the form of investment, systems development and operational costs are also incurred in providing payment services. Recovering such costs and achieving scale economies in payments processing influence efficiency in payment systems. Figure 4.3 shows the hypothetical relationship between marginal cost, average cost and the number of instructions processed by a settlement system.

Achieving scale economies requires output expansion that leads to decreasing cost conditions for a given product or service. An increase of payment and settlement instructions, for example, processed by a payment facility may lead to lower average costs per payment instruction for the operator as costs are spread over more items, after which cost-savings can be passed on to financial institutions, and finally, to their customers.

Unit cost decreases between output level Q1 and Q2 from C1 (average cost) and C2 (marginal cost) to C3 with the increase in payment instructions. Further output expansion from output level Q2 to Q3 leads to a U-shaped curve where unit costs rise to C4 (average cost) and C2 (marginal cost). Economic theory suggests marginal

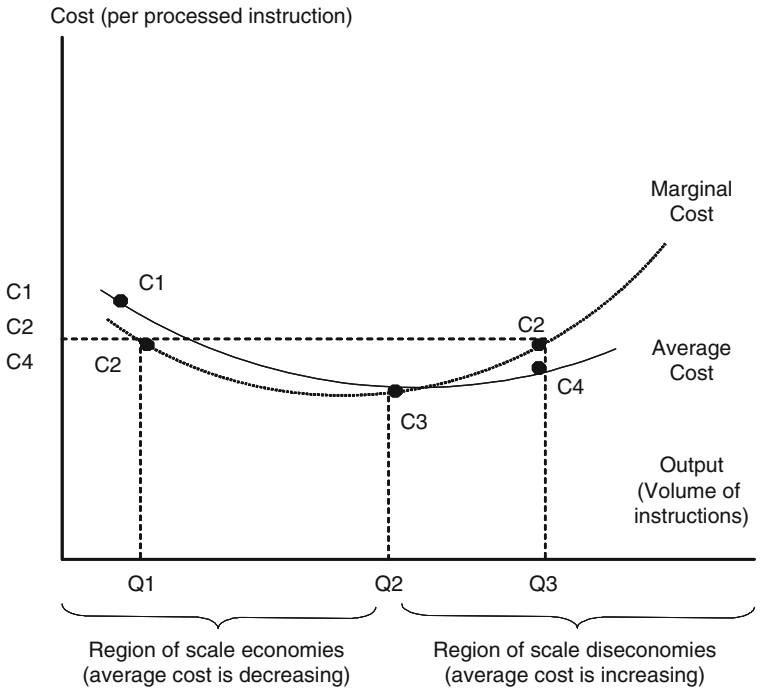


Fig. 4.3 The economies of scale framework

cost pricing as the optimal approach in resource allocation with price equaling marginal costs as users pay for the real resource cost of producing the payment service. As marginal cost is difficult to obtain in practice, one approximation is the use of average variable cost.

Scale economies can be expressed: SCE = (percentage change in total costs)/(percentage change in output). Scale economies exist when SCE <1, as total costs increases are less than output with a decrease in average cost with output expansion. Alternatively, scale diseconomies set in when SCE >1, or when total costs increases are higher than output with an increase in average cost. Constant returns to scale exist when SCE = 1.

4.1.4 The Product Life-Cycle Framework

Figure 4.4 illustrates the product life-cycle framework, as proposed by Porter (1980) and applied to bank payment services in Norway (Gresvik and Øwre 2001). The hypothetical framework shows the link between transaction growth for a given payment service over time. The location of different payment services on the curve

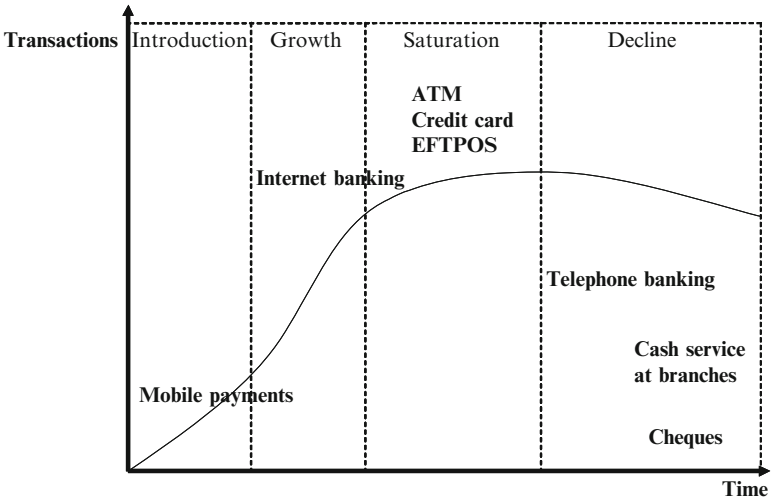


Fig. 4.4 The product life-cycle framework

varies across countries due to many factors, such as the maturity of the banking system and the level of economic development. Costs are involved in marketing and providing such services at each stage.

Marketing and depreciation costs for a new payment service are particularly high, with low transaction volumes and a surplus capacity, in the introduction stage. Users and transactions increase in the growth stage where demand may outrun supply in some peak periods. Wide acceptance and usage is experienced in the saturation stage with lower marketing costs and more price competition. Users have a wider choice of alternative payment providers and methods in the decline stage, leading to shifts across services and possible scale diseconomies for some services. Figure 4.4 may be used to illustrate the growth and decline of various payment services in Scandinavian countries such as Finland and Norway where mobile banking has been in the introductory stage despite high ratios of mobile phone per capita. Internet banking is in the growth stage where sharp transaction growth has been experienced. Card-based payments have reached a saturated stage, while cheques have declined because of cost-based pricing and the choice of cost-saving electronic payment methods (Jyrkönen and Paunonen 2003).

4.1.5 Payment Systems Efficiency Studies

Table 4.1 provides a summary of selected studies related to cost, pricing and efficiency in payment systems. This covers studies on central bank and private sector payment services published during 1993–2004. The literature can be organised as follows. Macroeconomic-oriented studies have focused on the linkage between

Table 4.1 Summary of selected studies related to payment systems efficiency

Payment provider: Authors (date)	Scope of study
Central bank:	
Gilbert et al. (2004)	– Productivity of Federal Reserve cheque-processing offices
Khiaonarong (2003)	– Cost of inter-bank settlement services across 31 payment systems
Lacker and Weinberg (2003)	– Payment economics
Heller and Lengwiler (2003)	– Liquidity management in the Swiss Interbank Clearing system
Williamson (2003)	– Payment systems and monetary policy
Kahn and Roberds (2001)	– RTGS and the costs of immediacy
Green and Todd (2001)	– Specialization strategy for the Federal Reserve in providing account-based settlement services and other services that have economies of scope
Hancock et al. (1999)	– Consolidation and scale economies in reducing electronic payment cost
Gilbert (1999)	– Efficiency of Federal Reserve cheque collection services
Lacker et al. (1999)	– Role of the Federal Reserve in the cheque collection systems
Angelini (1998)	– Competitive externalities in gross settlement systems
Lacker (1997)	– Examined clearing, settlement and monetary policy
Bauer and Ferrier (1996)	– Scale economies in Federal Reserve cheque, ACH and Fedwire payments processing services
Bauer and Hancock (1995)	– Scale economies and technological change in Federal Reserve ACH payment processing
Weinberg (1994)	– Sustainable pricing as a pricing strategy for the Federal Reserve where prices are pushed down to incremental cost when there is private competition
Bauer and Hancock (1993)	– Efficiency and productivity growth of cheque processing operations
Private sector:	
Swartz et al. (2004)	– Economics of a cashless society
Humphrey and Vale (2004)	– Scale economies, bank mergers and electronic payments in Norway
Raa and Shestalova (2004)	– Retailer payment costs in the Netherlands
Humphrey et al. (2003)	– Cost-savings from electronic payments
Gresvik and Øwre (2001)	– Payment costs in Norway
Jitsuchon and Khiaonarong (2000)	– Payment cost in Thailand
APACS (1996)	– Money transmission costs in the UK
Robinson and Flatraaker (1995)	– Payment costs in Norway
Flatraaker and Robinson (1995)	– Payment cost recovery in Norway
Tarkka (1995)	– Pricing of bank service charges in Finland

payment systems and monetary policy. This focuses on the efficiency of clearing and settlement arrangements from a monetary economics perspective. Payment economics has emerged as a field where agents and their medium of exchange are examined such as the use of private liabilities by financial intermediaries in an

exchange in a payment system (Lacker and Weinberg 2003). Heller and Lengwiler (2003) developed a model where a bank's reserve demand depends on the joint distribution of transactions, reserve requirements, and the interest rate, and found that savings on costly reserves required for immediate payments can be achieved with resources directed to liquidity management. Williamson (2003) developed a model to examine the role of money in centralised payment arrangements and found that efficiency is achieved with a zero nominal interest rate on overnight central bank lending, or through private overnight interbank lending. Lacker (1997) examined the role of intraday overdraft limits and fees, collateral requirements, reserve requirements, and interest on reserves in clearing and settlement systems. Other studies examined the link between settlement delays and costs (Kahn and Roberds 2001; Angelini 1998).

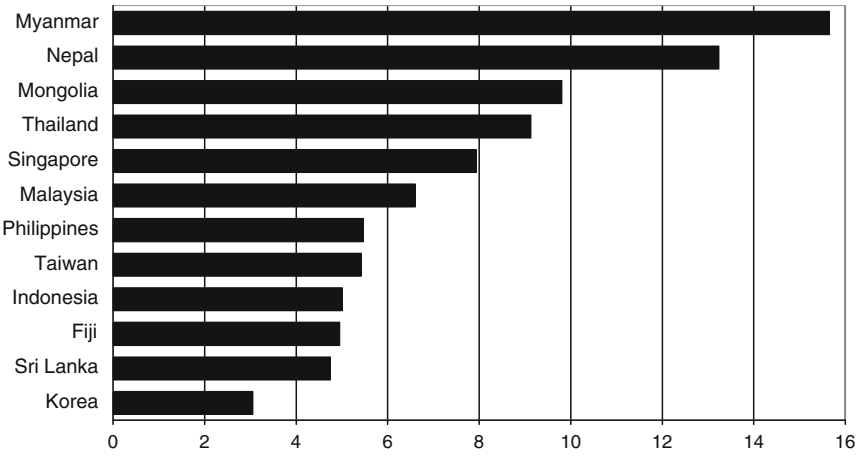
Microeconomic-oriented studies have focused on the costs, pricing, scale economies and productivity of payment systems. Scale economy studies have largely focused on the US payment system owing to the available long times series data on costs and other productivity measures and the public debate on the role of the central bank in promoting an efficient payment system (Gilbert et al. 2004; Hancock et al. 1999; Bauer and Ferrier 1996; Bauer and Hancock 1993, 1995). Studies have largely focused on countries like Norway, where commercial bank cost data over time is available, and to a lesser extent elsewhere in Europe and in Asia (Humphrey and Vale 2004; Raa and Shestalova 2004; Humphrey et al. 2003; Khiaonarong 2003; Gresvik and Øwre 2001; Jitsuchon and Khiaonarong 2000; APACS 1996; Robinson and Flatraaker 1995; Flatraaker and Robinson 1995; Tarkaa 1995).

4.2 Use of Payment Instruments and Implications on Efficiency

4.2.1 Cash Transactions

Overall efficiency in payment systems may be measured by relative transaction volumes. Similarly, overall risks can be measured through relative transaction values. This may be compared through the use of cash vs. cashless transactions. The resource costs required to produce the services, the potential cost-savings through scale economy operations, and the way the services are priced, vary and have a large influence on efficiency.

Figure 4.5 compares the ratio of currency in circulation to gross domestic product (GDP) (at current prices) across the SEACEN countries in 2002. Currency in circulation, or the *stock* of cash, is used as data on cash *flows* are not available, although there have been recent forecast studies on the use of cash in legal and illegal activities in Norway (Humphrey et al. 2000). Cash transactions remain a popular payment means in many countries with Myanmar having the highest ratio



Source: Asian Development Bank (2003)
Notes: Figures for Myanmar are for 2001

Fig. 4.5 Currency in circulation to GDP, in percent, 2002

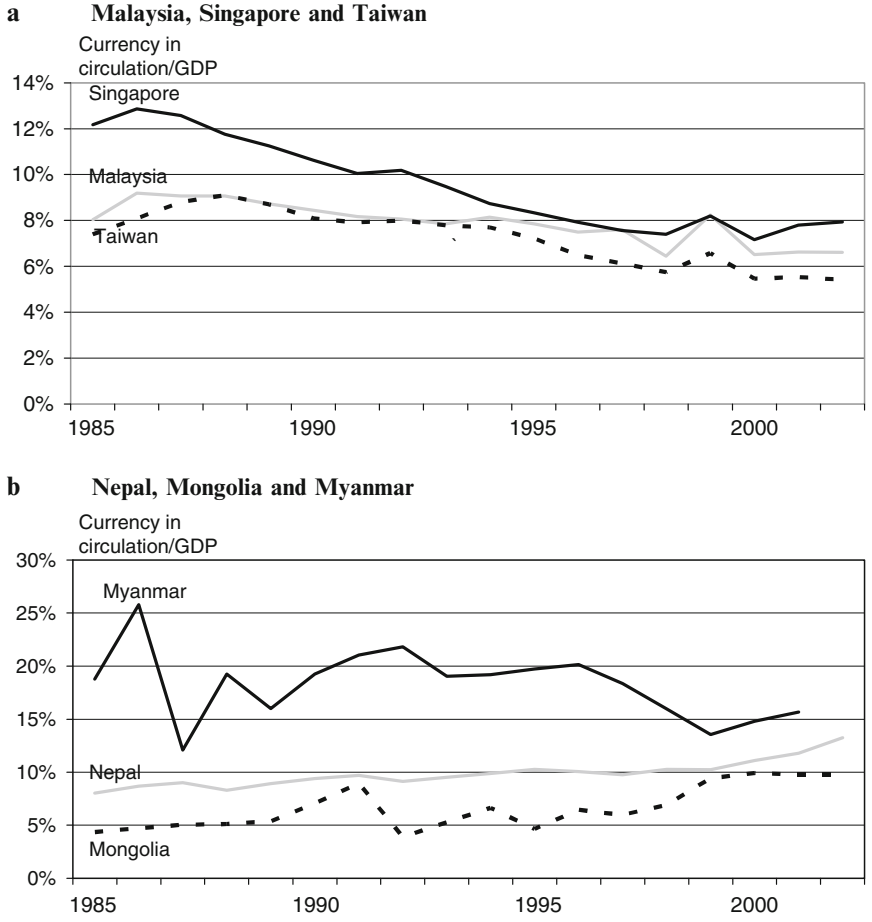
at 15%. Nepal, Mongolia and Thailand also had relatively high ratios. Korea has the lowest ratio at 3%.

Figure 4.6 illustrates the ratio of currency in circulation to GDP across the SEACEN countries for the period 1985-2002. Cash transactions experienced a downward trend in many countries such as Korea, Malaysia, Singapore, Sri Lanka and Taiwan. Comparatively, an upward trend in cash transactions was evident in Fiji, Indonesia, Mongolia, Nepal, the Philippines and Thailand. It is also interesting to note the common pattern across many countries where sharp increases in the ratio can be seen prior to 2000. This is particularly linked to the century date change or year two thousand (Y2K) problem.

Figure 4.7 illustrates the ratio of currency in circulation to money supply as measured by M1 in 2002. M1, or narrow money, comprises transferable deposits, such as demand deposits, and currency outside deposit money banks (IMF 2004). A wide range of payment services are account-based, where a customer opens an account with a commercial bank, for example, and gains access to such services. Some of these services are cashless by nature and are cheque-based, card-based or electronic-based. Thus, a lower ratio partly reflects the use of such cashless transactions and vice versa. Countries with relatively high ratios over 50% include Thailand, Myanmar, Nepal, Mongolia and Sri Lanka. Relatively low ratios were found in Korea and Taiwan.

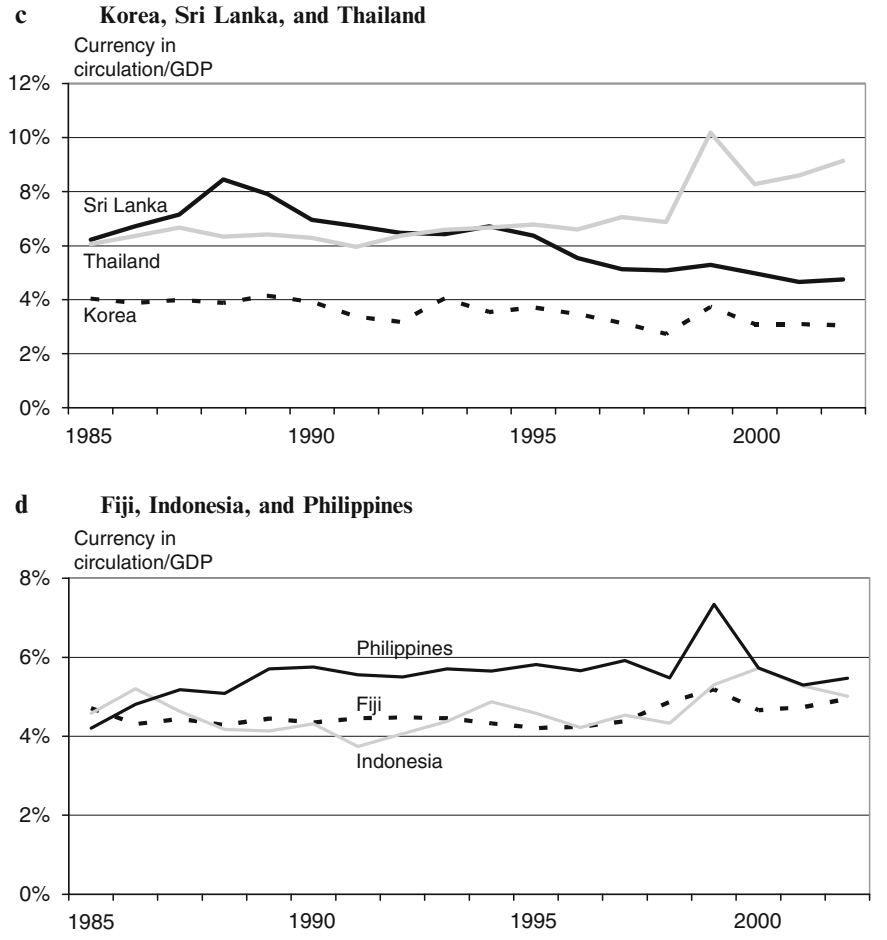
Figure 4.8 further illustrates the ratio of currency in circulation to M1 for the period 1985–2002. The ratios clearly exhibited a downward trend in Singapore, Malaysia, Taiwan, Korea and the Philippines. Comparatively, the ratios show a sharp increase for Mongolia, while there were incremental increases in Nepal, Thailand and Sri Lanka.

Figure 4.9 illustrates the ratio of currency in circulation to money supply as measured by M2 in 2002. M2 is a broader definition of money, comprising of M1 and quasi-money, which includes time, savings, and foreign currency deposits (IMF 2004). In practice, bank customers may have more than one account in a single bank or multiple accounts with different banks where cashless transactions flow across them. As mentioned, a lower ratio partly reflects the use of such cash and cashless transactions and vice versa. Countries with relatively high ratios above 15% include Myanmar, Mongolia and Nepal. Relatively low ratios were found in Korea, Taiwan, Malaysia and Singapore.



Source: Asian Development Bank (2003)
Notes: Figure for 2002 is not available for Myanmar.

Fig. 4.6 Currency in circulation to GDP, 1985–2002

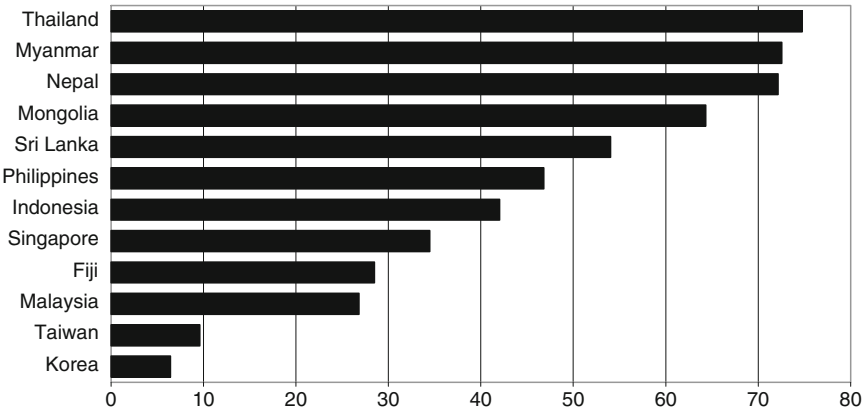


Source: Asian Development Bank (2003)

Fig. 4.6 (continued)

Figure 4.10 further illustrates the ratio of currency in circulation to M2 for the period 1985–2002. The ratios clearly exhibit a downward trend in many of the countries. Comparatively, the ratios show an upward trend for Mongolia and Fiji.

Several factors explain the choice of cash over alternative payment instruments. Precautionary and speculative purposes help explain the public's demand to hold cash for transactions (Laidler 1985). Cash holdings per person were found to increase with real per capita income but fall with inflation and higher interest rates, where there are high opportunity costs of holding idle cash balances (Humphrey et al. 1997). The period preceding the century date change clearly further explains how cash continues to command confidence from consumers, as central banks in



Source: Asian Development Bank (2003)
Notes: Figure for Myanmar is for 2001

Fig. 4.7 Currency in circulation to M1, in percent, 2002

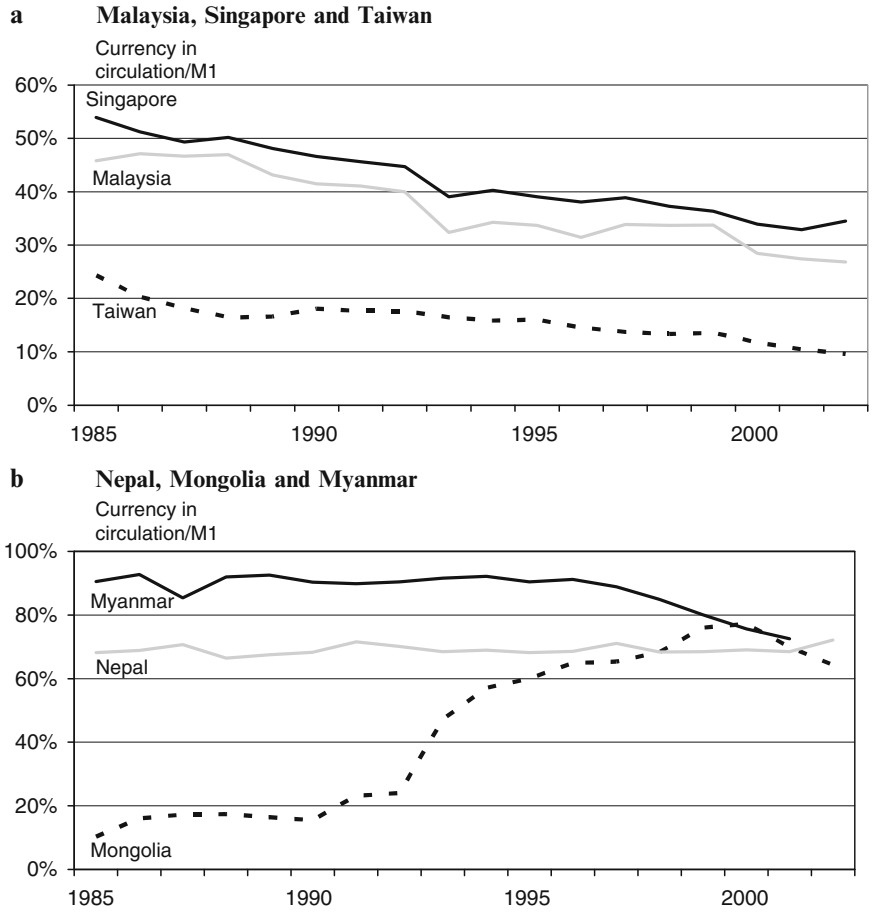
many countries printed more currency to prepare for any unexpected disruptions in the payments system. Crime is also a factor. With low crime rates, consumers are more comfortable with using cash for transactions, while with high crime rates, use of cashless transactions provide a safer method. Familiarity with the payment instrument also explains why cash continues to be popular. Cash has been in use for over many centuries when compared to other payment methods that are cheque-based, card-based or electronic-based. Having been tried and tested, it is widely acceptable.

Anonymity is another strong reason why cash is dominant. Compared with other payment methods, the use of cash does not leave a trail of evidence like the use of cheque, card or electronic payments. Large denomination currency notes are often linked to bad behavior such as their use in illegal activities of drug smuggling, tax evasion, vote-buying, etc. Thus, it has been strongly argued that as long as consumers "enjoy" this anonymity, the emergence of electronic money will not erode the power of the central bank in controlling the monetary base and the setting of interest rates (Goodhart 2000).

Availability of ATM terminals tends to increase cash usage (Boeschoten 1991, 1992). Although ATM terminals provide a channel to access a wide range of payment services such as funds transfers, utility payments, cash deposits and others, a majority of transactions are for cash withdrawals. Comparatively, the spread of point of sale (POS) terminals tend to decrease the use of cash transactions with consumers using credit cards and debit cards as payment alternatives.

Cash transactions come at a relatively high cost. Production costs are required to produce the instrument prior to use, and processing costs are borne by the payor (accounting/mailing), payee (processing/accounting), banks (processing/

transportation), and the central bank (processing/transportation). In addition, there are also opportunity costs of holding idle funds (Humphrey 1984). For commercial banks, cash costs can make up nearly half of all the costs for providing money transmission services, which also includes cheques, automated bulk payments, high-value funds transfers and plastic cards (APACS 1996). Cash costs borne by commercial banks are specifically related to counter withdrawal, ATM withdrawal, branch receipt, exchange, and the movement of bulk cash. Some central banks and commercial banks charge for cash related services. Others don't choose to subsidise or cross-subsidise cash services, after which price



Source: Asian Development Bank (2003)
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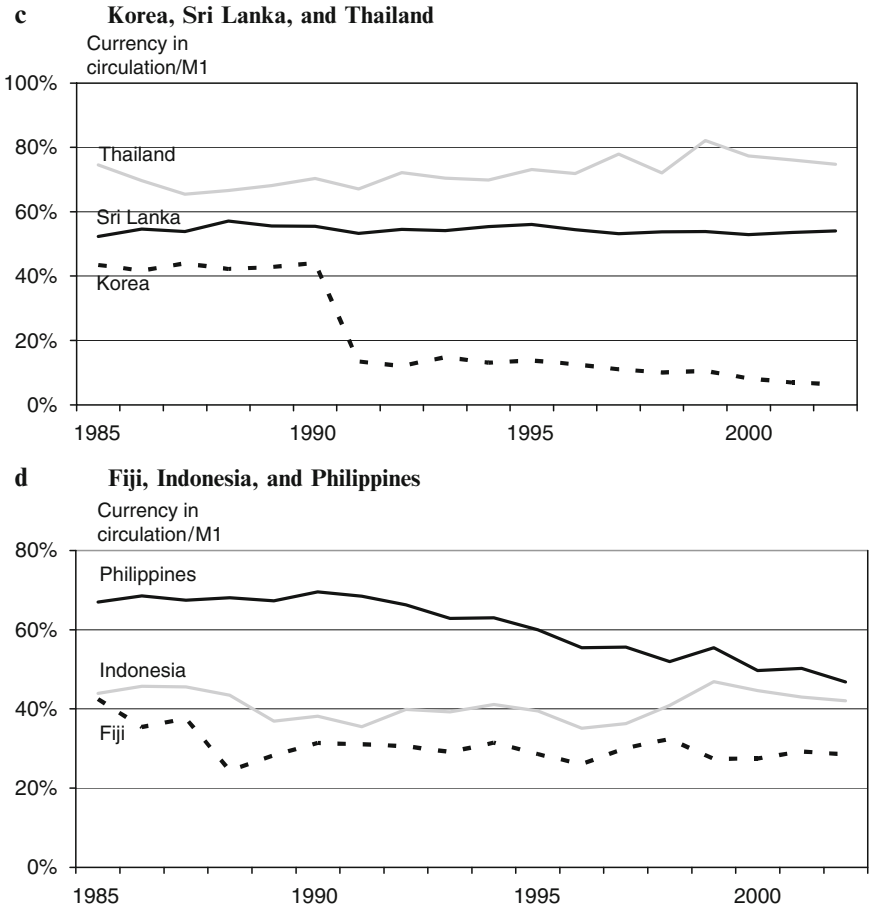
Fig. 4.8 Currency in circulation to M1, 1985–2002



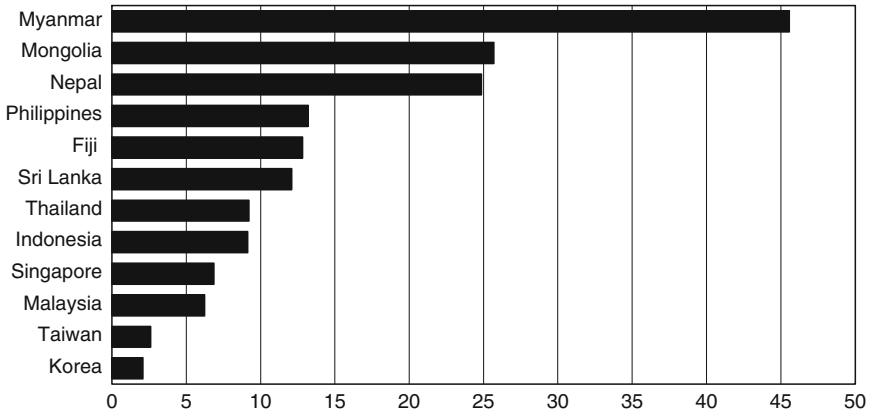
Source: Asian Development Bank (2003)

Fig. 4.8 (continued)

distortions are created for bank service charges. With high cost, the lack of scale economies, and possible subsidisation, use of cash transactions do not contribute to enhancing efficiency in the payments system.

4.2.2 Cashless Transactions

Cashless comprises cheques, cards and electronic payment methods. Earlier studies across the SEACEN countries suggest that there is a movement towards a "cashless" society, with cash and cheques remaining a popular payment instrument and



Source: Asian Development Bank (2003)
Notes: Figure for Myanmar is for 2001

Fig. 4.9 Currency in circulation to M2, in percent, 2002

where electronic payments were at an early stage of development (Torreja 2001a,b). Countries differ in their stage of economic development and to a large extent on early efforts to modernise payment systems. While some countries have introduced automated clearing houses (ACHs) as early as the 1980s, others have followed in the 1990s. Similarly, while RTGS systems were introduced as early as the mid-1990s for some countries, others adopted the system since 2000.

As mentioned, time series data on payment systems are not regularly compiled, updated and published for a majority of the member central banks in SEACEN, making cross-country comparisons relatively difficult. Using available data from secondary and electronic sources, four countries are used to illustrate the use of non-cash transactions (cheques, credit transfers, and debit card and credit card transactions per person) across the SEACEN countries as follows: Korea, Singapore, Taiwan and Thailand.

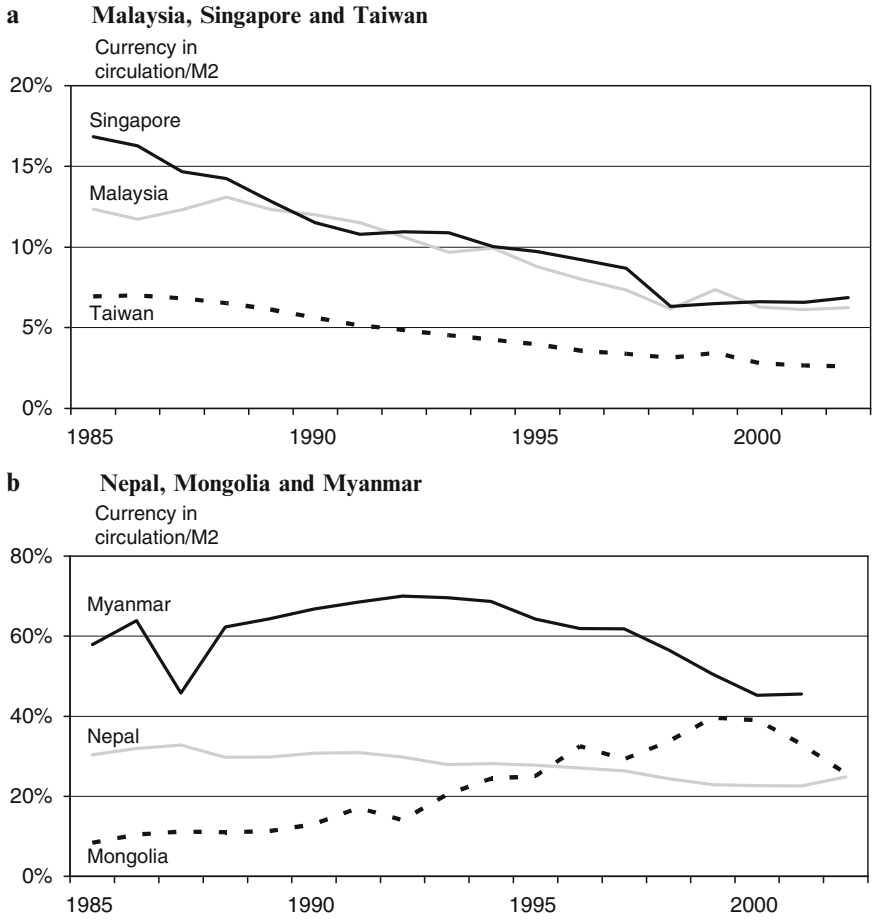
Figure 4.11 shows the number of cheque transactions per person per year for Korea and Singapore to be above 20, while Taiwan averaged 7 and Thailand 1 for the period 1995–2002. Figure 4.12 shows the number of paperless credit transfers per person per year with a relatively high number for Korea (39 in 2002), followed by Singapore (4 in 2002), Taiwan (3 in 2002) and Thailand (1 in 2002). The sharp increase for the period 1999-2002 in Thailand is due to the inclusion of intra-bank credit transfers. Figure 4.13 shows the continued growth of debit card transactions in Singapore (25 in 2002), while it use was much lower and decreasing in Korea (0.02 in 2002). This is partly explained by the continued growth of credit card transactions in Korea (28 in 2002).

4.2.3 A Model of Payment Instrument Use

We adopt a six-equation model developed by Humphrey et al. (1996) with modifications to examine the factors that influence each payment instrument use both over time and across countries. Equation (4.1) takes a log-linear form as follows:

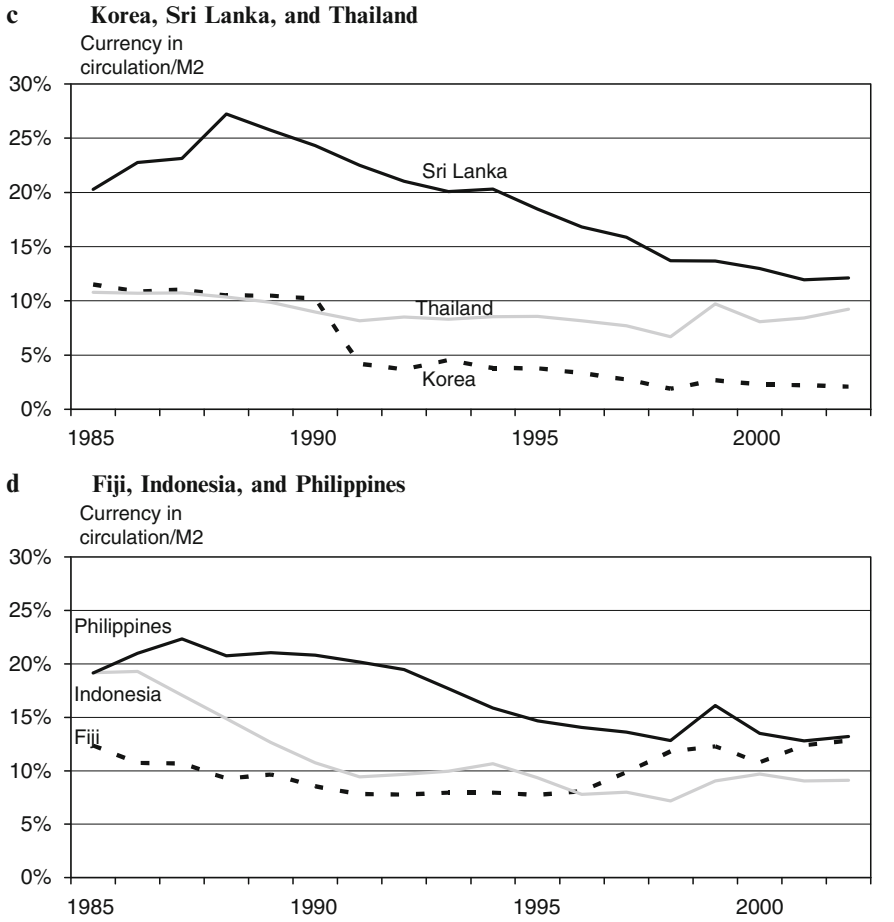
$$\ln I_i = \alpha_i + \beta_1 \ln GDP_i, + \beta_2 \ln ATM_i + \beta_3 \ln CASH_i + \beta_4 \ln CRIME_i + \beta_5 Y2K, \quad (4.1)$$

where:



Source: Asian Development Bank (2003)
Notes: Figure for 2002 is not available for Myanmar.

Fig. 4.10 Currency in circulation to M2, 1985–2002



Source: Asian Development Bank (2003)

Fig. 4.10 (continued)

I_i = annual transactions per person for payment instrument i (I = 1,…, 6) refers to cheque, ATM card, credit card, debit card, paperless credit transfers and postal money orders;

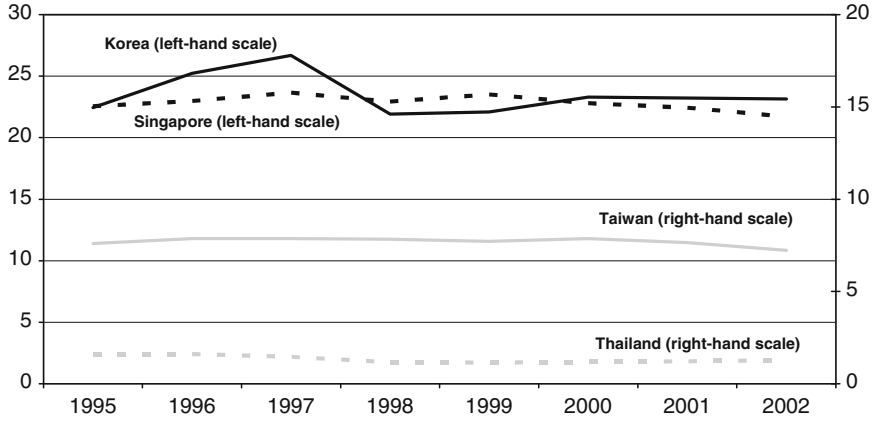
GDP = real per capita GDP for each of four countries (GDP at current prices translated into US dollars using an average exchange rate over 1995–2002);

ATM = number of automated teller machines per 1,000 person;

CASH = ratio of currency in circulation to GDP;

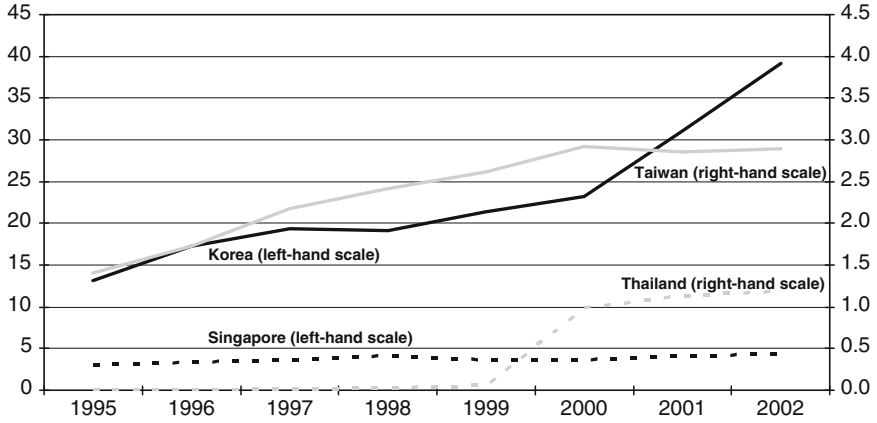
CRIME = number of crimes per 100,000 inhabitants for each country; and

Y2K = 1 if century date change
0 if otherwise.



Source: EMEAP (2002), Torreja (2001b) and central bank electronic sources.

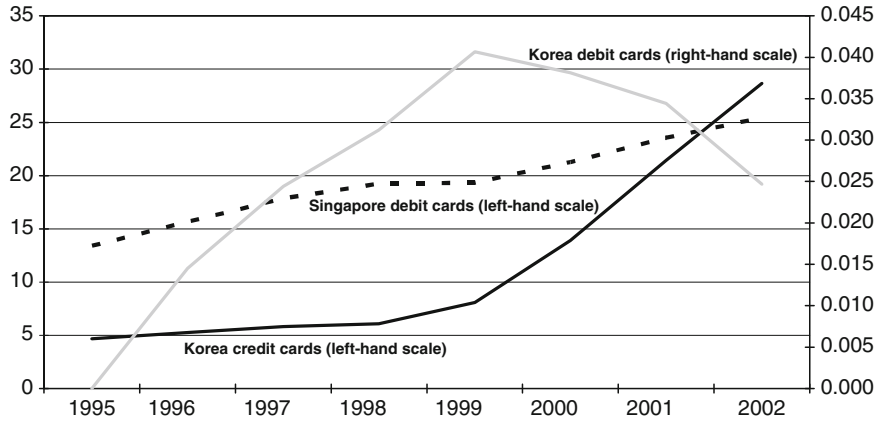
Fig. 4.11 Number of cheque transactions per person, 1995–2002



Source: EMEAP (2002), Torreja (2001b) and central bank electronic sources.

Fig. 4.12 Number of credit transfer transactions per person, 1995–2002

Separate equations for each of the six payment instruments above (cheque, ATM card, credit card, debit card, credit transfers, and postal money order) are estimated using the pooled least squares method. Pooled data for the period 1995–2002 from four countries – Korea, Singapore, Taiwan and Thailand – are used. Minor modifications were made to the original model to account for the lack of available data as follows. Transaction value per credit card is used as a proxy for the number of credit card transactions per person. Ratio of currency in circulation to gross domestic product is used as a proxy for annual cash holdings per person. A dummy variable is also added to account for the century date change or better known as Y2K. Point of sale terminals, prices, and the asset concentration ratio of the five largest banks in each country were excluded due to the unavailability of data.



Source: EMEAP (2002), Torreja (2001b) and central bank electronic sources

Fig. 4.13 Number of credit and debit card transactions per person, 1995–2002

The model helps explain the relationship between cash and cashless transactions, and the influence of other variables such as crime. In theory, cashless transactions increase with income growth, which is measured by real per capita GDP. Cash usage is positively correlated with the growth of ATMs and negatively correlated with the growth of point of sale terminals, crime rates, and a potential computer crisis (Y2K crisis) (Khiaonarong 2004a).

Some of the key findings can be summarised as follows: First, use of cashless payment instruments, particularly debit cards, cheques and credit cards increased with the rise of real per capita income. Use of ATM cards and postal money order transactions decreased, suggesting the decreasing reliance on the use of cash, which are based on cash withdrawals at ATM terminals and cash presentment for the purchase of postal money orders. However, paperless credit transfers showed a negative relationship to an increase in per capita income.

Second, an increase in the number of ATM terminals had led to a decrease in the number of cheque, credit card and debit card transactions. ATM card and credit transfer transactions, however, are positively correlated with an increase in the number of ATM terminals. Availability of ATM terminals is usually a convenient channel for cash withdrawals by the public, suggesting the use of more cash over cashless transactions. Nevertheless, it may also provide other payment service functions such as on-line funds transfers.

Third, an increase in cash usage is negatively correlated to the use of cheques and debit cards. It is also positively correlated to the number of ATM card transactions. Fourth, an increase in crime rates is positively correlated with an increase in the number of cheque and credit card transactions. Not all crimes are monetary-related, however. A relatively strong relationship was also found for credit transfers. The dummy variable for century date changes was not statistically significant for all the payment instruments except for postal money orders. The findings more or less support an earlier study in

fourteen developed countries (Humphrey et al. 1996). Although the adjusted r-squared figures were mainly high for the six equations, the results could be improved with a larger number of observations when payment data across the SEACEN countries are more complete and available for a longer time period.

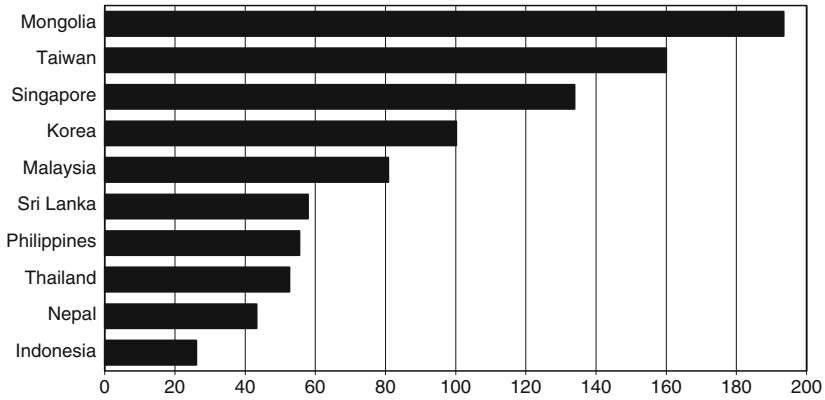
4.2.4 Financial Services Infrastructure and X-Efficiency

Payment systems are a key component of a country's financial infrastructure. Payment networks rely on financial institutions and non-financial institutions alike to initiate and receive payments. A well-developed computer and communications infrastructure provides a broader range of financial service delivery channels that are reliable, comprehensive and cost-effective, supporting efficiency in payment systems.

Institutional infrastructure plays an important role in providing access to the use of payment services. This basically includes the providers of payment services, particularly through commercial bank branches, and more importantly for developing countries, through post offices. Figure 4.14 illustrates Mongolia as the leading country in the number of commercial bank branches per one million people, with 193 public and private commercial banks serving a relatively small population of 2.4 million in 1999. Taiwan, Singapore, Korea and Malaysia were also the leading countries with 158, 134, 100 and 81 commercial bank branches per one million people, respectively. Indonesia has 26 commercial bank branches per one million people, partly explained by the relatively large population of 206 million in 2000. Customers gain access to account-based payment services and other financial services through opening an account with commercial banks. The number of commercial bank branches across countries is influenced by factors such as the maturity of the financial system, banking consolidation, and the choice of alternative financial service delivery channels such as the post office.

Customers may gain access to payment services, and possibly other financial services, through the post office. Figure 4.15 illustrates Fiji as the leading country in the number of post office branches per one million people, with 317 post offices serving a relatively small population below one million in 2001. Sri Lanka, Nepal and Mongolia were also leading countries with 245, 174, 154 post office branches per one million people, respectively. Myanmar, the Philippines and Singapore have 27, 31 and 36 post office branches per one million people, respectively. Payment instruments are in the form of postal money orders and postal cheques. Domestic and international money transmission, both for dispatch and receipt delivery legs, may be provided. The number of post office branches across countries is influenced by factors such as geography, the increase use of electronic mail, the preference of the post office as an informal channel for financial services, and the lack of adequate commercial bank branches.

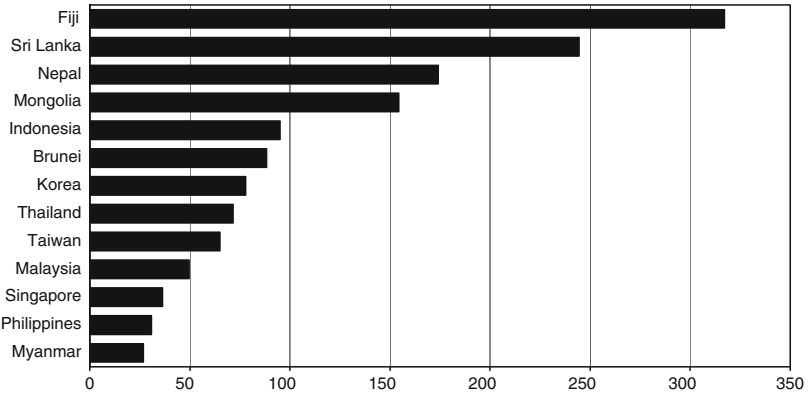
Telecommunications infrastructure serves as the computer and communications backbone for electronic payment networks. A "network effect" occurs with the relatively high penetration rate of telephone mainlines, mobile phones, personal



Source: EMEAP (2002); Torreja (2001b); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.

Notes: Figures for Philippines, Singapore, Malaysia, Taiwan, Thailand, Korea and Indonesia are 2000. Figures for Mongolia, Nepal and Sri Lanka are 1999. Data is not available for Brunei, Fiji and Myanmar.

Fig. 4.14 Commercial bank branches per 1 million people



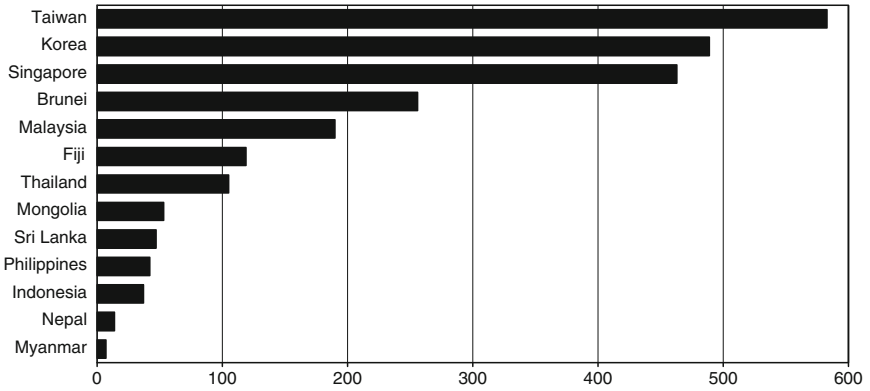
Source: Universal Postal Union, Statistics, www.upu.int; Torreja (2001b); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.

Notes: Figures are for 2002. Data for Fiji and Indonesia are 2001; Data for Nepal is 2000.

Fig. 4.15 Post offices per 1 million people

computers, and Internet subscriptions. Similarly, this network effect is applicable for electronic payment services as it opens up a wider range of financial service delivery channels to the general population. This can be gauged by comparing key telecommunication indicators across the SEACEN countries. Figure 4.16 illustrates Taiwan with the highest number of telephone mainlines at 583 per 1,000 people. Korea and Singapore are also leaders with nearly 500 per 1,000 people. Myanmar

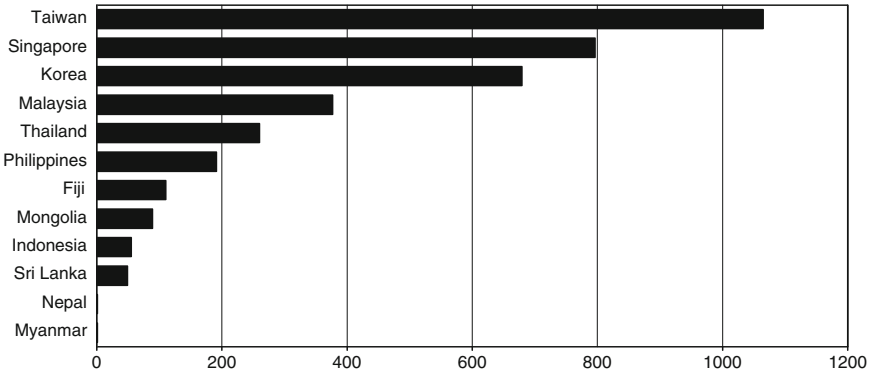
was lowest at 7 per 1,000 people. Telephone main lines form the basis of many banking services such as telephone banking through call centre and Internet banking. This becomes particularly important with large countries where major financial cities are in distant geographical proximity. Figure 4.17 illustrates Taiwan, Singapore and Korea as the leading countries in the number of mobile phones with 1,065, 796 and 679 per 1,000 people, respectively. Myanmar and Nepal were relatively low with each having 1 machine per 1,000 people. Mobile phones have gradually emerged as a new financial service delivery channel, after having surpassed the growth of telephone mainlines in many countries. Figure 4.18 illustrates



Source: International Telecommunication Union (2003); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.

Note: Figures are for 2002.

Fig. 4.16 Telephone mainlines per 1,000 people

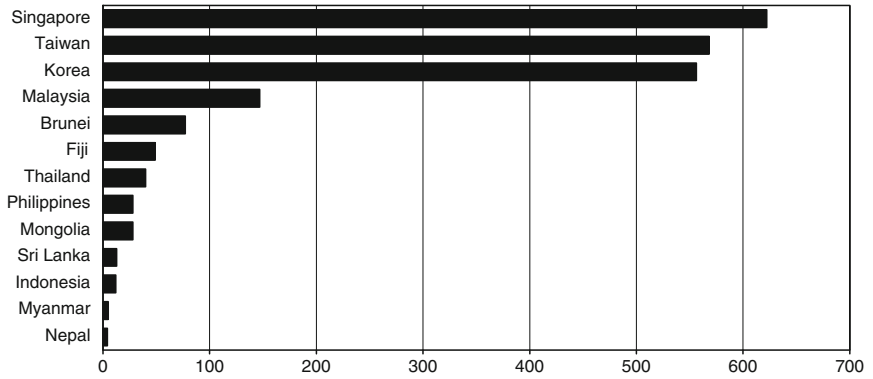


Source: International Telecommunication Union (2003); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.

Note: Figures are for 2002. Data is not available for Brunei.

Fig. 4.17 Mobile phones per 1,000 people

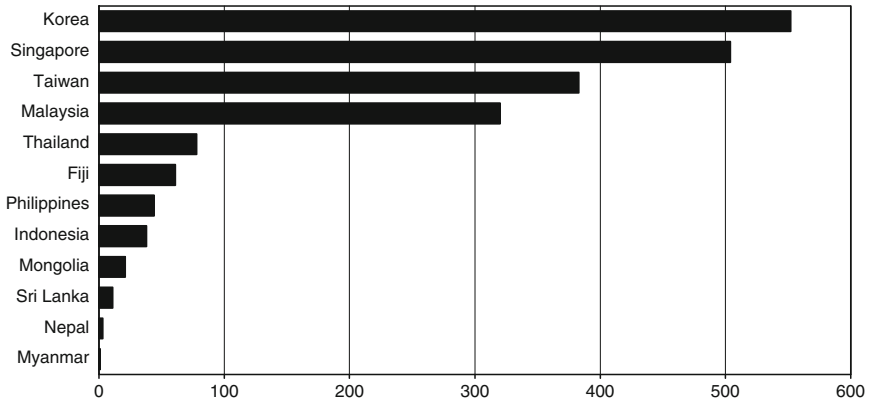
Singapore, Taiwan and Korea as the leading countries in the number of personal computers with 622, 568 and 556 per 1,000 people, respectively. Personal computers were initially introduced to access proprietary banking services, after which it has been increasingly used for Internet banking and other forms of electronic money schemes. Figure 4.19 illustrates Korea and Singapore as the leading countries in the number of Internet users with over 500 per 1,000 people. Myanmar and Nepal were relatively low at 1 and 3 per 1,000 people, respectively.



Source: International Telecommunication Union (2003); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.

Note: Figures are for 2002.

Fig. 4.18 Personal computers per 1,000 people



Source: International Telecommunication Union (2003); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.

Note: Figures are for 2002. Data is not available for Brunei.

Fig. 4.19 Internet users per 1,000 people

The figures above provide broad indicators. Although Internet users may be high or have high growth rates in some countries, this does not imply that there is a tendency to use Internet banking. Moreover, even if there are Internet banking users, it is important to examine if the accounts have been activated or if funds transfer services have been effected. It is often that users make on-line inquiries due to legal or security reasons.

X-efficiency includes other factors that influence the efficiency of payment systems that are hard to measure. For example, this may involve ownership and managerial factors. Ownership may affect efficiency as it largely influences the pricing objective of a payment system. Generally, there are three types: sole-ownership, private-ownership, and joint-ownership. Under sole-ownership by the central bank, a full cost recovery rather than a profit-oriented pricing objective may be the prime concern. In some central banks, such as the US Federal Reserve, this is a legal mandate. In others, such objectives may be more implicit in the rules and regulations that govern the payment system. In practice, as experienced in some countries, central banks may be willing to subsidise services in the interest of positive externalities. Under private-ownership arrangements, payment associations have been established to pursue the common interest of promoting efficient payment systems. The CPA, APACS, and APCA, as mentioned in Chapter 3, are some examples. Under association arrangements, it is common that members share in the investment and operational cost of payment services, and set fees independently to fully recover cost, compete, and promote cost-saving and efficient payment means. The central bank may have an indirect role in the establishment of such associations, or a more direct role whereby it is represented in the association. In some emerging economies, a national payments council may serve the same purpose of an association (Humphrey et al. 1997). Under joint-ownership arrangements, the central bank and commercial banks have a common interest in the payment system. This may be in the form of a joint-investment or the division of operational and monitoring responsibilities.

Management approach also plays a key role in efficient payment systems. Under a proactive approach, a forward-looking view of payment systems is adopted. This may involve making a regular, for example annual, review of fee schedules. To support this, a forecast of transaction volumes and projected costs are carried out, after which new fee schedules for the forthcoming period are presented to senior management for approval. Such pricing practices help account for changes in transaction volumes and the associated costs, which are reflected in revised prices accordingly. Alternatively, under a passive approach, the review of fee schedules is carried out on a "request" or "as-required" basis. Also, there is the lack of a specific time-frame for forecasting transaction volumes and costs.

4.2.5 Implications on Payment Systems Efficiency

A country may save 1% of its GDP annually as it shifts from a fully paper-based to a fully based electronic-based payment system, since an electronic payment costs

between one-third and one-half that of a payment instrument (Humphrey et al. 2003). Payment systems efficiency facilitates the turnover and transfer of funds in the economy, channeling them for more productive use. The implications on payment systems efficiency are fourfold.

First, promoting payment systems efficiency would largely rely on reducing cash usage where significant amounts of resources are spent. Cash transactions, as indicated by the ratio of currency in circulation to GDP, remain relatively high in a majority of the SEACEN countries. A declining trend, however, was evident for Singapore, Malaysia, Taiwan, Sri Lanka and Korea for the period 1985–2002. An upward trend was experienced in other member countries. As mentioned, the dominance of cash transactions is largely due to its use for precautionary, speculative and anonymity purposes. However, the resource costs required for producing, distributing, handling, and later destroying paper-based currency notes can be substantial to the total payment cost incurred in an economy. As such, this does not promote payment systems efficiency.

Second, the shift to cashless transactions as a more efficient payment method is largely influenced by income levels. Cashless transactions can be grouped as cheque and non-cheque instruments. Non-cheque instruments include electronic credit transfers and card-based payments. Use of cheque instruments per person were steady and did not experience any significant decline for Korea, Singapore, Thailand and Taiwan for the period 1995-2002. Being paper-based instruments like cash, cheques are also costly from operational and financial (float cost) viewpoints. Cheque truncation, however, has been introduced to replace the physical flow of paper with digital images of the cheque. This cuts down the manual process and enables electronic processing in ACHs. This helps promote operational efficiency and reduces float with faster turnovers. As there is a lack of studies on the economics of cheque truncation, their effects on scale economies and efficiency are unclear. Use of electronic credit transfers per person grew sharply in Korea and Taiwan, while this was relatively steady for Singapore and Thailand. However, use of debit card transaction per person grew sharply in Singapore. Korea experienced a sharp increase and then decline in the use of debit card transactions, which can be largely attributed to the sharp increase in the use of credit card transactions. Comparatively, the move to more efficient payment methods, as measured by payment instrument use per person, can clearly be seen through the increase in the use of credit transfers in Korea and Taiwan, and the shift to debit card transactions in Singapore. This is largely explained by income levels as measured by the real per capita GDP. Such transactions incur relatively lower payment unit cost when compared to paper-based transactions due to their scale economy effects.

Third, the shift to more efficient payment methods would largely depend on the development of a country's financial services infrastructure. The choice of financial services delivery channel would largely depend on the on-going changes resulting from financial liberalisation, banking sector consolidation, and telecommunications sector liberalisation. Consolidation, for example, may improve scale economies in payments processing. Telecoms liberalisation may lead to improved penetration rates for mainline telephones, mobile phones and Internet access. Equally important,

the wide spread diffusion of ATM terminals should also be seen as a significant factor in the use of cash transactions.

Finally, the shift to more efficient payment methods would largely depend on the x-efficiency factor. This covers organisational and managerial dimensions. The private sector, through payment system organisations or associations, may collectively promote the use of cashless transactions. In countries where such formal forums are absent, the central bank can play a leading role. Such contributions may take the following forms: adopting international best practices in the management payment systems owned and operated by the central bank; leading the establishment of an organisational body overseeing payment system; and commissioning studies on payment systems efficiency.

4.3 Pricing of Central Bank Payment Services

4.3.1 Pricing Method and Payment Transactions

Thirteen payment systems owned and operated by central banks in selected SEACEN countries are reviewed in this section. This includes eight large-value and five retail payment systems.[1]

Table 4.2 summarises the pricing method for selected payment systems. This includes their pricing method (cost recovery, market-based, or subsidised), proposal (who chooses and implements the pricing method), and review (who and how often pricing schedules are reviewed).

The cost recovery pricing method is used in a majority of payment systems. The choice and implementation of the pricing method is largely carried out by the payment systems department. Review of pricing schedules is mainly non-periodical, varying from every 5 years (Korea, Malaysia) to as required in a majority of central banks. Price schedule reviews may be focused at the payment systems committee-level (Singapore, Thailand) or involve senior management at the board level (Indonesia, Korea, Philippines). The legal basis for pricing in a majority of countries is based on central bank regulations governing payment and settlement systems. In Korea, responsibility is directly under the central bank governor.

The types of transactions handled and settled in the payment systems are wide ranging. RTGS systems support payment flows that arise from monetary policy operations, financial market operations, third-party customer funds transfers, and securities settlement. Retail payment systems handle cheque and electronic direct debit and direct credit transfers. In theory, average unit costs are reduced when operations have achieved scale economies, while further cost reductions are possible with scope economies, whereby more than one type of payment instrument is

[1] See Khiaonarong (2004a) for basic information for each payment system, including their year of implementation, ownership, message carrier, membership, volume of transactions, and value of transactions.

Table 4.2 Summary of pricing method

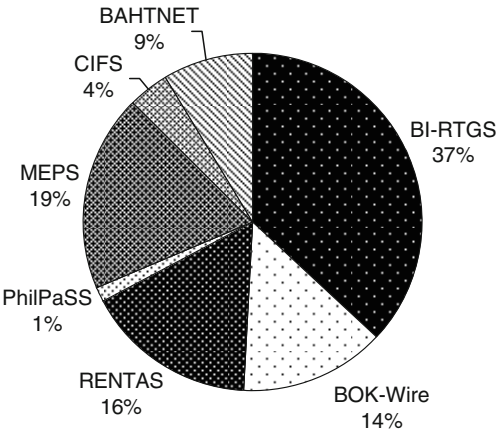
	Pricing method			
Payment system	Method	Proposal	Review	Comments
Indonesia				
BI-RTGS	S	Payment System Directorate	Board of Governor	Reviewed based on risk-reduction efforts
Clearing	C,S	Payment System Directorate	Payment System Director	Reviewed based on risk-reduction and efficiency enhancing efforts
Korea				
BOK-Wire	C	Governor	Every 5 years by Governor	Reviewed as required
Malaysia				
RENTAS	C	Management	Every 5 years	Reviewed as required
SPICK	C	Management	Every 5 years	Reviewed as required
Philippines				
PhilPaSS	C	BSP and BAP	Monetary Board	Reviewed as required
BSP RCO	C	BSP	Monetary Board	Reviewed as required
Singapore				
MEPS	C	PSSC	PSSC	Reviewed as required
Sri Lanka				
RTGS System	C	Central bank	Central bank	Reviewed as required
Taiwan				
CIFS	C	Central bank	Central bank	Reviewed as required
Thailand				
BAHTNET	C	PSC	PSG, PSC	Reviewed as required
ECS	C	PSC	PSG, PSC	Reviewed as required
SMART	C	PSC	PSG, PSC	Reviewed as required

Source: Survey questionnaire

Notes: C – cost recovery, M – market–based, S – Subsidised; BSP – Bangko Sentral ng Pilipinas; BAP – Bankers Association of the Philippines; PSC – Payment Systems Committee; PSG – Payment Systems Group; PSSC – Payment and Settlement Steering Committee; BSP RCO – BSP Regional Clearing Operations

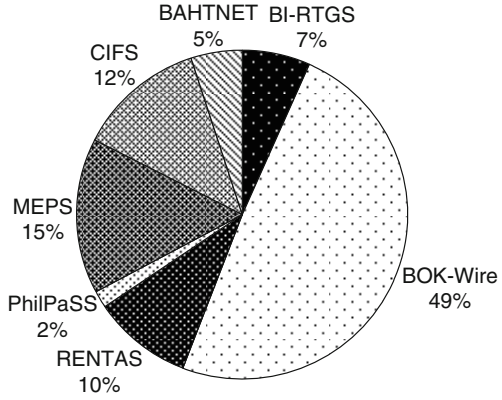
handled at a common payment facility with fixed costs spreading over more items in the long-run. Transaction values are also largely influenced by the level of economic and financial activity in each respective country.

A total of 12 million payment instructions valued at $37 trillion were processed by SEACEN RTGS systems in 2003. Figure 4.20 presents the percentage share of transaction volumes in seven selected SEACEN RTGS systems to total transaction volume. BI-RTGS, where the growth of transaction volumes doubled for the period 2002–2003, has the highest percentage share of 37%, followed by MEPS (19%), RENTAS (16%) and BOK-Wire (14%). Growth in these latter and other RTGS systems have been gradual for the period 2002–2003 period and are expected to be moderate in the medium term. While the first RTGS system among the SEACEN countries was introduced in Korea (BOK-Wire) in 1995, more recent implementations can be found in the Philippines (2002) and Sri Lanka (2003). MAS also plans to introduce MEPS+, the second generation MEPS system with new processing capabilities and features, in mid-2005.



Source: Survey questionnaire

Fig. 4.20 Percentage share of RTGS transaction volumes, 2003

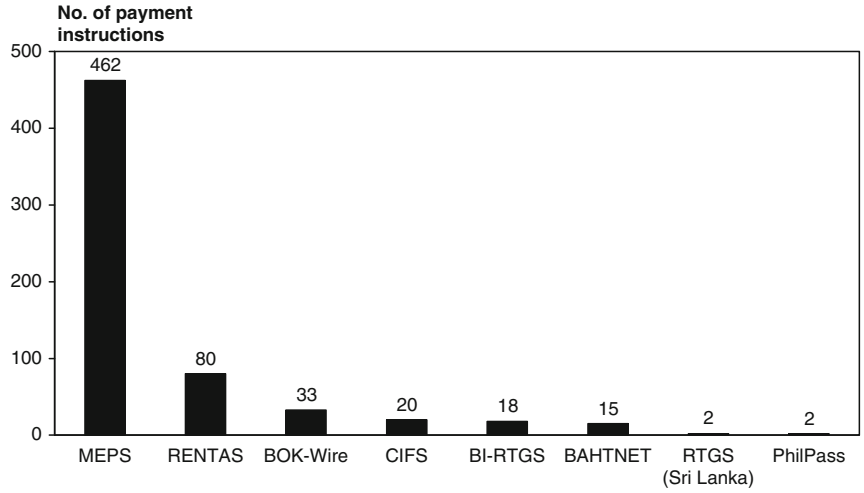


Source: Survey questionnaire

Fig. 4.21 Percentage share of RTGS transaction values, 2003

Figure 4.21 presents the percentage share of transaction values in seven selected SEACEN RTGS systems to total transaction value. Around half of total transaction values for RTGS systems across the SEACEN countries are handled by BOK-Wire (49%). This is followed by MEPS (15%), CIFS (12%), and RENTAS (10%). A majority of RTGS systems experienced moderate growth in transaction values except for BI-RTGS, where the annual growth rate of transaction value was 65% for the period 2002–2003.

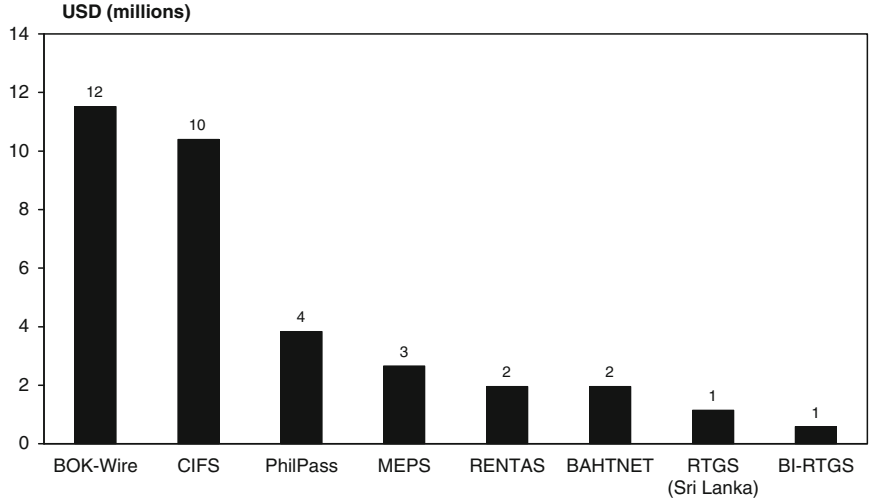
Figure 4.22 compares the number of RTGS payment instruction per one thousand persons in selected SEACEN RTGS systems. The highest ratio was for MEPS (462), followed by RENTAS (80), BOK-Wire (33), CIFS (20), BI-RTGS



Source: Survey questionnaire

Notes: Figure for RTGS System Sri Lanka is for September 8 to end-December 2003.

Fig. 4.22 RTGS transaction volume per one thousand people, 2003



Source: Survey questionnaire

Notes: Figure for RTGS System Sri Lanka is for September 8 to end-December 2003.

Fig. 4.23 RTGS transaction value per payment instruction, 2003

(18) and BAHTNET (15). RTGS systems in Sri Lanka and the Philippines were relatively low due to their recent introduction. Figure 4.23 compares the transaction value per payment instruction. The highest ratio was for BOK-Wire ($12 million) and CIFS ($10 million) with other RTGS systems ranging between $1-4 million.

4.3.2 Fees and Central Bank Services

Table 4.3 summarises the type and amount of payment systems fees. Fees are grouped as admission, membership, and transaction fees converted to US dollars at annual average exchange rate (Khiaonarong 2004a).

Admission and membership fees are not applied for a majority of payment systems. A one-time admission fee is applied to the Thai ECS cheque clearing system. Annual membership fees are applied in Malaysia, while monthly fees are used in Thailand and member administration fees in Indonesia. Transaction fees in large-value payment systems range from $0.12 (Korea) to $2.49 (Sri Lanka). This largely depends on many factors such as the pricing method, transaction volumes and the stage of development of the payment system.

Table 4.4 summarises the fee structure and allocation. A majority of payment systems adopt a flat fee structure for transaction charges. Time-based fee structures, where rates vary with the settlement time of payment instructions in RTGS systems or the delivery data of payment instructions prior to their effective date in ACH

Table 4.3 Summary of payment system fees, in US dollars

Payment system	Type and amount of fee		
	Admission fee	Membership fee	Transaction fee[a]
Indonesia			
BI-RTGS	None	None	0.82
Clearing	None	Monthly	0.11
Korea			
BOK-Wire	None	None	0.12
Malaysia			
RENTAS	None	Yearly	0.66
SPICK	None	None	0.01
Philippines			
PhilPaSS	None	None	1.29
BSP RCO	None	None	–
Singapore			
MEPS	None	None	0.72
Sri Lanka			
RTGS System	None	None	2.49
Taiwan			
CIFS	None	None	0.99
Thailand			
BAHTNET	None	Monthly	0.18
ECS	Yes	Monthly	0.02
SMART	None	None	0.01

Source: Survey questionnaire

[a]Transaction fees are per item charges for a funds transfer transaction, or for cheques and ACH transfer converted to US dollars using annual average exchange rates for 2003. For BI-RTGS, BoK-Wire and BAHTNET, fees in the normal operating hours are used and excludes fees in the "penalty" or "peak" time zones. For Indonesia, Clearing System, transaction fees are based on the Jakarta Electronic Clearing System

Table 4.4 Summary of fee structure and allocation

Payment system	Type of fee structure			Allocation
	Flat	Time-based	Volume-based	Fees borne by:
Indonesia				
BI-RTGS		√		Sender
Clearing	√			Sender
Korea				
BOK-Wire		√		Sender
Malaysia				
RENTAS	√			Sender
SPICK				
Philippines				
PhilPaSS	√			Sender
Singapore				
MEPS	√			Sender
Sri Lanka				
RTGS System	√			Sender
Taiwan				
CIFS	√	√		Sender/beneficiary
Thailand				
BAHTNET		√	√	Sender
ECS	√			Collecting/paying bank
SMART		√		Sender

Source: Survey questionnaire

systems, are used in Indonesia, Korea, Taiwan and Thailand (MEPS+ will also use time-based pricing for transaction charges). Rates are relatively low during normal operating hours, and rise sharply during the peak or closing hours of the payment system. Volume-based fee structures are not widely used where lower charges are applied to large-volume users. Where used, this is in the form of monthly volume discounts applied to users sending payment instructions exceeding the number of transactions in a specific time zone, whereby the discounts only apply to the exceeding transactions (BAHTNET). Fees are largely allocated to the sender of the payment instruction in a majority of the payment systems with the exception of the RTGS system in Taiwan (CIFS) and the cheque clearing system in Thailand (ECS).

The popularity of flat fees may be explained by two main reasons. First, the fee structure is relatively simple to develop and the revenue calculation is straightforward. Average unit cost may be used to determine the flat fees. Second, the non-competitive or monopoly-like environment characterised by the absence or lack of substitute or complementary payment services means that there is the lack of incentive to review fee schedules by the central bank to remain efficient and price competitive. Some central banks (i.e. MAS), nevertheless, regularly review fees to be in line with other RTGS systems.

Table 4.5 summarises the types of central bank services and schemes for intraday credit facility charges. None of the central banks charged for use of its settlement accounts. Also, a majority, with the exception of Bangko Sentral ng Pilipinas, do not pay interest on settlement balances. A majority of central banks offered free use

Table 4.5 Summary of central bank services and intraday credit facility charges

Payment system	Types of services and charges			
	Settlement account charges	Interest on settlement balances	Form of ILF facility	Interest rate for ILF facility
Indonesia				
BI-RTGS	None	None	Collateralized ILF charged	Overnight rate[a]
Korea				
BOK-Wire	None	None	Collateralized ILF free	Call rate[b]
Malaysia				
RENTAS	None	None	Intraday credit free	
Philippines				
PhilPaSS	None	Yes	Intraday repos free	Weekly rate[c]
Singapore				
MEPS	None	None	Intraday repos	
Sri Lanka				
RTGS System	None	None	Collateralized ILF free	
Taiwan				
CIFS	None	None	Collateralized ILF charged	CBC secured loan rate[d]
Thailand				
BAHTNET	None	None	Collateralized ILF free	14-day repo rate[e]

Source: Survey questionnaire

[a]Weighted average overnight rate for overall money market (PUAB) at one day prior to the application of the intra-day liquidity facility (FLI)

[b]Unpaid intraday overdraft converted to a temporary loan carrying a penalty interest rate (average call transaction rate + 2%)

[c]Overnight repurchase agreement has to be paid not later than 11.00 the following day, after which participants are charged P1,000 per week of availment

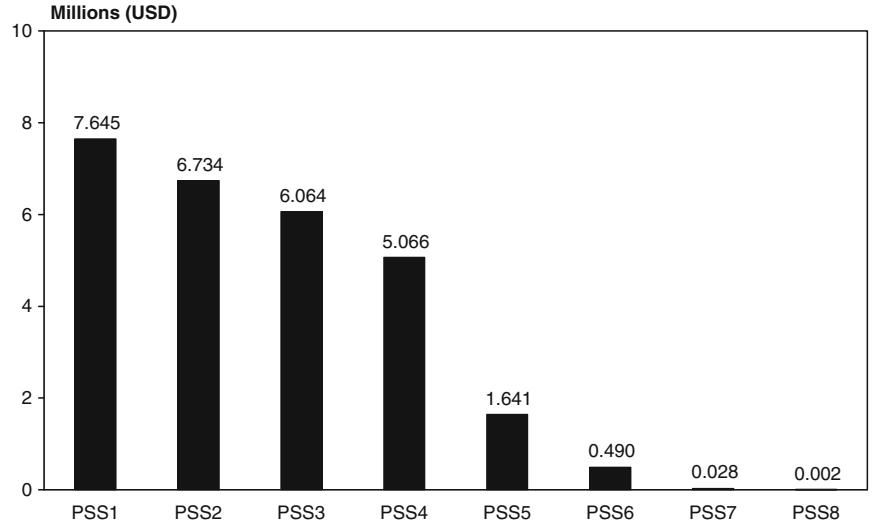
[d]Interest charges are calculated by minute

[e]Use of ILF overnight incurs interest charges equivalent to the 14-day repurchase rate plus the rate of 1.5%

of an intraday liquidity facility backed with collateral. Also, a penalty rate is often applied for an unpaid intraday overdraft or for use of credit over night.

4.3.3 Costs and Revenue

Figure 4.24 summarises the investment costs for eight selected SEACEN payment systems since 2000. Local currencies are converted to US dollar value using annual average exchange rates for the period 2000–2003 with the exception for two payment systems where a specific investment year was indicated. Total investment cost



Source: Survey questionnaire

Fig. 4.24 Investment costs in payment systems, 2000–2004

for the period 2000–2004 amounted to $28 million. Total investment cost for RTGS and retail payment systems amounted to $26 million and $2 million, respectively. The average investment cost for an RTGS system amounted to $5 million. This is largely explained by the higher degree of central bank involvement in the ownership and operation of RTGS payment systems. A majority of the investment costs were self-funded by the central bank.

Investment costs were for the following purposes: development and procurement of a new RTGS and securities settlement system; enhancement of existing cheque clearing and RTGS system; development of a computer back-up centre (set-up of relay and communication devices); connection to external payment and settlement systems (e.g. CLS Bank); and computer system upgrades. Types of costs included in the investment cost are as follows: computer hardware; computer software; consulting charges; SWIFT upgrade charges, data management; telecommunication control; administration; training; facilities (renovation, communication and equipment costs).

Table 4.6 summarises the types of costs included in the accounting process. This forms the basis of the pricing structure and schedule. A majority of countries include operating, development and capital costs in determining fees. The investment horizon ranges from 5 to 10 years, largely depending on the pricing method. With subsidised methods, where operating costs are excluded in the accounting process, a longer period was used (e.g. BI-RTGS). Other factors influencing the investment horizon include the life-cycle for information technology investments and accounting rules. A majority of central banks adopt central bank wide accounting rules for the depreciation of assets.

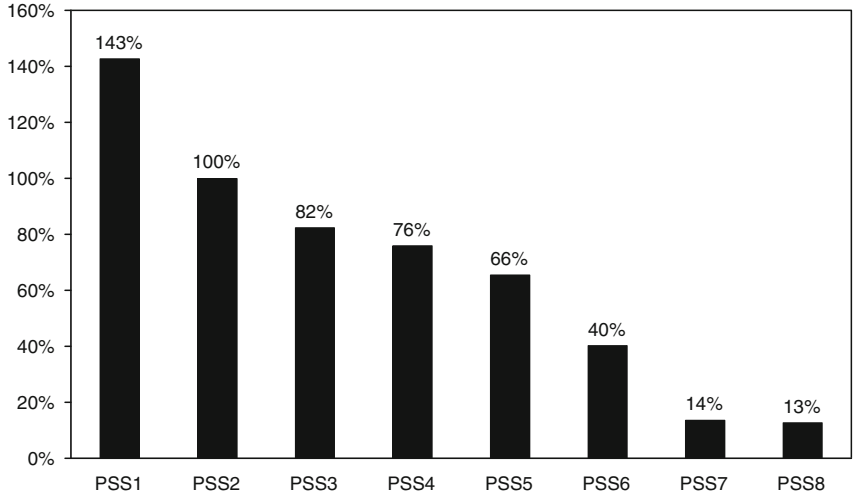
Table 4.6 Summary of costs included in the accounting process

Payment system	Costs covered in the accounting process			
	Operating cost	Development cost	Capital cost	Comments
Indonesia				
BI-RTGS		√	√	Investment and communication cost Labor, building, electricity and overhead costs excluded Payback period of 10 years
Clearing				Investment and communication cost Software, machinery lease, interest, inflation
Korea				
BOK-Wire	√	√	√	Fixed costs amortized over 5 years
Malaysia				
RENTAS	√	√	√	Cost recovery at 5 years
SPICK	√	√	√	Cost recovery at 5 years
Philippines				
PhilPaSS	√	√	√	Investment horizon of 8.5 years
BSP RCO	√		√	Investment horizon of 8.5 years
Singapore				
MEPS	√			Operational cost covers personnel, IT, general and administrative costs Participants pay all up-front installation costs for terminals
Sri Lanka				
RTGS System	√	√	√	Recovery of operating costs
Taiwan				
CIFS	√		√	Mainframes and software amortized at 10 years Peripherals and related installations amortized at 4 years
Thailand				
BAHTNET	√	√	√	Hardware depreciation at 5-years Software depreciation at 3-years
ECS	√	√	√	Same as above
SMART	√	√	√	Same as above

Source: Survey questionnaire

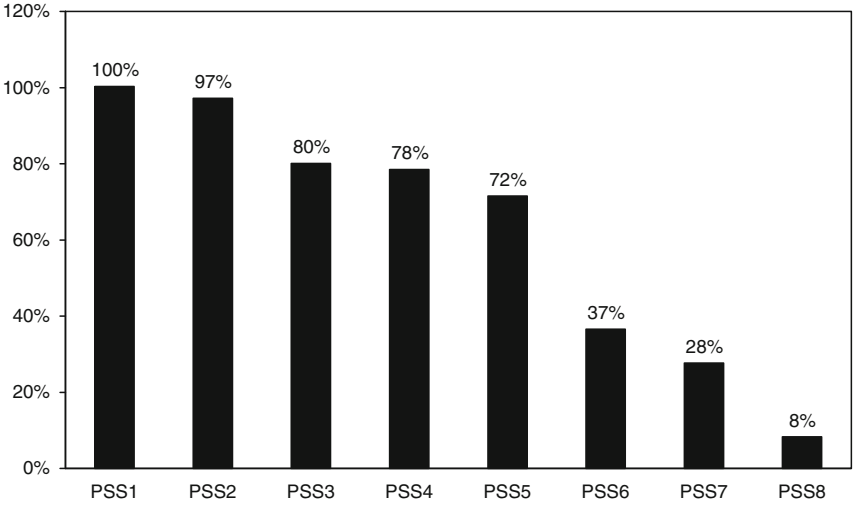
Figure 4.25 illustrates the total cost recovery ratios for eight payment systems in the SEACEN countries in 2003. This includes two retail and six large-value payment systems. The total cost recovery ratio indicates how much total operating revenues recovered total operating cost for the given year. Full cost recovery is achieved at 100%. Figure 4.26 illustrates the unit cost recovery ratios, which indicate how much per item transaction fees recovered unit cost. Unit cost recovery ratios are independently ranked from the total cost recovery ratio for each payment system.

Partial cost recovery was found in a majority of payment systems. The average total cost recovery ratio was 52% for RTGS systems, with the highest at 100% and



Source: Survey questionnaire

Fig. 4.25 Total cost recovery ratio in selected SEACEN payment systems, 2003



Source: Survey questionnaire

Fig. 4.26 Unit cost recovery ratio in selected SEACEN payment systems, 2003

lowest at 13%. Averages for retail payment systems are not calculated due to the relatively small sample size. Partial unit cost recovery was also found in a majority of RTGS systems, with the average unit cost recovery ratio at 53%, and the highest and lowest ratios at 97% and 8%, respectively.

Subsidies were clearly evident in the cost recovery ratio results. Total subsidies for six payment systems amounted to $3.7 million. Total subsidy for RTGS systems alone amounted to $3.3 million. The highest and lowest subsidies amounted to $1.8 million and $0.2 million, respectively. The average subsidy per RTGS payment instruction equaled $1.13 with the highest subsidy per item at $4.06.

Data sources and assumptions used in the current study require some explanation prior to predicting average unit cost econometrically. This is largely due to the lack of payment cost data across the SEACEN countries. As such, cost data from a previous study are used to increase the number of observations, particularly examining the relationship between the behaviour of average unit cost and transaction volume. Actual cost data were available for 21 payment systems in 2001, three in 2002, and four in 2003. Using 2001 cost data as a base, unit cost estimates were developed for 18 and 17 payment systems for 2002–2003, respectively. Operating costs are assumed to increase incrementally with the annual rate of inflation in each country measured by changes in the consumer price index. Moreover, assumptions are made on the absence of large-scale technological investment cost in payment systems during this period.

Transaction volume statistics were obtained from published and electronic sources through the BIS, the ECB, national central banks, and payment industry associations. The total number of observations was 63 for 21 payment systems. This is reduced to 15 observations when only five payment systems from the SEACEN countries are used. The above cost and transaction volume data set are used for estimating scale economies in large-value payment systems in the following section.

4.3.4 A Model for Estimating Scale Economies in Large-Value Payment Systems

We adopt the log-linear and translog cost function models to examine scale economies in large-value payment systems. The log-linear takes the following form:

$$\ln UC_i = \alpha_{UC} + \beta_1 \ln VOL_i. \tag{4.2}$$

The translog cost function takes the following quadratic form:

$$\ln TC_i = \alpha_{TC} + \beta_1 \ln VOL_i + \beta_2\, 1/2\, (\ln VOL_i)^2, \tag{4.3}$$

where:

UC = unit cost for inter-bank payments and settlement system; and
TC = total cost for inter-bank payments and settlement system;
VOL = total number of payment instructions

Equation (4.2) is used to examine the effects of the number of payment instructions on unit cost. Equation (4.3), the translog cost function, is a more specific model developed for large-value payment systems and cheque clearing systems, examining

Table 4.7 Regression results on scale economies using pooled data

Explanatory variables	Dependent variable: unit cost (model 1); total cost (model 2)			
	Sample A: International		Sample B: SEACEN	
	Model 1: Log-linear	Model 2: Translog	Model 1: Log-linear	Model 2: Translog
ln (VOL)	−0.3582 (−5.9906)*	−1.4458 (−1.5857)^{x}	−0.5819 (−1.7912)^{x}	−1.8439 (−0.0758)
Ln (VOL)^2		0.1359 (2.2937)*		0.1641 (0.0929)
R^2-adjusted	0.3600	0.6704	0.1362	−0.0344
N	63	63	15	15

Notes: T-statistics are reported in parenthesis. Significant at 1% ($^{+}$), 5% (*) and 10% (^{x}).

the effects of output expansion on average unit cost (Humphrey 1984). The translog or "transcendental logarithmic" production function is relatively flexible in approximating arbitrary production technologies in terms of substitution possibilities, and provides a local approximation to any production frontier (Intrilligator 1978; Christensen et al. 1973; Griliches and Ringstad 1971).

In practice, the sample of payment systems used in the current study operates at different levels of technology and local conditions. In theory, the same technology is assumed to apply for all payment systems, while central banks seek to minimise costs with increased output. A majority of payment systems operate with technology supporting real-time gross settlement systems, and a majority of central banks also pursue the cost recovery pricing objective. An increase in the number of payment instructions processed by a particular payment system spreads out the fixed cost component of the total cost, leading to average unit cost reductions over the long-run.

Table 4.7 summarises the regression results on estimating scale economies in selected large-value payment systems for each of the two equations. There are two set of samples. Sample A includes 21 payment systems from around the world (Asia-Pacific, Europe and North America) with 63 observations. Sample B includes five payment systems from the SEACEN countries with 15 observations. The size of the latter sample was constrained by the lack of cost data from member countries. Regression results for both log-linear and translog models show a negative relationship between cost and volume, or scale economies, for both set of samples, respectively. Under Model 2, a U-shaped cost curve seems to set in when current volume is expanded, as measured by volume squared. However, scale economies, or diseconomies, at a given level of output, is better explained by plotting predicted average unit cost on a scatter diagram.

Figures 4.27–4.29 present a scatter diagram of the long-run average unit cost with cost-output point estimates for individual years for the period 2001–2003. Figure 4.30 provides a 3-year average for the period 2001–2003. Average unit costs are reported in US dollars with transaction volumes converted to their logarithmic values. The scatter diagrams show a common pattern of an L-shaped curve.

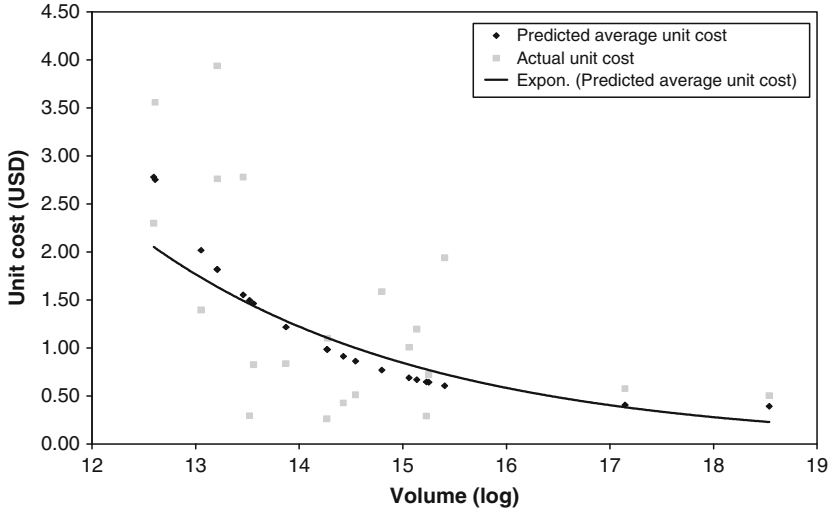


Fig. 4.27 Average unit cost in large-value payment systems, 2001

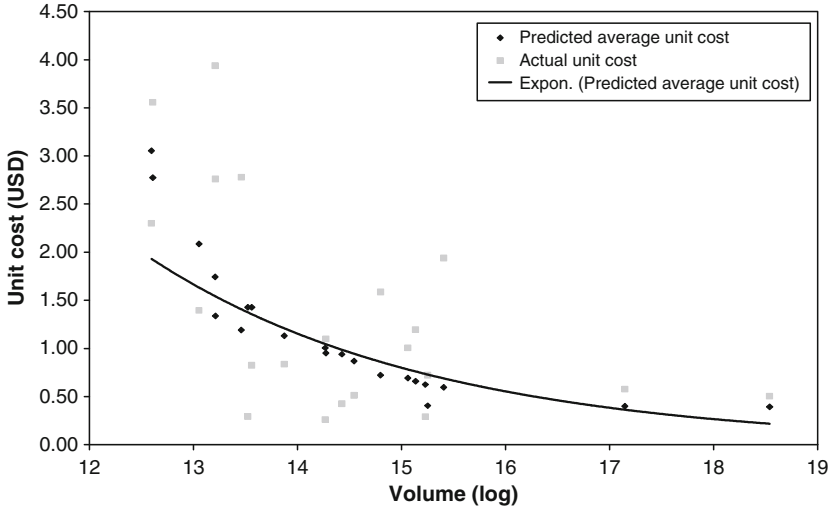


Fig. 4.28 Average unit cost in large-value payment systems, 2002

In theory, average unit cost firstly falls sharply, while leveling out and remaining flat when a certain level of output is achieved.

Table 4.8 groups the payment systems into three transaction classes based on their annual average transaction volumes handled for the period 2001–2003. The average annual transaction volume for this sample period is 96,490 items. A majority of payment systems are classified as medium-scale operations where the annual number of payment instructions processed ranged from one to 10 million items, accounting for 4% of average total transaction volume. Actual average unit

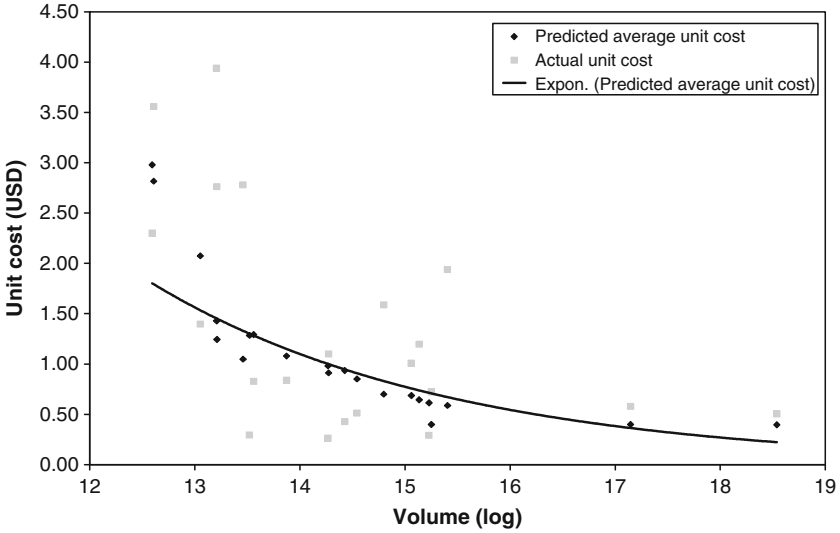


Fig. 4.29 Average unit cost in large-value payment systems, 2003

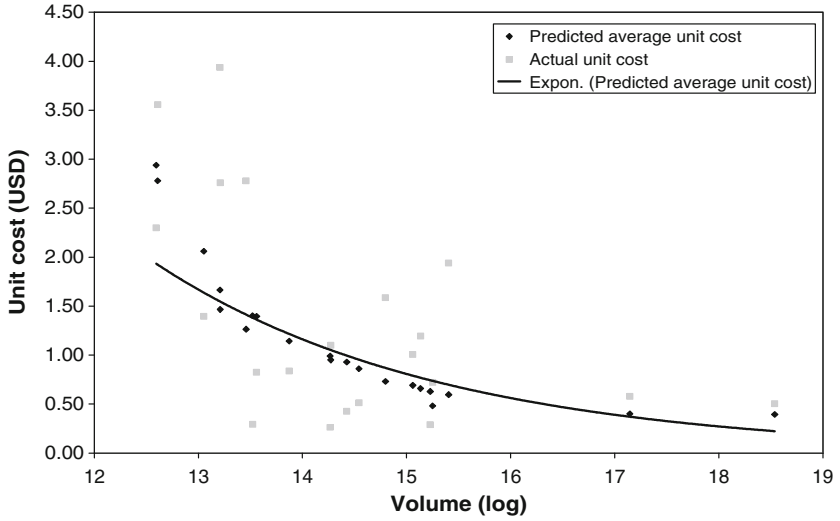


Fig. 4.30 Average unit cost in large-value payment systems, 2001–2003

Table 4.8 Average unit cost by scale of transaction volume

Transaction class	Sample	Volume range (in millions)	Approximate percent of average total transaction volume (%)	Actual average unit cost ($)	Standard deviation
Small-scale	7	0.2–1.0	1	2.34	1.1619
Medium-scale	11	1.0–10.0	4	1.03	0.6590
Large-scale	3	10.0–120.0	95	0.44	0.1206

Source: Author's estimates

costs decreases with an increase in the number of transaction volumes processed. In fact, average unit costs were halved between each of the transaction classes. Figure 4.31 shows predicted average unit costs falling from $3 to $1.5. Figure 4.32 shows average unit costs decreasing to $1 on average in medium-scale operations. Figure 4.33 shows average unit cost dropping below $1 for large-scale operations where annual transaction volumes are above 10 million items.

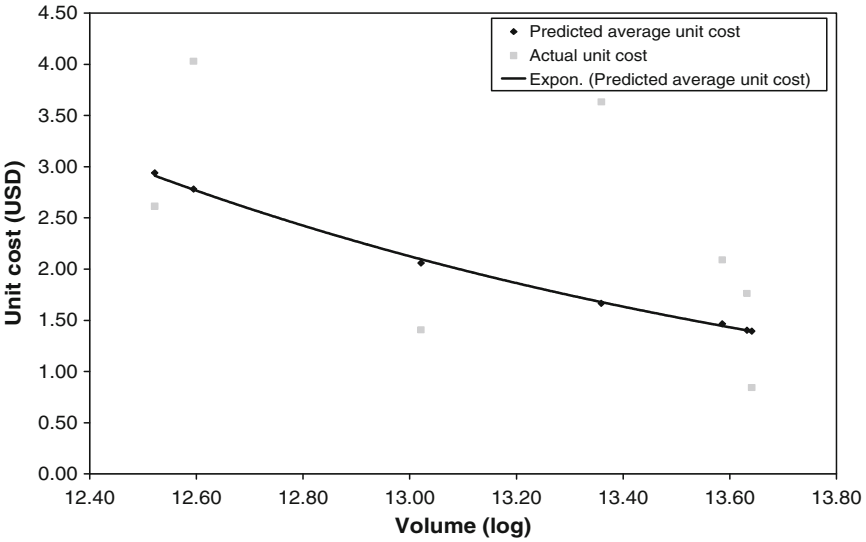


Fig. 4.31 Average unit cost in small-scale operations, 2001–2003

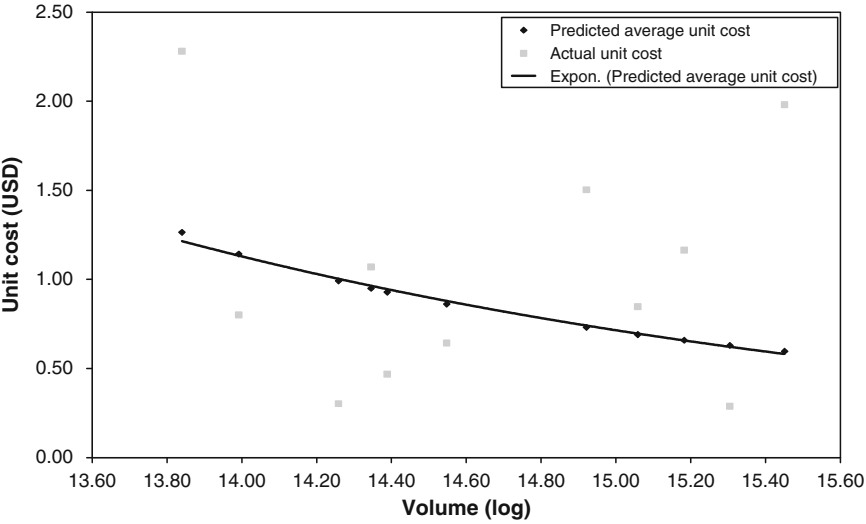


Fig. 4.32 Average unit cost in medium-scale operations, 2001–2003

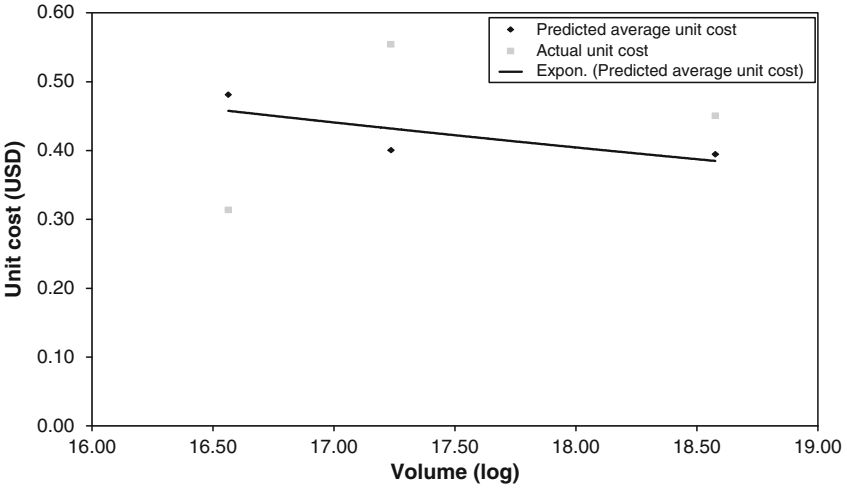


Fig. 4.33 Average unit cost in large-scale operations, 2001–2003

4.3.5 Key Issues

Three key issues related to the pricing of central bank payment services are raised in this section. First, periodical price schedule reviews were lacking in a majority of payment systems. Price schedule reviews were largely infrequent, ranging from 1 to 5 years, while some were based on the "as required" discretion. This is largely explained by the non-competitive environment with the lack of substitute or complementary services, and the absence of any incentive for price competition as the central bank usually pursues the non-profit objective, and moreover, may hold the monopoly on inter-bank payment and settlement services. A major weakness of infrequent price schedule reviews is that prices do not fully reflect the on-going changes in development costs, operational cost, and transaction volumes for a particular payment system. Changes in payment cost may arise from the introduction of new or the enhancement of existing payment systems, where operational cost changes may result from the replacement of manual with automated work processes. Transaction volumes may increase due to increased economic and financial activity, but may also decline as a result of consolidations in the banking and business sectors, where inter-bank or inter-firm settlements are replaced by intra-bank and intra-firm transactions. Equally important is the possible entry of regional or international competitors in the future.

Second, payment revenues relied largely on transaction fees. Admission and membership fees were only applied to one and four payment systems, respectively. As payment systems evolve and additional investment and development costs are incurred for enhancing an old or introducing a new system, there is an issue on how additional costs should be recovered. While transaction fees usually help recover

the operating cost of the system, this does not necessarily cover the fixed investment costs, which may be recovered through admission and membership fees. Reliance on transaction fees as the main source of revenue partly explains the reason for achieving partial cost recovery for total cost and unit cost in a majority of payment systems.

Third, transaction fees were largely flat. Flat transaction fees adopt a single rate regardless of the number of transaction volumes initiated by a sender. Use of flat fees is convenient for revenue calculation and forecast, while an underlying weaknesses is a pricing structure that does not support scale economies in payments processing where cost-savings, in the form of lower per item charges, are passed on to large-volume users. Moreover, volume-based pricing may possibly lead to a shift from paper-based to more electronic payment flows if the market benefits from the price incentives. Alternatively, it has been argued that this may lead to the issue of concentration or quasi-system, whereby volume discounts only changes payment flow concentration from small to larger users as the payment flow is largely determined and dependent on the economic activities of a country. Use of time-based pricing was also used, mainly aimed at preventing payment flow concentration during the peak or closing hours of a payment system, and hence reducing potential systemic risk. Use of volume-based pricing, in the form of volume discounts, was used to a lesser degree and their effects on promoting scale economies remains inconclusive. In sum, the dominant use of flat fee structures and risk-reducing time-based pricing structure are not in the best interest of enhancing efficiency in the payments system.

4.3.6 Policy Recommendations

Payment systems operate under unique local conditions in different countries. Although there may not be a uniform approach to resolving pricing issues for all payment systems, it helps to draw upon some "international best practices". Four major policy recommendations aimed at improving the pricing of central bank payment services and enhancing their overall economic efficiency are proposed as general guidelines in this section as follows:

Firstly, the accounting methodology applied to cost data collection assists in obtaining accurate figures. Central bank wide accounting rules, if applicable, may be applied to track the cost of payment and settlement services annually. Furthermore, a breakdown of total costs into fixed and variable cost components would assist in the review and setting of future price schedules. It may also help if the costing process is a collective effort between the payment systems and accounting departments of the central bank. Collection and forecasting of revenue figures is relatively straightforward with flat fee structures, increasing with difficulty as different pricing structures such as time-based and volume-based pricing are combined. Using computer tools may help track revenue under such sophisticated pricing structures.

Secondly, a forecasting model of payment transaction volumes assists with capacity planning and the impact analysis on operating costs and revenues. For example, while real GDP may be a significant determinant for the growth of cheque and ACH transactions, it was not a significant factor in a real-time gross settlement system, whereby commercial bank claims on government bonds (which serves as collateral for use of the intraday liquidity facility) played a more important role (Khiaonarong 2004b). As payment systems handle different types of transactions, it helps to develop a detailed forecasting model that captures the variables, other than GDP, that influence their growth.

Thirdly, a pricing strategy assists with the optimal departure from an existing to a new fee structure. For many SEACEN central banks, this involves departing from a flat to a new fee structure. The choice of pricing strategy varies and may include the following: average cost pricing, marginal cost pricing, market sensitive pricing, peak-load pricing, par value pricing, benefit flow pricing, and two-part pricing (Humphrey et al. 1997; Humphrey 1984). Choosing a specific pricing strategy largely depends on the broader policy objective and accumulative experience with pricing by each central bank.

Two-part pricing has been a widely accepted pricing method due to its ease of understanding and implementation among all the methods above (Humphrey 1997). The setting of two-part pricing (P_i) requires the following data: the total variable cost (TVC_i) and total fixed cost (TFC_i) of the *i*th payment service, the total the volume of payments to be processed ($V_{i,\,\text{processed}}$), the number of files submitted to be processed as batched payments ($V_{i,\,\text{file}}$), and the number of payment accounts serviced in real time ($V_{i,\,\text{accounts}}$). Fee setting for large-value and retail payment systems may take the following forms under two-part pricing:

For RTGS systems:

$$P_i = \text{TVC}_i / V_{i,\,\text{processed}} + \text{TFC}_i / V_{i,\,\text{account}} \tag{4.4}$$

For ACH and cheque clearing systems:

$$P_i = \text{TVC}_i / V_{i,\,\text{processed}} + \text{TFC}_i / V_{i,\,\text{file}} \tag{4.5}$$

The advantage of two-part fee structure are threefold. First, cost-savings are passed on to large-volume users as they are charged a lower rate per item. This also encourages economies of scale in payments processing. Second, full cost recovery is more likely to be achieved as fixed and variable costs are fully accounted for in the fee structure. While variable costs are recovered through different per item charges applied to different transaction volumes, fixed costs are recovered through monthly charges, or per input file submitted. And third, real resource costs and pricing are more transparent with the avoidance of price distortions and subsidisation.

And lastly, periodical price schedule reviews assist in formulating fee schedules that reflect continuous changes in technology, transaction volumes, and costs. The frequency of the price schedule review needs to be determined. This review may be based on a yearly rather than on the life cycle period of the payment system, which in many cases, is 5 years. Senior-level involvement in reviewing and approving

the new fee structures is particularly important. This may involve a committee on payment systems or a senior management committee in the central bank that considers and approves the proposed fee schedules annually. A transparent pricing policy is pursued with an advanced public announcement of the new pricing structure and their effective dates.

We have shown how policy approaches in the SEACEN countries significantly affect payment systems efficiency. Two major findings were as follows. First, cash remained a dominant payment method in a majority of SEACEN countries. A declining trend, however, was found in three countries – Korea, Singapore and Taiwan – where existing empirical data suggested a shift towards the use of more efficiency-enhancing cashless transactions such as debit cards, credit cards and electronic credit transfers.[2] Using pooled data from four countries for the period 1995–2002, results indicated the following: use of cashless transactions increased with the rise in per capita income; use of cash transactions was negatively co-related with the use of cheque and debit card transactions; an increase in ATM terminals was negatively co-related with the use of cashless transactions, suggesting a rise in cash withdrawals; and an increase in crime rates is positively correlated with an increase in the number of cheque and credit card transactions.

Second, total investment cost in payment and settlement systems amounted to approximately $28 million for the period 2000–2004. These investments were largely for the development and enhancement of real-time gross settlement systems. Survey data suggests that a majority of payment systems did not fully recover cost. Subsidies amounted to approximately $3.7 million in 2003. Unit cost recovery ratios also suggest that transaction fees did not fully recover unit cost in a majority of the payment systems. This can be explained by three reasons: periodical price schedule reviews were lacking; payment revenues relied largely on transaction fees; and the structure of transaction fees are largely flat. Using pooled data for 21 large-value payment systems for the period 2001–2003, results indicated that the average unit cost demonstrated an L-shaped curve where the predicted unit costs can fall from $3 to $0.40 in the shift from small-scale to large-scale operations. This suggests relatively strong scale economies and payment systems efficiency. While there are arguments in favor of subsidisation, as payment systems are viewed as a public good, there are also arguments in favor of cost-based pricing to prevent price distortions and payment market failure. Therefore, the key challenge for the central bank is to strike a balance between the risk-cost tradeoff objectives it pursues.

The role of the central bank in promoting payment systems efficiency is twofold. The first role focuses on market guidance. This involves encouraging the public to shift from the use of cash to more efficiency-enhancing cashless transactions. This may be achieved through the co-operation of payment associations, banking

[2] Other countries such as Malaysia and Sri Lanka also experienced a downward trend in cash transactions, as measured by the ratio of currency in circulation to GDP. The lack of historical data on cashless transactions for the period 1995–2002, however, limited the empirical analysis of their effects on shifting cash to cashless transactions in these countries.

associations, or the banking industry in general as retail payment services are largely owned and operated by the private sector. The second role focuses on a four-step process to improve the efficiency of central bank payment services in the following areas: collection of cost and revenue data; forecasting of demand; formulation of pricing strategy; and review of price schedule.

Chapter 5
The Diffusion of Payment Innovations

Abstract We illustrate the relative use of cash and electronic payments in five Asian countries–Japan, Korea, Singapore, Taiwan, and Thailand-as well as Hong Kong, an important economic zone of China. The purpose is to compare cash and other payment instrument use across these countries, determine the trend in cash use over 1995–2003, and illustrate how the transaction share of electronic payments in non-cash transactions has changed. This can provide a foundation for comparing payment system efficiency and technology adoption among Asian countries. We further note the apparent bank and retailer costs of accepting different payment instruments to get some idea of whether or not replacing cash transactions with electronic payments may lead to social benefits. A logistic projection of the share of electronic transactions in non-cash payments and the intensity of cash use in consumption is then presented.

Are Asian economies moving towards the so-called cashless society? Forecasting results in this chapter contributes to that debate. Cashlessness has been on the policy agenda of many central banks since the information technology revolution spawned many new electronic finance and payment schemes. Such developments also have broad implications for promoting efficiency in financial systems as well as maintaining financial and monetary stability, and provides insightful lessons on how countries can promote the use of electronic payments to catch up along the efficiency frontier.

Most people give little thought to how they make payments. Although the social cost of a country's payment system may comprise upwards of 2–3% of GDP, and account for 5% of the value of an average transaction, consumers rarely face the direct costs of making a payment. In more recent studies, such social cost can be just under half a per cent of GDP (Gresvik and Haare 2008). Payment expenses borne by retailers are typically folded into the price of the good being purchased while banks often recoup their payment expenses through fixed fees or from deposit balances that pay no or a low interest rate.

Developed countries, realizing that electronic payments (excluding credit cards) are a cheaper method of payment than paper-based giro and cheque instruments at the bank and retailer level, have been shifting to electronic substitutes. In particular, debit cards have substituted for cheques and cash. Although data on cost savings

T. Khiaonarong and J. Liebenau, *Banking on Innovation,*
Contributions to Economics, DOI 10.1007/978-3-7908-2333-2_5,

are very difficult to obtain, it is estimated that the shift to electronic payments and substitution of ATMs for traditional banking offices in Europe over 1987–1999 has reduced bank operating cost by some $32 billion, saving 0.38% of 12 nations' GDP (Humphrey et al. 2006).

The situation is quite different in Asia where cash use is very high and cheque and other paper-based payment instrument use has been minimal. Here the availability of electronic substitutes, while progressively replacing the small number of cheques, has made little progress in replacing cash. Some national governments, generalising from the experience of developed countries which had a larger number of paper-based instruments that could be replaced, have concluded that they too should shift from cash and cheque use to electronic payments.

While evidence exists that electronic payments often are only one-third to one-half as expensive as paper-based payments at the bank level in developed countries, this cost difference need not apply to cash. Indeed, the information that exists for retailers is that accepting cash at the point of sale is cheaper per transaction than accepting a cheque or card payment (especially for low transaction values). Thus shifting from cash to electronic card payments at the point of sale may not be as beneficial as has been the shift from cheques and paper-based giro transactions to electronic substitutes. Even so, for convenience reasons, many consumers in developed countries (excluding Japan) seem to favor card use over cash and have made this shift themselves when an electronic alternative exists.

Although consumers may find cards more convenient than cash, a reduction in cash use has implications for government revenues and debt. When the growth of cash in circulation starts to slow, annual returns to governments from seigniorage will also slow. Seigniorage comes from issuing currency that costs from $.05 to $.08 per note to print (depending on anti-counterfeit designs) but generates revenue to the government equal to the face value of the notes issued. As the expense of issuing, distributing, and maintaining fitness of currency in circulation is markedly less than the interest cost of servicing debt of the same face value, this difference is seigniorage revenue to the government. If cash use falls absolutely, revenues will be needed to redeem currency that no longer circulates and seigniorage revenues would be replaced by debit service costs.

Reduced use of cash has other implications as well. In addition to the effect on implementing of monetary policy (Drehmann et al. 2002), the difficulty of tracing cash transactions makes tax evasion and other illegal activities simpler so reduced use of cash may, depending on the anonymity of its replacement, also reduce tax evasion. To address these negative aspects of cash use, Norway now requires all cash transactions exceeding NKr 100,000 (about $16,000) be reported to authorities in order to limit tax evasion, black market activity, and money laundering (Ministry of Finance 2004).[1] Singapore, perhaps seeking the same ends as well as retaining seigniorage revenues, has been investigating the possibility of substituting

[1] Other countries have similar reporting requirements (e.g., cash deposits exceeding $10,000 at banks in the U.S.) but restrict them to financial institutions while in Norway everyone and all types of transactions are covered.

government-issued smart cards to replace cash (Kok 2002). More generally, Singapore has provided financial support for programmes to improve the efficiency of their payment system (e.g., cheque truncation, mobile phone and other electronic payment arrangements) and relaxed regulations restricting e-money issuance by non-banks (Monetary Authority of Singapore 2002, 2004). In Japan, the government has supported legislation intended to promote electronic banking and called for greater investment in information technology by financial institutions in order to improve payment system efficiency (Financial Services Agency 2004). Although considerably less direct, Taiwan and Hong Kong have implemented policies benefiting electronic payment activities. In Thailand, the focus to date has been on determining the cost of payments at the bank level (Jitsuchon and Khiaonarong 2000; Thailand Development Research Institute Foundation 2004). Thailand has also implemented a joint-review of payment service fees with the aim of encouraging electronic payments and lowering transaction costs as well as strengthening the competitiveness of financial institutions.

In what follows, we illustrate the relative use of cash and electronic payments in five Asian countries–Japan, Korea, Singapore, Taiwan, and Thailand–as well as Hong Kong. The purpose is to compare cash and other payment instrument use across these countries, determine the trend in cash use over 1995–2003, and illustrate how the transaction share of electronic payments in non-cash transactions has changed. This can provide a foundation for comparing payment system efficiency and technology adoption among Asian countries. We further note the apparent bank and retailer costs of accepting different payment instruments to get some idea on whether or not replacing cash transactions with electronic payments may lead to social benefits.

A logistic projection of the share of electronic transactions in non-cash payments and the intensity of cash use in consumption is then presented. Forecasts of likely cash use in a country assists in making decisions concerning the possible issuance of new currency or coin denominators, continuing investments in cash distribution centre and in projecting annual seigniorage revenues. It also helps in determining the near term efficiency of a country's payment system (a consideration in negotiating/adopting current free trade agreements for the provision of financial services).

5.1 Cross-Country Use of Cash and Electronic Payments

Over 50 years ago, the only real substitute for cash at the point of sale in most countries was the paper cheque, which is still strongly used in the U.S., the U.K., and France. This was also true for developing countries although cheque use was comparatively small. In many European countries, an additional paper-based substitute for cash involved giro transactions for bill payments and employee disbursements using a national network of post offices and the mail. Finally, a paper-based credit card network developed in the U.S. to serve travelers since, with thousands

of only local banks, access to cash was difficult and accepting cheques was risky. As technology and telecommunications improved, giro transactions in Europe became electronic as did credit card transactions in the U.S. and overseas. More recently, access to cash dramatically improved with the development of ATMs, which expanded into debit card networks in the U.S. and especially Europe as substitutes for both cheques and cash.

One indicator of cash use in a country is the ratio of the value of currency and coin in circulation to the value of GDP. Some idea regarding the cross-country use of cash is shown in Table 5.1 along with per person use of cheques and electronic payments.[2] In terms of cash use, the U.S. appears to use less cash for transactions than does Germany or Italy, which, in turn, uses less cash than Singapore, Hong Kong, and Japan. In terms of cheque use per person, the U.S. and France are clear outliers (as would be the U.K. if it were included) compared to the de minimis use of cheques in the other countries. The number of electronic payments per person is generally inversely related to the ratio of cash in circulation to GDP, suggesting a broad substitute relationship that is most evident when comparing Japan and Hong Kong with, say, France, Germany, and the U.S.

Figure 5.1 shows the relationship between the indicator of cash use (the ratio of cash in circulation to GDP on the X-axis) to the share of electronic transactions in non-cash payments between 1995 and 2003 for the Asian countries we are interested in. All six Asian countries (including Hong Kong as a "country") have raised their share of electronic payments in total non-cash transactions to where this share is around 70% or higher in 2003. At the same time, the apparent intensity of cash use has expanded for three countries (Japan, Thailand, and Hong Kong), stayed approximately the same for one (Singapore), and fallen for two (Korea and Taiwan).

Table 5.1 Indicators of cash and non-cash use across countries, 2003

	(Currency and Coin)/GDP	Cheques per Person	Electronic Payments Per Person[c]
France	2.0[a]	64	151
Germany	3.3[a]	2	160
Italy	4.7[a]	9	47
Japan	14.6	1	30
Singapore	8.1	21	409
Hong Kong	10.5	18	8
U.S.	2.4[b]	126	152

Source: BIS (2005)

[a] Indicates that data are for 2001, the latest that is available for some countries

[b] The actual U.S. ratio is 6.1 but was reduced since some 60% of the value of currency is believed to circulate outside of the country

[c] Electronic payments includes credit/debit cards and card-based e-money for point of sale transactions along with credit transfers and direct debits for giro and ACH transactions for bill payment, employee disbursement, as well as business to business payments

[2] No data exists on the number of cash transactions so no per person measure is available.

Figure 5.2 shows the yearly evolution of the value of cash in circulation as a ratio of GDP over 1995–2003 for all six countries. There is a more or less consistent rise in this ratio for Japan, Thailand, and Hong Kong and reduction for Korea and

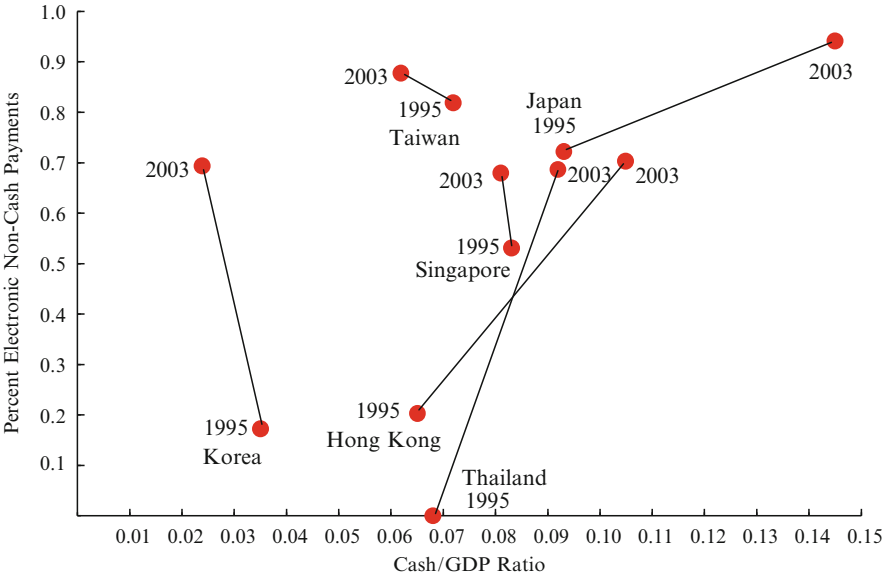


Fig. 5.1 Electronic payments and use of cash, 1995–2003

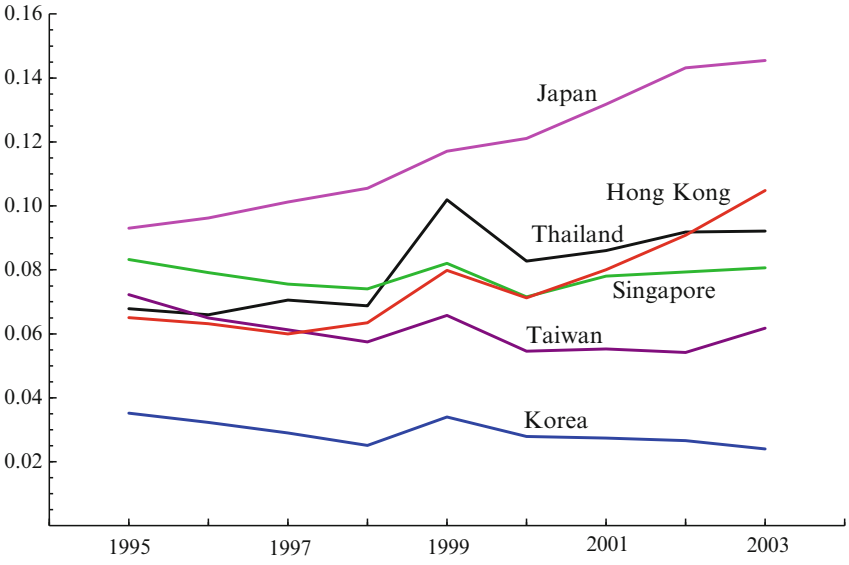


Fig. 5.2 Cash to GDP ratio, 1995–2003

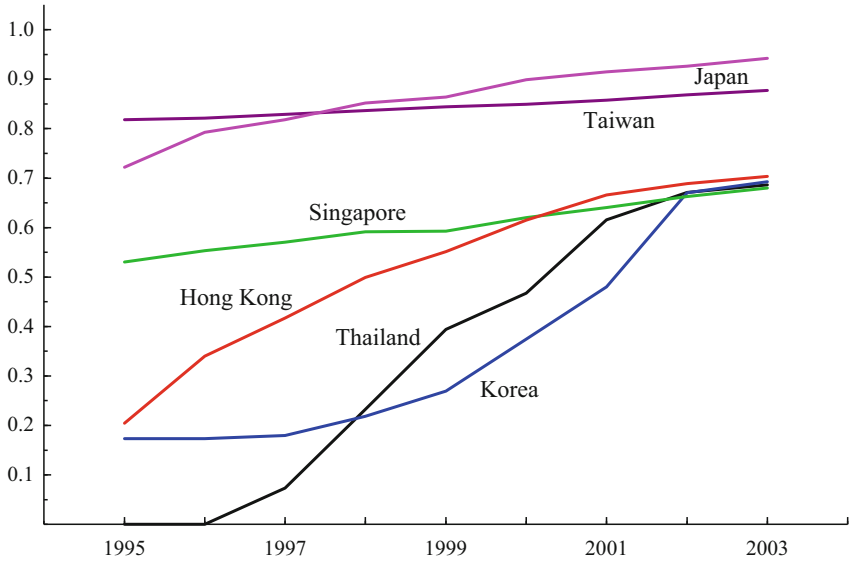


Fig. 5.3 Percent of electronic non-cash transactions

Taiwan. According to this indicator, only Korea seems to have reduced its cash use to levels experienced in the developed countries seen in Table 5.1.

The yearly evolution of the share of electronic transactions in all non-cash payments is shown in Figure 5.3. Here the greatest increase in the share of electronics has been achieved by Thailand, Korea, and Hong Kong. By 1995 Japan and Taiwan had already achieved a relatively high share of electronic payments and consequently show only a slight increase going forward to 2003. As is seen in Table 5.1, France and the U.S. have a much greater scope for continuing to substitute electronic payments for cheques than do Japan, Singapore, or Hong Kong. For these and other Asian countries, the growth of electronic payments is dependent on reducing cash use rather than shifting away from cheques (or paper-based giro payments) as has occurred so far in developed countries.

5.1.1 Alternative Indicator of Cash Use

It is possible to determine an alternative measure of cash use from the following:

$$\text{Cash} = \text{Consumption} - \text{Cheque} - \text{DCard} - \text{Ccard} \tag{5.1}$$

where:

Cash = estimated value of consumer cash payments
Consumption = observed value of household consumption
Cheque = observed/approximated value of cheques

DCard = observed/approximated value of debit card payments and
CCard = observed/approximated value of credit card payments

The estimated value of cash from (5.1) is a residual measure but is likely a more accurate indicator of the legal value of cash used in consumer point of sale and bill payments than is the ratio of cash in circulation to GDP. Circulating cash (especially the largest currency denominations) are commonly used in unreported illegal activities. As explained in Khiaonarong and Humphrey (2005), the data used to compute this alternative cash measure involves assumptions, linear interpolations, and other procedures needed to compute (5.1). This is not unusual as payment data for developed countries is often only marginally better (for Europe) and sometimes worse (for the U.S.).

The ratio of the value of cash computed from (5.1) to total household consumption in our six countries is shown in Figure 5.4. Using a ratio controls for differences in the level of disposable income across countries. Both Japan and Thailand appear to use cash for over 90% of their purchases and bill payments while Taiwan has a ratio in the mid to low 80% range. Hong Kong and Singapore both rely on cash for around 70% of their consumption while Korea is lower still at or below 60%. The large apparent reduction in cash use in Korea after 1999 is associated with a sharp rise in credit card purchases between 1999 and 2002. New entry of non-bank cards into the market and over-promotion of credit card use by all issuers led to this result. So much credit card debt was incurred that cash withdrawals on one set of cards held by consumers was increasingly used to pay off balances on others. The resulting debt spiral inflated credit card purchases and thereby reduced

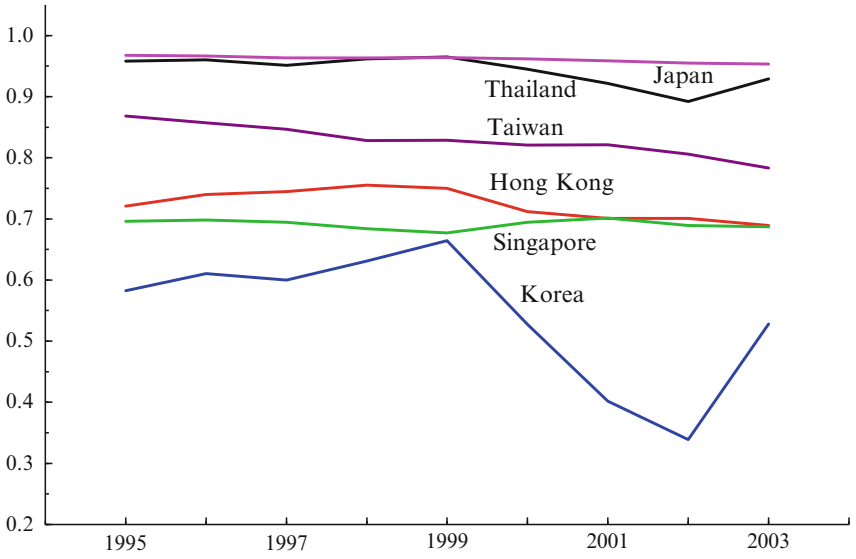


Fig. 5.4 Percent cash use in consumer payments

our measure of cash use in consumption. Interestingly, although our credit card data excludes cash advances and withdrawals, many consumers pay their credit card bills using cash instead of an electronic payment.

The apparent levels of cash use for legal consumer payment activities in Hong Kong, Singapore, and Korea are similar to those currently estimated for Norway (53%), Spain (around 60%) but far higher than for the U.S. (20%).[3] Cash use in the U.S. is low because over the last 50 years cheques significantly replaced cash for point of sale and especially bill payments. Indeed, as early as 1975, the share of cash in consumer payments was only a little over 30%. Except for the U.K. and France, Europe did not experience a large degree of cash replacement from cheques and only more recently has the share of cash fallen, largely due to the use of debit cards (Snellman et al. 2001). For our six Asian countries, the European experience of debit cards replacing cheques is the most likely near term outcome, rather than the European experience of cards replacing cash. Japan, for example, has long had the opportunity to replace cash with credit or debit cards but little substitution has actually occurred. The main reason for this result seems to be that Japan is a relatively safe country with many ATMs so the need for an alternative to cash is correspondingly lower than elsewhere (Federation of Bankers Associations of Japan 1994).

Another way to view cash use is in terms of the average value spent per adult per year. For comparability, the cash values estimated in (5.1) have been translated into U.S. dollars using purchasing power parity exchange rates and are shown in Figure 5.5. The average adult in Japan spends about $18,000 in cash each year

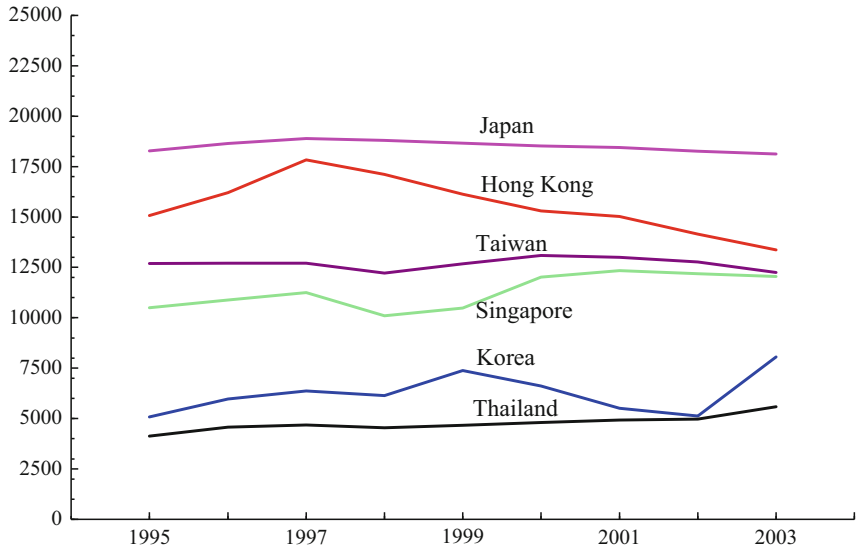


Fig. 5.5 Value of cash used per adult per year

[3] In order, these estimates are from Humphrey et al. (2004), Carbo et al. (2003), and Humphrey (2004).

while the average adult in Korea and Thailand spends between $4,000 and $6,000 per year. The range for Singapore, Taiwan, and Hong Kong is between $11,000 and $15,000 a year. These differences, of course, reflect different disposable income levels as well as savings rates but what is interesting is that these approximations to real cash expenditure levels have been relatively flat over 1995–2003 even as these countries (Japan excepted) were growing.[4]

Have electronic payments made much of an inroad to cash use in Asia? The answer has to be that to date electronic payments have been replacing cheques (Figures 5.1 and 5.3) but do not seem to have affected cash use very much if at all (Figures 5.2, 5.4, and 5.5). The experience of our six Asian countries has not, so far, followed the pattern of some countries in Europe or the U.S. where the share of cash use in consumer transactions has been declining. We next examine the limited information that exists on the cost of different payment instruments to assess the degree that explicit reductions in bank or retailer costs may lead to savings if electronic payments did replace cash.

5.2 Costs of Using Different Payment Instruments

Very little information is available on the bank cost of supplying different payment instruments or on the retailer cost of accepting them. Even less information exists concerning cash. Given the data available, we focus on the payment cost of cheques, debit cards, and cash for use at the point of sale.

5.2.1 Bank Payment Costs

Norway has collected representative information on the bank cost of handling different payment instruments for more than a decade. This is the only country we know of that does so. The bank cost data includes labor, building, materials, and computer expenses incurred in processing payments as well as allocated bank branch office expenses associated with the various payment types. The approximate weighted average bank cost per transaction over 1988–2001 has fallen from $2.52 to only $0.95, a reduction of 62% over 13 years (Gresvik and Øwre 2002).[5] Bank costs in Norway for cheques, debit cards, and cash are shown in Table 5.2. Cheque costs are very high at $4.02 compared to other countries that use far more cheques but exclude associated branch costs (e.g., $0.35 for Spain or $0.43 for the U.S.).[6]

[4] Recall that problems with credit card data for Korea between 1999 and 2003 have affected the variation in Figure 5.5 for Korea during these years.

[5] These figures exclude the cost of cash withdrawals over the counter at a bank office.

[6] As shown in Khiaonarong (2003), cheque processing costs by themselves are less than $0.05 per item. Norway's cheque costs are high because office expenses are included and cheque volume is very low (accounting for only 0.3% of all non-cash payment transactions).

This compares to $0.44 in Norway for a debit card transaction. Thus the bank cost of a debit card is only 11% as much as the cost of a cheque and 31% of the cost of supplying cash. For banks, substituting electronic debit card transactions for cheques or even cash could reduce their operating cost.

5.2.2 *Retailer Expense of Accepting Different Payment Instruments*

Retailer costs are based on limited survey information. As seen for Australia, Germany, and the U.S. in Table 5.2, cash appears to be markedly cheaper to accept than either cheques or a debit card.[7] Taking the average of the costs shown across these three countries suggests that the retailer cost of accepting a cheque averages $0.77, is $0.55 for a debit card, and only $0.12 for cash. A recent study in the Netherlands comparing the social cost of retailer acceptance of a debit or "cash in a chip" card payment versus cash found that cash was cheaper for transaction values less than $17 but that its electronic substitute was cheaper to accept for values greater than $17 (Raa and Shestalova 2004). Thus cash need not always be cheaper–it can depend on transaction size. This seems to mirror consumer behavior as well since in many developed countries consumers prefer a card payment to cash when the transaction amount is relatively large but use cash when the transaction value is relatively small.

It appears that while retailers benefit from accepting cash relative to other payment instruments, banks may not. This sets up a conflict since, in large measure, it is the consumer – not usually the bank or the retailer – who selects out of the alternatives available which payment instrument to use in transactions. Banks can try to introduce the debit card as an alternative to cash but would likely face some resistance by retailers and garner only slow adoption (if incentives are not offered) by

Table 5.2 Illustrative bank and retailer costs for cheques, debit cards, and cash

Country/Year	Cheque	Debit card	Cash
Bank payment Costs:			
Norway/2001	$4.02	$.44	$1.35–$1.52
Retailer payment costs:			
Australia/2001	0.28	0.10–0.23	0.07
Germany/1999	0.65–0.93[a]	1.14	0.12–0.20
U.S./2000	1.25	0.34[b]	0.12

Sources: See Humphrey et al. (2006). Data converted into U.S. dollars
[a] Cheques are truncated and collected electronically, lowering cost
[b] On-line debit card

[7] Although not shown here, credit cards are typically the most expensive payment instrument for merchants to accept. This is due to the relatively high merchant fee that is triggered with credit card use (primarily to cover reward programmes) rather than the result of markedly higher real resource costs compared to a debit card.

consumers. Currently, these bank-consumer–retailer trade-offs are being made in Asia with little consideration of other issues, such as tax evasion, illegal activity, and government seigniorage revenues.

5.2.3 Estimating the Number of Cash Transactions

It is difficult enough to estimate the value of cash payments in a country. It is harder still to try to approximate the volume or number of cash transactions. When time-series data are too short to use an econometric model (as is the case for our Asian countries), the value of cash payments in a country can be approximated from the equality: Cash = Consumption –Cheque –DCard –CCard, which we implemented above and used to generate Figures 5.4 and 5.5. A similar approach to approximating the total number of cash transactions is not possible since the total number of all payment transactions in a country (unlike the value of personal consumption) is unknown. However, if sample survey data are available for a set of retailers, these data can be factored up to approximate the value and volume of cash transactions as well as the average value per transaction. For example, in the U.S. there exists a rather comprehensive survey of the cost of different payment instruments accepted at supermarkets (Food Marketing Institute 2001). The 2000 survey reports the percent of payments by number of transactions (cash 43%, cards 23.7%, cheques 33%) and value (cash 19.5%, cards 30%, cheques 50.6%).[8] Combined with survey information on the number (23.3 billion) and value ($1.6 trillion) of card transactions in the entire U.S. in 2000 (Gerdes and Walton 2002, Table 5.1), this yields an estimate of the total consumer cash transaction volume of 42.3 billion, value of $1.04 trillion, with an average value per cash transaction of $24.60.[9] This ad hoc approach gives values similar to a more careful analysis which reports 50.9 billion consumer cash transactions for a value of $1.09 trillion and an average value per transaction of $22 (The Nilson Report 2003).[10]

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[8] Straight cash transactions are 39% while electronic benefit transfers, WIC cheques, and food stamps make up the rest of the 43% figure in the text. As all three of these additional transactions reflect government welfare-based transactions, we include them with cash since cash would be the most likely alternative payment method. Card transactions include online (PIN number based) debit cards, credit cards, and offline (credit card signature/terminal based) debit cards.

[9] The number of cash transactions is derived from (43% cash transactions)/(23.7% card transactions) × (23.3 billion card transactions in the U.S.) = an estimated 42.3 billion cash transactions in the U.S. For the value of cash transactions, the calculation is: (19.5%)/(30%) × ($1.6 trillion) = $1.04 trillion. Cheque data should not be used here unless the number and value of consumer (not total) cheques is available.

[10] Another consultant firm comes up with an estimate of 680 billion cash transactions in the U.S. from the following: (252 million adults) × (7.4 cash transactions per person per day) × 365 = 680 billion. The same firm estimates that in Belgium each person makes only 2.1 daily cash transactions even though it is well known that use of cash in Europe exceeds that for the U.S. The approach used here is, obviously, critically dependent on the estimate of the number of cash transactions per person per day, a number that a small but well designed survey could determine.

While we know of no data for our six Asian countries regarding the number of cash transactions, this information could be developed using straightforward sample surveys and would be especially important if the average value of cash transactions were divided into (say) four parts, such as very small, small, medium, and large. When electronic payment cards substitute for cash, large and medium size cash transactions are the first to be affected. Only later will cards affect smaller cash payment values. Since the substitution of cards for the very smallest size cash transactions has to date been unsuccessful even in developed countries, it would be best to concentrate on cash payments at retail outlets (which would primarily cover medium and large cash transactions) since this is where cards initially have the greatest likelihood of substituting for cash.

5.3 Projecting Shares of Electronic and Cash Payments in Asia

Logistic and Gompertz growth or S-curves have been used in a variety of situations to forecast the adoption and dispersion of new technologies in industry. The logistic S-curve is used here to fit and forecast the share of electronic payments in total non-cash transactions and also the share of cash in consumer payments. In a detailed empirical comparison, Meade and Islam (1995) have shown that the standard logistic and Gompertz S-curves outperform more complicated models.[11] The logistic curve we estimate specifies a payment share (S_t) as a function of time (t):

$$\ln (S_t / (1 - S_t)) = a + b\ t + e_t \qquad (5.2)$$

where:

b = the coefficient of diffusion or the slope of the S-curve.[12]

In (5.2) the pattern of initial payment instrument substitution is used (via symmetry around its inflection point) to predict the remaining pattern of replacement. The non-linear, symmetric logistic curve and the Gompertz non-linear, asymmetric curves ask too much of our limited data (which has few degrees of freedom and inflection points) to be reliably estimated here so we implement only the linear, symmetric logistic model (5.2).[13]

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[11] This is largely because more complicated models have more parameters to estimate and the data available typically can not support the increased complexity.

[12] The share of electronic payments in non-cash transactions is expected to rise and corresponds to the formulation of the equation shown. However, since the share of cash in consumer payments is expected to fall, rather than rise, St in the cash application is actually measured as (S*t = 1−St). After estimation, 1−S*t gives the predicted ending cash share (St) which, as seen from Figure 5.4, is unlikely to be very small in the near term.

[13] The more general, but more difficult to estimate, non-linear, symmetric logistic model is St = S't/(1 + c exp(−b t)) while the non-linear, asymmetric Gompertz model is St = S't(exp(−c exp(−b t))). Both of these models are more usefully applied when the data set is less sparse.

5.3.1 Share of Electronic Payments in Non-Cash Transactions

The results of the logistic estimation where S_t = (number of electronic transactions)/(total number of non-cash transactions) are shown in Figure 5.6. Fitted shares are shown for 1995–2003 and correspond to, but are smoother than, the progression of observed shares shown in Figure 5.3. Extending the time period forward yields projected shares for 2004–2013. The S-shape of these curves is best seen for Hong Kong, Korea, and (especially) Thailand. Initially, adoption of new technology rises at an increasing absolute rate, reaches an inflection point when it expands at a constant rate, and then continues to rise but at a decreasing rate as the adoption of new technology saturates the potential market (which here, plausibly enough, is very close to 100% for electronic payments and 0% for cheques).

The curves in Figure 5.6 are based on the estimated equations in Table 5.3. The high R^2s are partly the result of the short time period for which payment data are available but mostly they are high because the observed payment share data in Figure 5.3 that was used in the estimation actually varies in a manner specified in (5.2).[14] All the parameters were significantly different from zero and are of the expected sign. Fitted share values for 1995, 1999, and 2003 are shown in Table 5.3 as well as 5-year and 10-year forward projections. While only Japan has an electronic payment around 0.9s in 2003, the projection suggests–if past trends continue–that all but Singapore will be in that position in 5 years. In sum, five of the six countries will by 2008 be in the final stages of substituting electronic payments for cheques.

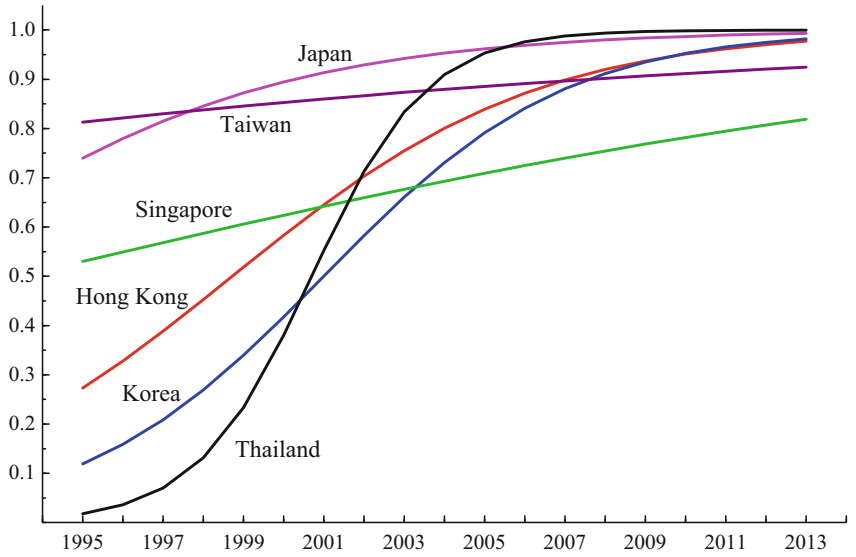

Fig. 5.6 Predicted share electronic non-cash transactions

[14] As seen below, this is not the case for the cash share estimations.

Table 5.3 Fitted and forecasted shares of electronic payments

	Fitted			Predicted		$\ln(S_t/(1-S_t)) = a + b\,t$		
	1995	1999	2003	2008	2013	A	b	R^2 adj
Hong Kong	0.27	0.52	0.75	0.92	0.98	−1.24	0.263	0.92
Japan	0.74	0.87	0.94	0.98	0.99	0.83	0.219	0.99
Korea	0.12	0.34	0.66	0.91	0.98	−2.33	0.333	0.90
Singapore	0.53	0.61	0.68	0.75	0.82	0.05	0.077	0.99
Taiwan	0.81	0.85	0.87	0.90	0.92	1.41	0.058	0.98
Thailand	0.02	0.23	0.83	0.99	1.00	−4.69	0.700	0.91

Note: All estimated parameters are significantly different from zero at the 99% level of confidence, except one (where the significance level was 95%). There were nine time-series observations (7 d.f.). The R^2 value is adjusted for degrees of freedom

At the same time, depending on the availability of card terminals, the use of incentive pricing for payment transactions by banks/retailers, and consumers' assessment of the benefits of cash versus electronic payment methods, electronics may begin to play an important role in replacing cash (at least for legal, higher value transactions).

5.3.2 Share of Cash Payments in Consumption

Applying logistic estimation to the observed shares shown in Figure 5.4, where S_t = (value of cash payments)/(total consumer payments) and $S^*_t = 1-S_t$ was used in (5.2), gave the fitted (1995–2003) and projected (2004–2013) cash shares in Figure 5.7. None of these curves evidence the traditional S-shape since none of the six countries is far enough down the road of substituting away from cash for consumer payments to have reached an inflection point. Earlier work indicated that Italy, Germany, the U.K., and other European countries have also not reached an inflection point in their declining use of cash (Snellman et al. 2001). All six Asian countries, as well as many in Europe, are only in the initial stages of replacing cash with electronic payment instruments, although some are more advanced in this process than others. The lack of an inflection point for the curves in Figure 5.7 is the reason the R^2s for the logistic estimation in Table 5.4 are often very low.

The observed cash share information in Figure 5.7 and our logistic estimation results suggest that Hong Kong, Taiwan, and Thailand may see a slight but significant reduction in the share of cash used for consumer payments. A reduction in the share of cash need not also mean that the value of cash in circulation and the associated growth of seigniorage revenues will fall. Only when the share falls fairly rapidly would this be a concern. In contrast, the stable cash share outlook for Japan and Singapore indicates a stable rise in seigniorage revenues, although that stable share is much lower in Singapore (at .68) than in Japan (.94). The dramatic decline in the fitted and projected cash shares for Korea need to be discounted at present due to the previously noted data problems in that country. Overall, the cash share results indicate that the implementation of monetary policy is unlikely to be

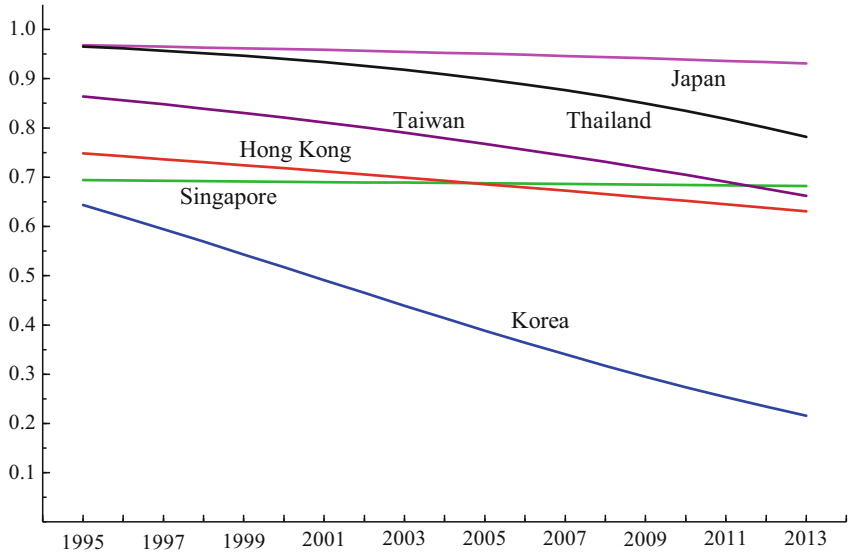

Fig. 5.7 Predicted share cash consumer payments

Table 5.4 Fitted and forecasted shares of cash in consumer payments

	Fitted			Predicted		Ln(S*t/(1−S*t)) = a + b t		
	1995	1999	2003	2008	2013	A	b	R^2 adj
Hong Kong	0.75	0.72	0.70	0.67	0.63	−1.12	0.031	0.40
Japan	0.97	0.96	0.95	0.94	0.93	−3.45	0.045	0.92
Korea	0.64	0.54	0.44	0.32	0.22	−0.70	0.105	0.33
Singapore	0.694	0.691	0.689	0.686	0.682	−0.82	0.003	−0.08
Taiwan	0.86	0.83	0.79	0.73	0.66	−1.91	0.065	0.93
Thailand	0.97	0.95	0.92	0.86	0.78	−3.44	0.114	0.53

Note: All estimated parameters are significantly different from zero at the 99% level of confidence, except one (where the significance level was 95%) and another which was insignificant (the slope value for Singapore). There were nine time-series observations (7 d.f.). The R^2 value is adjusted for degrees of freedom which, for Singapore, turns the unadjusted of $R^2 = 0.05$ into a negative value

affected in our countries (neglecting Korea) since the cash share is projected to exceed 65% 5 years out and exceed 60% 10 years out.

In sum, although not well known, the cost of making a consumer payment may on average comprise around 5% of the value of a purchase. The development of electronic payment alternatives to paper-based payment instruments and cash may permit resources to be saved by banks and retailers. Electronic alternatives also seem to be valued by consumers as a more convenient and safer way to initiate transactions.

Generalising from the experience of developed countries over the last decade or two, some national governments in developing countries have suggested that they

too should shift from cheque and cash use to electronic payments. Much evidence exists that electronic payments (excluding credit cards) are generally from one-third to one-half as expensive as paper-based payments at the bank level. The six Asian entities we study (Hong Kong, Japan, Korea, Singapore, Taiwan, and Thailand) are well on their way of replacing cheques with electronic card payments. Indeed, although only Japan had achieved .90 share for electronic payments in non-cash transactions by 2003, all but Singapore are projected to achieve a .90 or higher share within 5 years (by 2008). Many European countries have achieved a similarly high share for electronic payments while others who have historically been large users of cheques (France, the U.K., and the U.S.) have much lower electronic non-cash payment shares. In the latter case, this is because over the last 50 years, cheques replaced a large portion of consumer and even business use of cash while such replacement has been minimal in our six Asian countries (so there were fewer cheques to replace to begin with).

The next stage in the substitution process would be the replacement of cash by electronic payments, a process which has started in the U.S. and some European countries (in Scandinavia) but, to date, has been weak in other European countries (e.g., Germany, Italy) as well as our six Asian countries. Some evidence exists suggesting that while banks could save costs if electronic payments replaced cash, retailers could find that their costs may rise. Thus the overall, social cost effect of such a substitution is not as clear as it has been for electronic payments replacing cheques and paper giro payments. While many consumers in developed countries seem to favor card payments over cash for convenience and safety reasons, this has not been the experience of Japan which has long had the opportunity for a similar substitution but has only moved slightly in that direction. The share of the value of cash in consumer payments for Japan was .95 in 2003 and is only projected to fall to .94 by 2008 whereas the projection for the other five Asian countries is for the cash share to fall below .75 for all but Thailand.

Although the projected share of cash in consumer payments is projected to fall for all but Japan and Singapore (where the share is expected to be stable), this reduction should have no real effect on the implementation of monetary policy and little near term affect on government seigniorage revenues. In the distant future, if cash use falls absolutely (as it is close to doing in some Scandinavian countries), cash in circulation will have to be redeemed through expanded government debt or (in the case of Thailand and perhaps other countries) sales of assets that currently back currency issue. These considerations and others, such as the relative social costs of replacing cash with electronic payments, would be important to determine before governments decide to provide inducements to shift away from cash for payments (as some are already doing).

Chapter 6
Capability Development: The Banking Sector

Abstract We have seen that the Asian economies studied have undergone considerable changes in payment systems and that this has affected commercial banking. In this chapter we show in detail how innovation has occurred in the Thai banking sector. In Thailand banks were placed under enormous pressure to innovate in the mid-late 1990s first by a push towards financial services liberalisation, followed closely by a major financial crisis. In this transformative period numerous innovations arose and we show how the banking community responded to them and the means by which they were disseminated and implemented. We assess survey results that illustrate the broad indicators of innovation. We apply these assessments to IT introduction and usage in the commercial banking industry, the level of automation among types of payment routines, and the major sources of commercial bank capabilities contributing to, or constraining, innovation.

This chapter examines innovation in the commercial banking sector. The Thai banking sector provides a case in point whereby banks were under pressure to innovate under an environment of financial services liberalisation, which was followed by a financial crisis. We focus on the transformative period at the end of the 1990s and show how innovations arose, how the banking community responded to them, and the means by which they were disseminated and implemented.

The present survey results illustrate the broad-level indicators of innovation, including an overview of IT introduction and usage in the commercial banking industry, the level of automation among the selected types of payment routines, and the major sources of commercial bank capabilities contributing to, or constraining, innovation.

Banks can be conceptualised as a type of technological institution, playing a major part in the services sector, influencing other sectors of the service economy, and affecting all industries that borrow from them. This theme builds upon previous studies which argue that banks play a constructive role in promoting and shaping national policies for technological development (Jequier and Hu 1989; Barras 1990).

Since the early 1980s, there have been many developments in both bank-related and electronic funds transfer (EFT) research. Other work has begun to illuminate these applications in commercial bank contexts (Mason et al. 1997; McKenney

T. Khiaonarong and J. Liebenau, *Banking on Innovation*,
Contributions to Economics, DOI 10.1007/978-3-7908-2333-2_6,

et al. 1997). In some studies, the role of information systems was examined in relation to bank re-engineering, bank mergers, strategy formulation, and strategies of electronic banking systems in an emerging market economy context (Mentzas 1994; Oppenheim and Shao 1994; Dutta and Doz 1995; Remenyi and Cinnamond 1996; Johnston and Yetton 1996; Currie and Willcocks 1996).

EFT has been one of the major subjects studied since the 1980s. This has resulted in a research agenda and the analysis of the impact of some banking systems on society and public policy (Kraemer and Colton 1980; King and Kraemer 1980). For example, Clarke et al. (1990) studied such public policy implications in a survey of the practices and intentions of the Commonwealth government agencies in relation to EFT systems, EFT at point of sale (EFTPOS), and electronic data interchange (EDI). Almost 30 years ago, in their guidelines for future research, King and Kraemer (1980) argued that institutions played an important role in EFT development. This is mainly because of the bias created by chosen definitions by different institutions which may focus on payment systems, financial systems, electronic records, total systems, and media or communications. The choice of a specific definition suggests an institution's consciousness of its market position.

Banks play a central role in the innovation process. They invest relatively large amounts of physical, organisational, and human resources related to IT, which are aimed to increase productivity and to improve efficiency in work routines. For example, Cassiolato (1992) studied the important role of user-producer relations towards the diffusion of new technology in Brazil's banking industry, while Fincham et al. (1994) examined the relationship among strategy, technology, expertise, and innovation in the financial services sector.

Banks acquire technology from both local and foreign sources. Such replication of resources may include the importation, imitation, and transfer of technology in tangible and intangible forms. However, the rate of resource replication will be determined and affected by attributes. For example, Pennings and Harianto (1992) argued that the innovation adoption decisions of commercial banks depend on their stock of skills accumulated over time, incorporating IT experiences and inter-firm relationships. This, too, needs to be adapted to the unique conditions in a specific country's financial and banking systems. Through this process, indigenous managerial and technological capabilities are developed and strengthened.

Banks also diffuse innovations. This process occurs within and among them, and also includes other payment participants such as business firms, government agencies, and even households. The decision to diffuse a specific innovation may vary among the types of banks. For example, this may be progressive for commercial banks which aim to profit from introducing new payment services and to maintain a technological advantage over their competitors. Alternatively, this may be more cautious for central banks which aim to maintain stability, security, and reduce risks in the payment systems.

6.1 Innovation in the Banking Sector

Information technology is central to all banks and after decades of ambivalence, technical infrastructure now universally receives strong senior management support. The case of Citicorp and the Bank of America provide two examples. At Citicorp, early attempts to develop automatic teller machines (ATM) in the 1980s were unsuccessful. However, the company's senior management, seeing IT as offering competitive advantage, provided full support. This led the bank to form a subsidiary company, following an agreement with another computer firm, which transferred around 30 of its technical staff to work at the bank's newly established company (Glaser 1988). This created the necessary human resource skills required by Citicorp in ATM development, contributing to an early-mover advantage over other commercial banks. More importantly, this enabled it to acquire and accumulate technological capabilities which are used for new product and services development. By the 1990s, Citibank, which is an affiliated company of Citicorp, changed its policy from making to outsourcing ATMs, despite its strong technological capabilities (Financial Times 1999). Moreover, it has developed and tested new financial services such as the Citibank Commerce, which is a new electronic commerce service made available to five Asian countries, including Hong Kong, Singapore, the Philippines, Australia and Thailand.

The Bank of America, like Citicorp, gained technological leadership through the support of senior-level management. McKenney et al. (1997) argue that three major types of individuals played key roles in introducing dominant designs for the bank's operation during the period 1958–1964. This included a non-technological "leader" who possessed a vision to introduce technological innovations, a "maestro" who fully understood the technological and business aspects of the company, and the "supertech" who are team members that work on the detailed managerial and technological tasks to fulfil the leader's vision. Such managerial support has been behind the development of innovative services such as the financial electronic data interchange and internet pilot project in 1994 (Segev et al. 1998).

Now we turn to our detailed study of the Thai commercial banks, which have also experienced a wide range of technological changes in face of financial liberalisation.[1] This has included the introduction of organisational changes through re-engineering programmes, the application of IT into current working processes, and the increased importance given to skilled staff in financial service development. Such changes, particularly in bank re-engineering, have received an impetus as a result of the country's financial crisis in 1997 that affected both government-owned and commercial banks (The Asian Banker 1997a).

In the case of government-owned banks, this has included the Government Savings Bank and the Government Housing Bank. In 1996, the Government Savings Bank, under new managerial leadership, introduced organisational changes which

[1] The study of innovation in Thai banks follows the 1997 Asian financial crisis up to 1999. As of 2008, some financial institutions noted in the case study have closed or merged with other entities. See http://www.bot.or.th for up to date information.

included the decentralisation of executive decision making powers to branch managers. Counter services were improved through the installation of on-line computers among all branches, and a credit scoring system was adapted from Bangkok Bank (Bangkok Post 1997a). In addition, the bank developed its financial IS, upgrading them to international standards (Money and Banking 1996).

In 1997, the Government Housing Bank installed its first ATM as part of its expansion strategy into electronic banking. The bank contracted T.N.-Nixdorf Computer to provide 20 machines in 1997 and 52 machines in the following 5 years. At the same time it applied for network membership in the TBA, permitting the bank's 800,000 customers to gain access to over 3,500 ATMs located nation-wide (Bangkok Post 1997b). In 1997, the two government banks were also approached by T.N.-Nixdorf Computer to install 'elecTRA' terminals which was aimed to provide non-cash transactions services to customers through the Internet (The Nation 1997a).

In the case of commercial banks, technical changes have influenced large, mid-sized, and small-sized banks alike. Such changes experienced by the two latter groups are discussed in this chapter, while changes experienced by the large banks are examined in the following chapter. Three major changes may be observed among the mid-sized and small-sized commercial banks.

The first major change was in bank reengineering. Mid-sized and small-sized banks introduced reengineering programmes, aimed at improving organisational structures and banking operations. One of the main strategies, in contrast to the large banks, has been the identification of market niches in the industry, and the strengthening of capabilities to serve customers in specific areas. This has often involved the focusing of firm resources in a particular area of expertise. The Union Bank of Bangkok, for example, has mainly focused resources on retail banking to compete with larger banks. This was supported with newly developed on-line computer systems which provided fibre-optic and satellite connection between the commercial bank's head office and branches (Money and Banking 1997a). The bank was then able to establish benchmarks for its working processes. For example, the average time to process a customer ATM card application was set at approximately 10 mintues, while the withdrawal or deposit of cash was below 3 mintues (Bangkok Post 1997c). Alternatively, other commercial banks like Nakornthon Bank identified the firm's expertise in corporate banking, import-export, risk management, and technology acquisition. Elsewhere, Siam City Bank focused on a two-prong organisational strategy in both wholesale and retail banking services (Bangkok Post 1997d).

The second major change was in the acquisition and strengthening of skilled staff. This development was part of organisational restructuring programmes aimed to professionalise banking operations. Family-owned banks, for example the Bank of Asia and the Bangkok Metropolitan Bank, appointed professional bankers from both the central bank and other commercial banks to key managerial positions. Elsewhere, in 1997, the Bank of Asia appointed a former central bank governor as chairman of the bank. This development also included the appointment of another former central bank assistant governor who overlooked the commercial bank's internal auditing (Bangkok Post 1997e). Such recruitment strategies sought to acquire professional banking skills, particularly from former central bank officials, to strengthen the managerial capabilities of the bank.

The Bangkok Metropolitan Bank also hired in banking expertise. The bank adopted an "open door" policy by appointing external experts to manage the organisation, which was largely owned by the Techapaibul family, as of 1997. In 1993, the bank appointed a former executive vice-president of the state-owned Krung Thai Bank as managing director, who had powers almost equivalent to the president's position. To deepen and balance its patronage links it also appointed a former president of the Thai Military Bank as executive chairman.

However, the bank failed to retain former senior-level bank executives. Prior to the new appointments, the bank acquired banking experts, including a former central bank deputy governor and a former Government Savings Bank director general. Nevertheless, many senior-level executives left partly because the appointees experienced a lack of clear management roles and responsibilities, a legacy of control by family members (Bangkok Post 1997f).

Such recruitment strategies have partly helped banks adopt professional banking standards. The training of staff was also important. This included the introduction of new banking policies which preferred the training or retraining of current employees, as compared to the recruitment of new personnel. One of the main reasons is due to the monitoring of management costs introduced through the reengineering programmes.

The third major change was increased investments in IT. This was partly influenced by reengineering programmes. Technological developments within several mid-sized and small-sized commercial banks help illustrate such multi-million baht IT investment plans and projects. In 1997, Siam City Bank announced technological improvement plans, costing approximately 400 million baht (Money and Banking 1997b). This budget covered the improvement of computer network standards, the introduction of a business process improvement project, the implementation of a customer information system, the upgrading of software to support 24 hour ATM services, and the modification of an EXIMBILL system to support international trading activities. The plans included an investment of approximately 110 million baht on computer software upgrades for the bank's accounting system (Bangkok Post 1997g). The new computer system, called Oracle G/L, was adopted from the Union Bank of Switzerland and included capabilities such as the transmission of financial reports to the SET and the integration of internal management communication systems.

The Bank of Asia also introduced a 5-year reengineering programme, costing approximately 600–700 million baht which included the upgrading of current computer software and systems in support of retail and information services (Bangkok Post 1997h). This resulted in the bank reducing the recruitment of new employees and instead stressed the training of current staff. Since early 1996, the bank reduced its staff from 2,800 to 2,570 employees, emphasising the recruitment of new personnel with strong skills in marketing and IT. When the bank was acquired by ABN/AMRO in the post-crisis period, it introduced the Bank Station system, which was mainly an ABN/AMRO-built cash management service targeted at its existing multinational clients in Thailand (The Nation 1999a). By mid-1999, the Bank of Asia introduced other innovative services such as a new electronic loan origination system based on Lotus Notes technology (The Nation 1999b).

Nakornthon Bank invested approximately 300 million baht, from the early 1990s, as part of its technological improvement programme (Bangkok Post 1997i).

The bank's strength in technology acquisition influenced its ability to compete with larger financial institutions in niche markets and they gradually acquired more technology and expertise through foreign joint venture partnerships.

Bangkok Bank of Commerce also prepared an IT investment budget of approximately 200 million baht, as of early 1998 (Bangkok Post 1998a). One of the major objectives was to change existing computer and communications infrastructures among the bank's branches from a decentralised UNIX-based to a centralised client-server-based system. Part of the budget, of approximately 46 million baht, was set aside for implementing a branch automation system which aims to collect and analyse information from bank branches more effectively. The bank planned to develop customer and financial information systems which seek to contribute towards the development of telephone banking, office banking, and Internet-based banking services.

Bangkok Metropolitan Bank invested approximately 188 million baht in branch automation (Money and Banking 1997c). This includes the installation of seven to eight personal computers in the front and back offices of branches which are connected to a BMB communications network. This network includes direct computer connections between metropolitan-based branches and the bank's head office, as compared to satellite connection between provincial branches and the head office. The bank also enhanced existing ATM systems to support credit card transactions originating from international credit card companies such as Master Card, and has developed EFTPOS with other third parties. In addition to ATM developments, the bank went forward with plans to introduce innovative financial services such as advanced loan systems, telephone banking, and Internet-based banking services.

Laem Thong Bank, which is the smallest commercial bank in terms of network and customer base, partnered with a local telecommunications company to provide electronic banking services (Bangkok Post 1997j).[2] This partnership strengthened the commercial bank's technological base by providing a competitive range of retail banking services. This included the planned introduction and adaptation of existing telecommunications infrastructure to provide new delivery channels for payment services through the Internet, call centre, electronic information kiosks, and even services delivered through a network of convenience shops (Bangkok Post 1997k). Around 2,000 ATMs were installed nation-wide, covering 240 convenience shops owned by the United Communications Industry, and 1,500 service stations owned by the national petroleum organisation (Bangkok Post 1997l).

These cases illustrate some significant developments in the commercial banking industry. Banks in the medium and small-sized categories have adopted IT to increase efficiency and to provide innovative financial products and services. Although their size is small in terms of assets or branch networks, they are using IT as a base to gain competitive advantage, particularly in the provision of payment services. For innovators the main question was how to source such technologies, and how to transfer and replicate them among the banks.

[2] In 1997, the bank increased its capital at 2.9 billion baht. Part of the new shares was acquired by United Communication Industry (20 million shares), Multimedia and Services Company (15 million shares) and Total Access Communications (15 million shares). The latter two firms are subsidiaries of United Communication Industry (UCOM).

One main source of technology is from computer and consulting companies. Such companies, which are mainly foreign-based, develop and distribute new technologies though their local joint venture firms or subsidiaries. For example, in 1997, General Asia Bank adopted a customer servicing software called Alliant from Fiserv, a foreign financial software house. The computer system, which is part of an 800 million baht 5-year IT investment plan, was adapted from similar installations in Birmingham's Midshire Building Society and the Prudential Bank, based in the United Kingdom (The Nation 1997b). International computer companies, for example Hewlett Packard, also partnered with local systems integration firms to promote and provide data warehousing services to commercial banks (The Nation 1997c). General Asia Bank also developed Internet-based banking software for local commercial banks which was distributed through its local subsidiary, Security First Technologies (The Nation 1997d).

The introduction of smart card technology by international card-issuing organisations into Asia also illustrates this point (The Asian Banker 1996). The best early example of this is the marketing and development of the Mondex smart card programme by a joint-venture partnership in Asia between Master Card International and the Hong Kong and Shanghai Banking Corporation (The Nation 1997e). This joint-venture agreement created a strong strategic partnership between the marketing and technological expertise offered by each firm which subsequently took them beyond the Mondex programme.

This overview provides the background to the survey that was conducted to identify how banks acquired, adapted, and advanced technologies to provide innovative payment services. To provide a general overview of technologies used in the banking industry, IT usage and awareness levels are listed in Figure 6.1. These technologies and systems were selected to identify and assess new delivery channels for providing payment services by the banks.

The survey results suggest wide usage of key technologies in the commercial banking industry. The aggregate results indicate that 48% of the banks used the technologies and applications, 30% had planned to use them, 20% were aware and only 2% were unaware. The results also suggest progressive IT plans among the banks in introducing new types of technologies, for example home banking (60%), smart card systems (50%), and Internet-based banking (50%).

The results also indicate the slow adoption of major technologies. The adoption of EDI provides one illustration. Although EDI services have been available in Thailand since the early 1990s, there remain unresolved problems that are beyond the scope of banks. First, the government was slow to establish a national EDI service provider. Although an EDI feasibility study for international trade was commissioned in 1993 and completed in the following year, the final decision to establish a national EDI service provider, named TradeSiam, was not reached until 1997. Furthermore, international value added network service providers like IBM, which operated similar services, regarded the government's set-up of a national EDI service provider as the monopolising of such services in the country. The government's slow move towards the establishment of this service provider and the criticisms made by similar service providers both played a part in inhibiting the early adoption

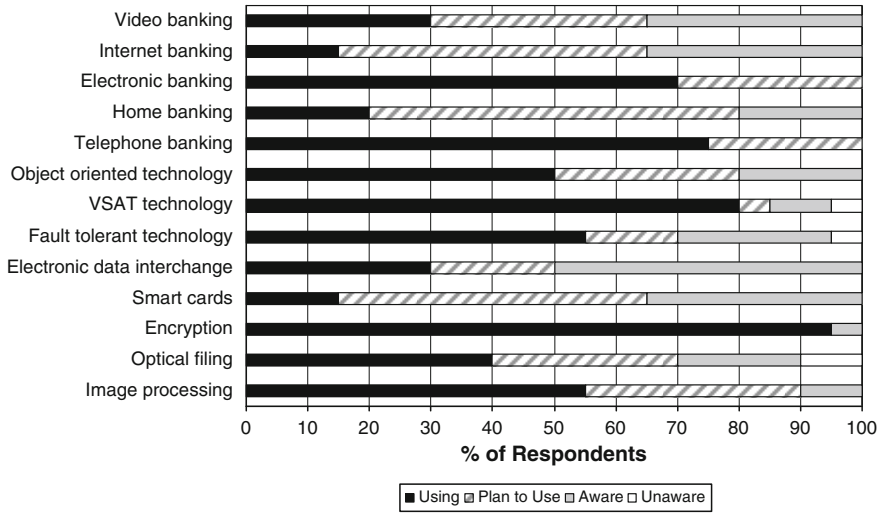

Fig. 6.1 IT usage and awareness in the commercial banking industry

of EDI in Thailand. The banks were slow to adopt EDI for themselves because of such unclear developments between the public and private sectors.

Second, business enterprises have remained reluctant to take the risks of being early adopters of EDI. Nevertheless, several banks started to provide EDI services by the end of the 1990s, as illustrated in Figure 6.1. Such services take the form of financial EDI, involving the exchange of payment details between the information systems of different trading partners. However, very few companies have used this service which is partly due to the speed of technological changes outpacing legal changes in the country (Bangkok Post 1997m). This is a common problem faced by commercial banks in the European Union and the European Free Trade Association countries in adopting financial EDI (ANA 1993).

In sum, three major changes occurred in the Thai banking industry: the introduction of wide-ranging reengineering programmes, the acquisition of managerial capabilities, and increased investments in IT. The survey results suggest relatively high IT usage and awareness levels among the commercial banks, although they were slow to adopt advanced applications, particularly EDI. Such multi-million baht investment plans and projects focused on payment automation and associated payment services development.

6.2 Payment Automation

This section summarises the survey results which identified the level of payment system automation among the commercial banks. These systems were selected to examine their level of preparedness in relation to the development of three major

payment systems by the central bank which include wholesale and retail payment systems. The characteristics of commercial bank payment routines were assessed based on the level of computerisation, the sources of computer software, and the make or buy origins of the computer software accordingly.

The introductory dates of commercial bank payment services are indicated in Table 6.1. Payment services have become an alternative area for commercial bank sources of fees-based income, particularly in the form of transaction cost incurred by parties transferring funds among financial institutions, business enterprises, government agencies, and individuals. This includes, for example, charging high transaction fees for high-value but low-volume financial transactions and vice versa.

Thai banks gradually improved their payment processes. In the early periods of introduction, payment services were primarily paper-based and involved manual processing and handling. Since the first introduction of computers for the batch processing of customer data in the early 1970s, Thai banks gradually applied IT to automate other banking functions. This has been particularly important in the automation of routines in payment services.

Table 6.1 Dates of bank establishment and payment service introduction

Bank	Birth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
B1	1944	1973	1979	1986	1982	1996	1984	1979	1989	1989	1994
B2	1945	1984	1984	1984	1984	1990	1992	1995	ND	ND	ND
B3	1966	1966	1984	1990	1992	1996	1996	1984	1990	1990	1994
B4	1906	1982	1988	1994	1992	1983	1995	1983		1994	1991
B5	1957		1987	1987	1988	1995	1997				
B6	1934		1996		1990	1997	1996	1990			
B7	1950	1985	1990	1997	1990	1996	1996			1997	1997
B8	1949	ND	1992		1992	1996	1996	1988			1988
B9	1944	1990	1991		1990	1995					1990
B10	1941	1988	1991	1991	1991	1996	ND	1994	1996	1996	1995
B11	1949	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B12	1945	1987	1987	1990	1990	1996	1994	1987	ND	ND	ND
B13	1933	ND	ND		1990	1995	1995				
B14	1939	1996	1993	1997	1993	1996		1993			1994
B15	1948	1996	1996		1993	1997		1986			1994

Notes: ND – Service offered but no dates provided
(1) Cashing cheques
(2) Salary payment
(3) Dividend payment
(4) Utilities payment
(5) Interbank funds transfer
(6) Third party funds transfer
(7) International payment
(8) Securities (bond) payment
(9) Securities (stock) payment
(10) Managing foreign exchange

6.3 Payment Routines

The role of routines in innovation was introduced in Chapter 2. Routines were defined as sources of skills, which when changed, contribute to innovation (Nelson and Winter 1982). The scope of routines in our study is focused on payment processes which can be grouped into retail and wholesale systems accordingly. Retail payment routines are characterised by recurring high-volume but low-value financial transactions and entail the processing of personal cheques, salary payment, dividend payment, utility payment, and third party funds transfer.

Wholesale payment routines, in contrast, are characterised by low-volume but high-value financial transactions such as the processing of high-valued cheques between businesses, the transfer of funds between financial institutions, international payment, securities payment, and the settlement of foreign exchange transactions. This may also involve the transfer of large amount of funds between governmental bodies in the financial system.

This classification, however, is not exclusive. The transaction volumes and values of some payment services vary, for example in third party funds transfer systems, and may be represented in both groups. One of the main objectives of the survey was to identify the sources of innovation in ten types of payment routines. The mode of payment routines operated by Thai banks, as of 1997, is illustrated in Figure 6.2. Three modes are identified, namely manual, partly computerised, and fully computerised payment routines.

The aggregate results suggest that the majority of payment routines were completely computerised (51%). This was particularly true for payment routines which

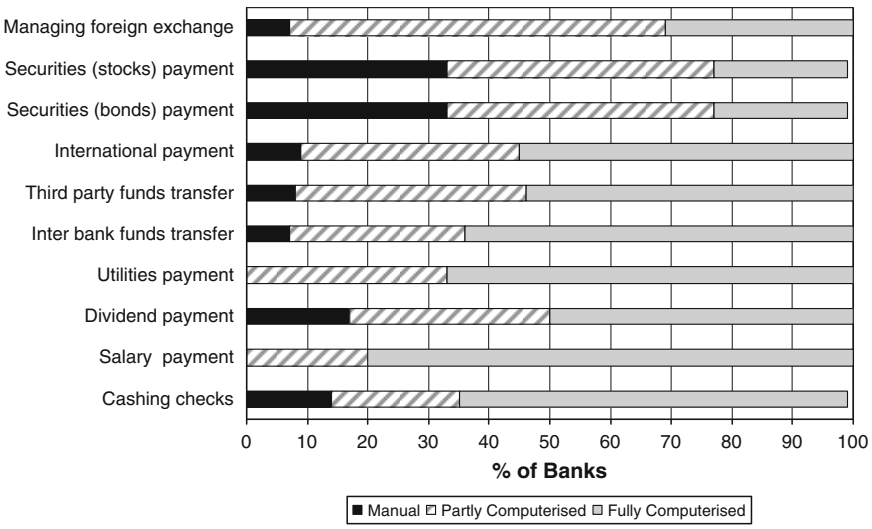

Fig. 6.2 Mode of payment routines

involved the cashing of cheques (64%), salary payment (80%), utilities payment (67%), inter bank funds transfer (64%), international payment (55%), and third party funds transfer (54%). The results also suggest the slow introduction of IT in other payment routines, such as in securities payment which have only started to be computerised by the banks and the central bank as of 1997.

The survey results further suggest that the sources of commercial bank computer software were mainly custom-made. This is indicated in Figure 6.3, and includes the development of payment systems tailored for individual requirements among a majority of the banks (52%), particularly in salaries payment (11%), utilities payment (11%), and foreign exchange management (8%). The results also indicated a majority of banks used packaged computer software, particularly in international payments (80%), inter-bank funds transfer (50%), and third party funds transfer (50%). The sources of computer software packages originated from standardised SWIFT messaging systems in the first system and from the central bank in the latter two systems.

The aggregate results also suggest that the banks have strong capabilities in developing payment systems. Figure 6.4 indicates the majority of banks have developed their computer software for payments in-house (66%), while a small number have purchased them (34%). A large number of banks have relatively strong systems development capabilities, particularly in salaries payment (93%), dividends payment (80%), and utilities payment (86%).

The survey results suggest relatively strong technological capabilities among the commercial banks. The majority of the payment systems developed were custom-made and developed in-house. This indicates commercial bank capabilities in the development of information systems and the decreased dependence upon external

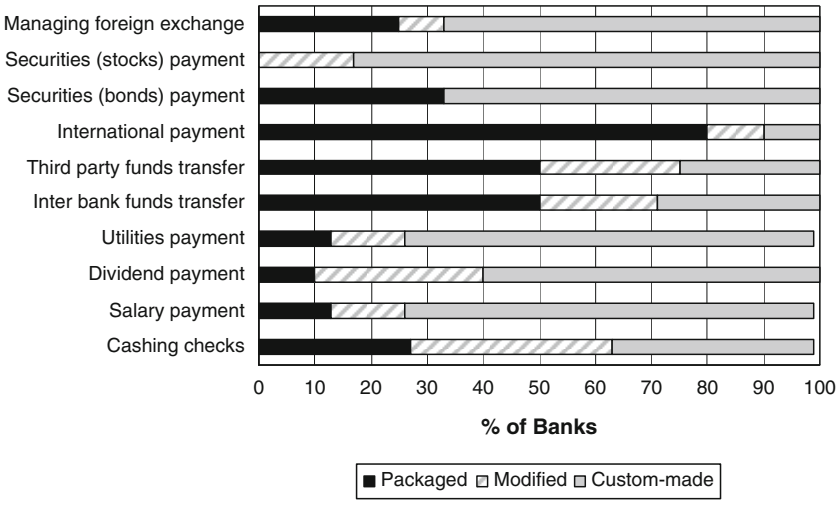

Fig. 6.3 Sources of computer software

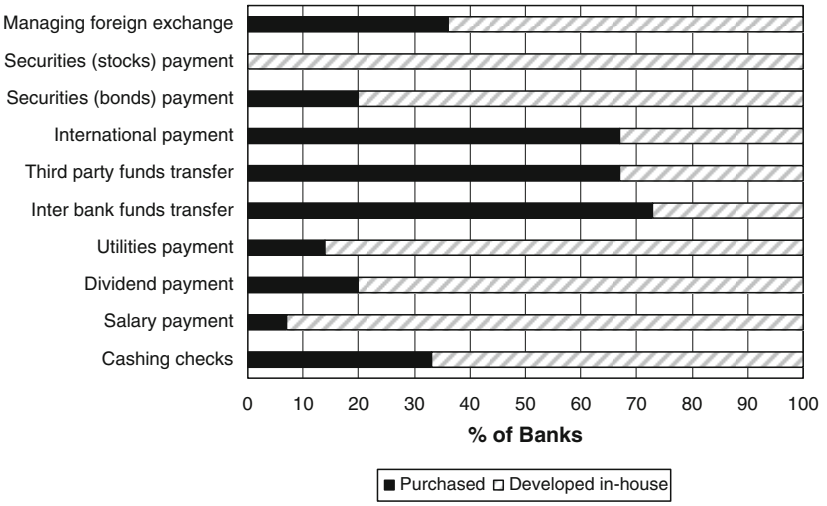

Fig. 6.4 Software purchased or developed

sources of computer software. The payment systems, however, have largely been systems for recurring payments, particularly for salaries and utilities payments. Such types of payment systems are less sophisticated, as compared to the development of securities settlement systems and international payment systems.

The central bank helped strengthen these technological capabilities. The development of three main payment systems contributed to the integration of commercial bank computer networks which were originally private or co-operative on-line systems. This reduced investment cost and enhanced the existing capabilities of present payment systems. For example, the development of BAHTNET permitted the transfer of funds between commercial banks or third parties without payment participants having to maintain multiple bank accounts.

In sum, the survey results suggest that a majority of payment routines were fully computerised. Most of the computer software supporting these systems was custom-made and developed in-house. At the aggregate level, these indicators suggest that the local commercial banking industry have relatively strong capabilities in developing payment systems. These sources of capabilities are further identified in the following section.

6.4 Innovative Capabilities

This section summarises the survey results which identified the sources of capabilities in the commercial banking industry. Sources of capabilities may involve the transfer of technology through formal and informal channels. Formal channels may

include the transfer of technology through direct foreign investment, wholly owned foreign subsidiaries, foreign controlled joint-ventures, on-the-job-training, and other related sources. This group can also include internal or external transfers. Internal transfers are characterised by, for example, the flow of knowledge from foreign investors and experts to a local work force within foreign subsidiaries or foreign controlled joint ventures. External transfers occur through the spread of technology from international commercial banks to their domestic counterparts.

Informal channels may include the transfer of technology through unpackaged mechanisms. This transfer of technology takes the form of published information, trade exhibitions, international conferences, technology contracts with foreign consultants, turnkey arrangements, and other related sources. The scope of technology involved in both formal and informal channels is non-deterministic and encompasses both tangible and intangible forms of technologies. These technology transfer channels form the sources for acquiring, building, and strengthening commercial bank capabilities.

6.4.1 Indicators of Innovation

The survey identified three broad-level indicators of innovation. The statistical averages helped determine the strengths and weaknesses within each category of questions. The first group of indicators was information which influenced new product and service development. This was categorised as sources originating from companies, customers, competitors, and included information acquired through the training and travel of bank staff in foreign countries and companies, local and foreign customers and competitors, related sources such as bank overseas representative offices, and joint venture contracts with both local and foreign counterparts.

The second group of indicators was learning mechanisms. Four main mechanisms were identified, including private, foreign, governmental, and other sources. The main sources of innovation included commercial bank technical agreements and assistance, the working experiences of bank staff, the use of computer companies, and the contracting of consulting companies. The other important sources of technology included quasi-governmental institutions and associations like NECTEC, TBA, and SET.

The third group of indicators was technological capabilities. This included the identification of strengths and weaknesses in acquisitive, operative, adaptive, and innovative capabilities among the banks. These four levels of capabilities help determine the level of commercial bank capabilities in each category. Commercial banks have higher levels of technological capabilities, provided that they have relatively strong innovative capabilities which are characterised by their ability to conduct R&D and make major modifications with technology. To begin, the survey results for sources of bank information are illustrated in Figure 6.5.

6.4.2 Sources of Information

The first group of innovation indicators was sources of information. The majority of banks ranked these sources positively which influenced new product and services development. The average percentages, as indicated in Figure 6.5, were relatively high for each main category of information, namely competitor (65%), company (44%), customer (43%), and other sources (42%). The survey results also suggest that these sources were relatively important factors in creating

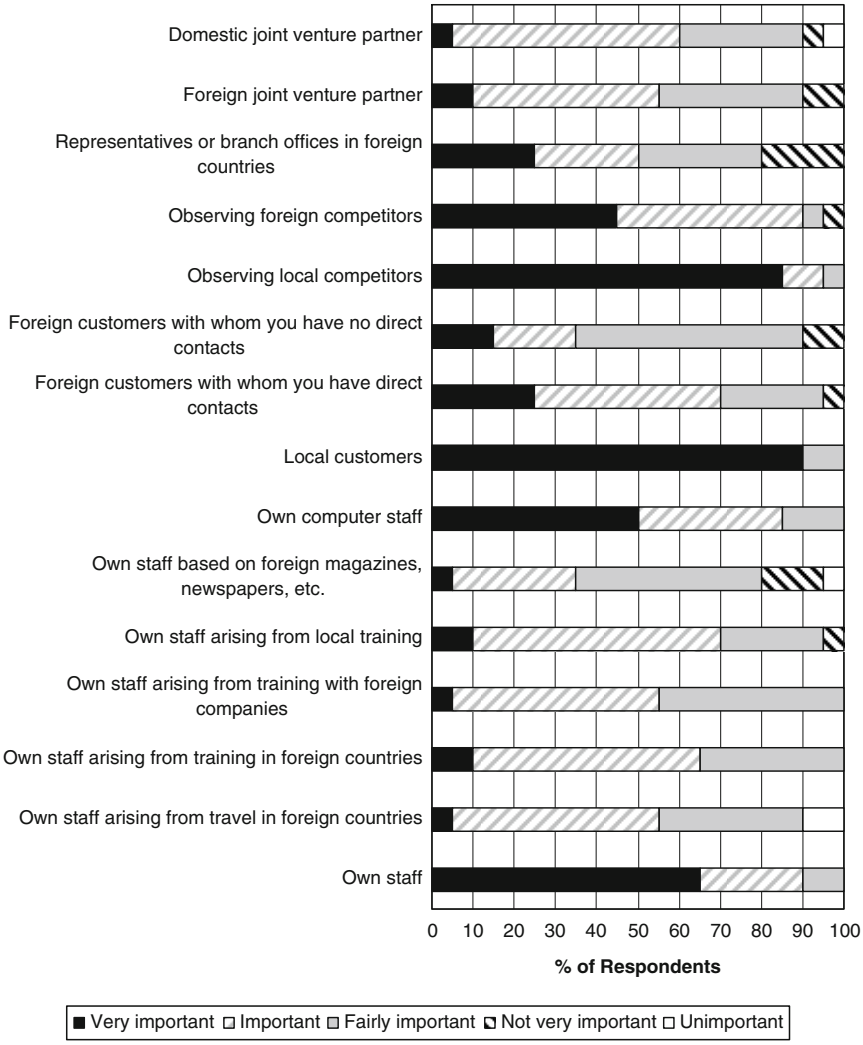

Fig. 6.5 Source of information

capabilities and formed the basis for new financial services development. The strengths and weaknesses within each main category can be examined in their sub-categories.

The first source of information was from within the companies. In this category, the sources of information was the strongest from staff (65%), being mainly based on computer staff (50%). The strengthening of staff skills was strongly influenced by training in the country (60%), training in foreign countries (55%), travel in foreign countries (50%), and training with foreign companies (50%). The survey results also suggest that bank personnel contributed towards acquiring information for their organisations, whether they may be through training or travelling.

The second source of information was from customers. In this category, the source of information was strongest from Thai customers (90%). However, these sources were relatively important for foreign customers who were indirectly connected (55%) and directly related (45%). The survey results suggest the high consideration given by the banks to customers. In some banks, for example Siam Commercial Bank, this has led to customer-based business process management.

The third source of information was from competitors. In this category, the sources of information were strongest from the observation of Thai competitors (85%) and relatively strong from foreign competitors (45%). For example, Cash and Mookerjee (1990) studied how KASIKORNBANK (formerly Thai Farmers Bank) created competitiveness from a newly developed information system in response to its domestic competitor, Siam Commercial Bank, which, in the early 1980s, was the first Thai commercial bank to introduce ATM systems.

The last source of information was from miscellaneous places. In this category, the sources of information were relatively important. The strong sources of information included local joint venture partners (55%) and foreign joint venture partners (45%). There were, however, some interesting developments. For example, Siam Commercial Bank benefited indirectly from its joint venture partnership with a semi-autonomous organisation called the National Science and Technology Development Agency (NSTDA). This helped promote the transfer of managerial and technological capabilities from foreign firms to local companies, including the commercial bank itself.

6.4.3 Sources of Learning

The second group of indicators was sources of learning. This included the acquisition of technical and managerial knowledge which influenced new products and services development. Such sources of "know-how" form the basis of introducing innovative banking services and were grouped into four main categories. The first source of learning was from private sources in Thailand. This is illustrated in Figure 6.6. In this category, the overall ranking for the sources of know-how was important (48%), and mainly included sources originating from technical assistance with local joint-venture partners (60%). The sources of learning from staff

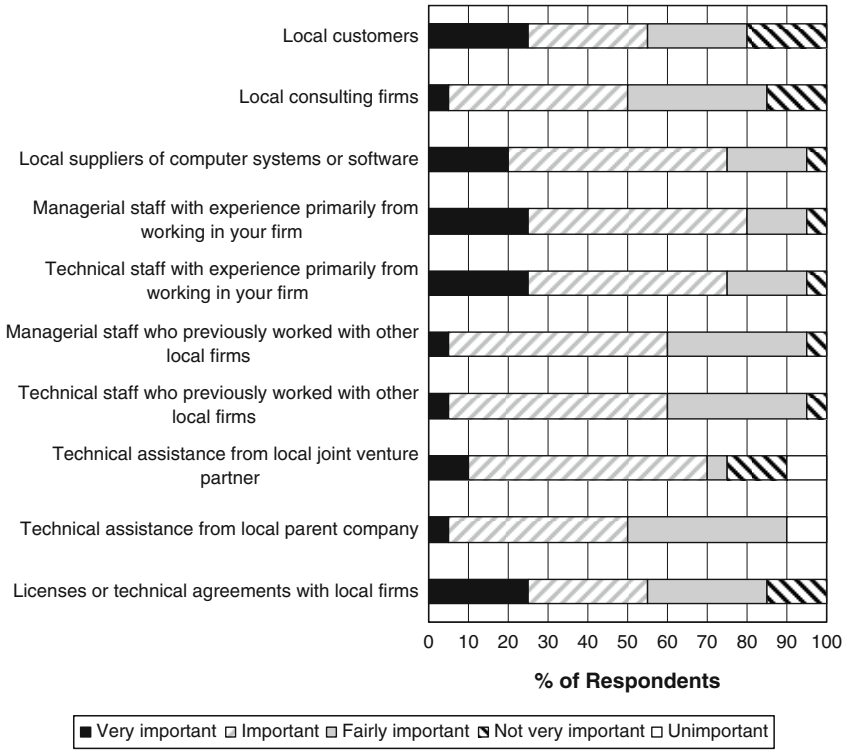

Fig. 6.6 Private sources of learning

were equally important. This included technical staff who have acquired working experiences in other companies (55%), and technical staff who have accumulated working experiences from the company (50%).

The indicators were similar for managerial staff. This included managerial staff who have acquired working experiences in other companies (55%), and managerial staff who have accumulated working experiences from the company (55%). Other important sources included the acquisition of know-how from local suppliers of computer systems and software (55%), and to a lesser degree source of learning from local consulting firms (45%).

The survey results suggest the importance of skilled staff. Rankings in technical and managerial staff were relatively similar. First, the commercial banks have attracted skilled technical and managerial staff, for example from the central bank or other computer companies, although this may not be explicitly stated in their policies. Second, policies have promoted the improvement of staff skills through training centre, rather than increasing employment.

The second source of learning was from foreign sources. This is illustrated in Figure 6.7. In this category, the overall ranking for the sources of know-how was also important (50%), mainly including sources from foreign consulting firms

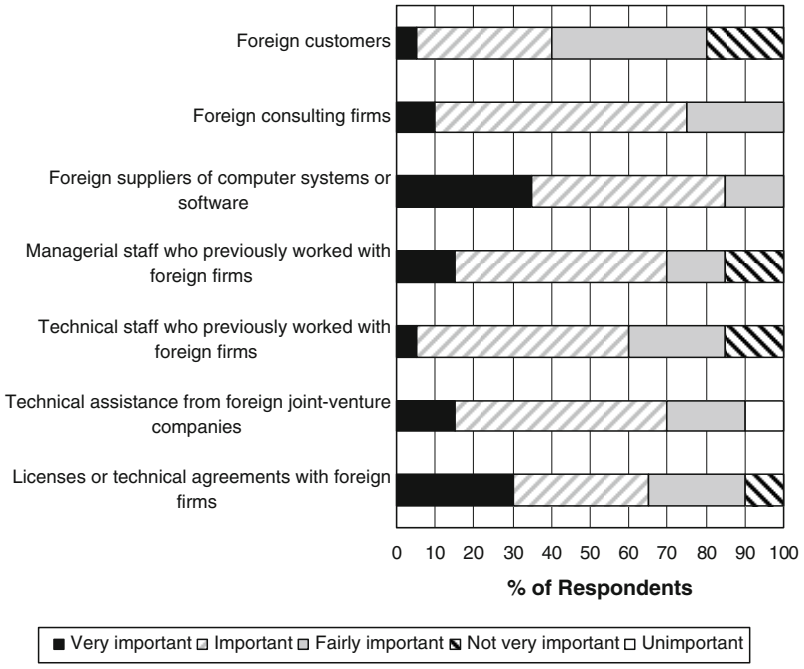

Fig. 6.7 Foreign sources of learning

(65%). The other main sources of learning were from technical assistance from foreign joint-venture firms (55%), technical and managerial staff who have working experience with foreign firms (55% respectively), and lastly, foreign suppliers of computer systems and software (50%).

The survey results suggest the reliance on foreign sources of technology. For example, commercial banks have entered into co-operative agreements with international credit card companies and foreign commercial banks to provide more innovative and competitive financial services and have hired foreign consulting firms to advise on the formulation of technology policies, strategies, and the re-engineering of banking operations.

Government provided a third source of learning. This is illustrated in Figure 6.8. In this category, the overall ranking for the sources of know-how was not very important (29%). The weakest sources of knowledge were from staff with acquired working experiences from other government agencies (55%) and licenses or technical agreements with government firms (40%). Similarly, the sources of learning were also relatively important for technical assistance from key government ministries (40%), and government joint venture partners (40%).

Two government sources of know-how, however, were ranked as very important. This included the sources of know-how acquired from the Bank of Thailand (50%) and the Ministry of Finance (35%). Senior level officials from the Ministry of Finance and the central bank have played key roles in advising and sometimes

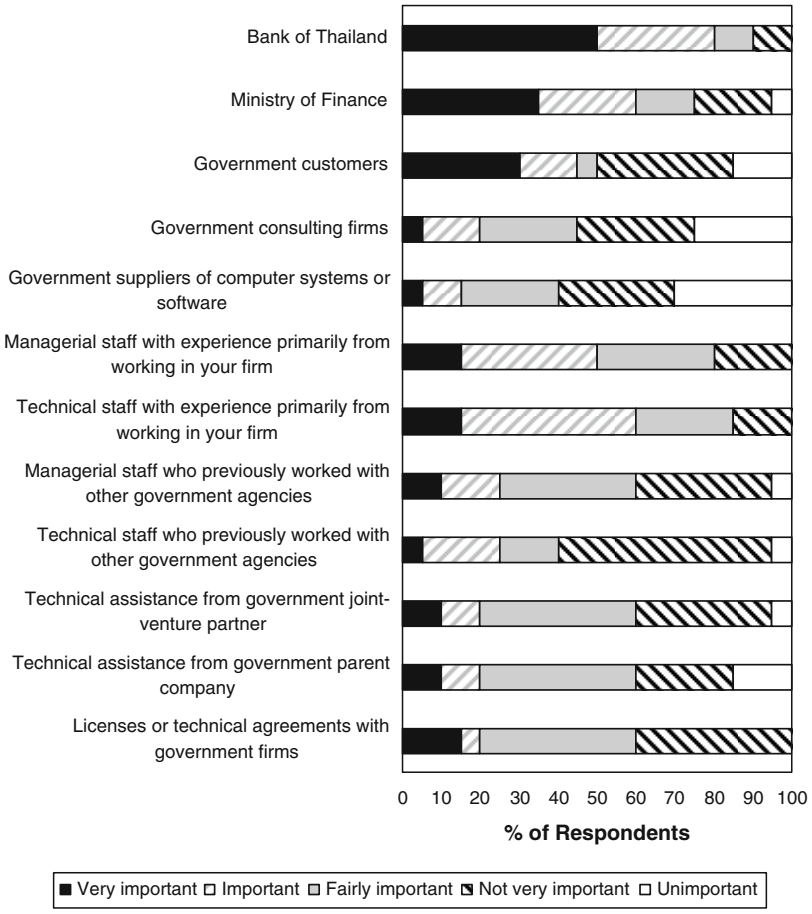

Fig. 6.8 Government sources of learning

managing Thai banks. The Bank of Thailand, in particular, has played a leading role in supporting Thai banks in the modernisation of the national payments system.

The survey results suggest the weak role of government as a source of know-how. Nevertheless, there was also an indication of a strong role to be played by both governmental and quasi-governmental institutions in IT innovation. For example, commercial bank non-cooperation in the development of a national payment system led the central bank to take a leading role in investing, developing, and managing a new electronics payment system. The central bank helped develop the necessary computer software systems and trained payment participants, including the major financial institutions accordingly.

Figure 6.9 lists three other sources of learning. In this category, the overall ranking for the sources of know-how was important (40%). There are many other important sources of know-how in Thailand. This includes, for example, key

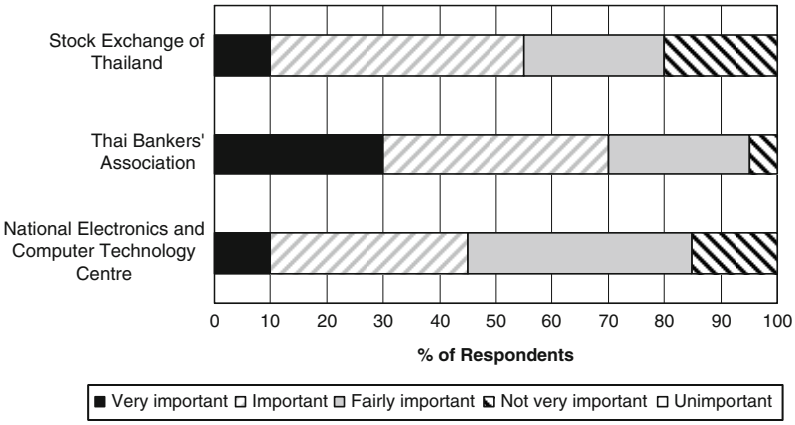

Fig. 6.9 Other sources of learning

quasi-governmental institutions and associations that have interest in the use of IT for payment system development. This mainly included the SET (45%), the TBA (40%), and to a lesser extent NECTEC (40%).

These institutions contribute towards innovation both explicitly and implicitly. The SET, for example, developed and operated an automated securities system called ASSET. The TBA represents the interests of Thai commercial banks such as in the raising of ATM service fees to recover increased operational costs. NECTEC is a leading quasi-governmental institution which has helped promote the use of IT nationally, including applications in the financial services area.

6.4.4 Sources of Technological Capabilities

The third group of innovation indicators was sources of technological capabilities. Building technological capabilities among the banks is a function of identifying the strengths and weaknesses in the sources of information and the main sources of learning which contributed to new product and services development. The survey identified four main categories of commercial bank technological capabilities which are summarised in Figure 6.10.

The first category was acquisitive capabilities (AC-C). This indicated a commercial bank's ability to search, negotiate, and procure relevant technologies, in addition to being able to transfer, install, and assess their operational know-how accordingly. The acquisitive capabilities of the commercial banks were ranked as strong (50%), particularly in the negotiation for technology (60%) and the procurement and assessment of technology (50% respectively).

The second category was operative capabilities (OP-C). This indicated a commercial bank's ability to operate, control, and maintain computer and telecommunications

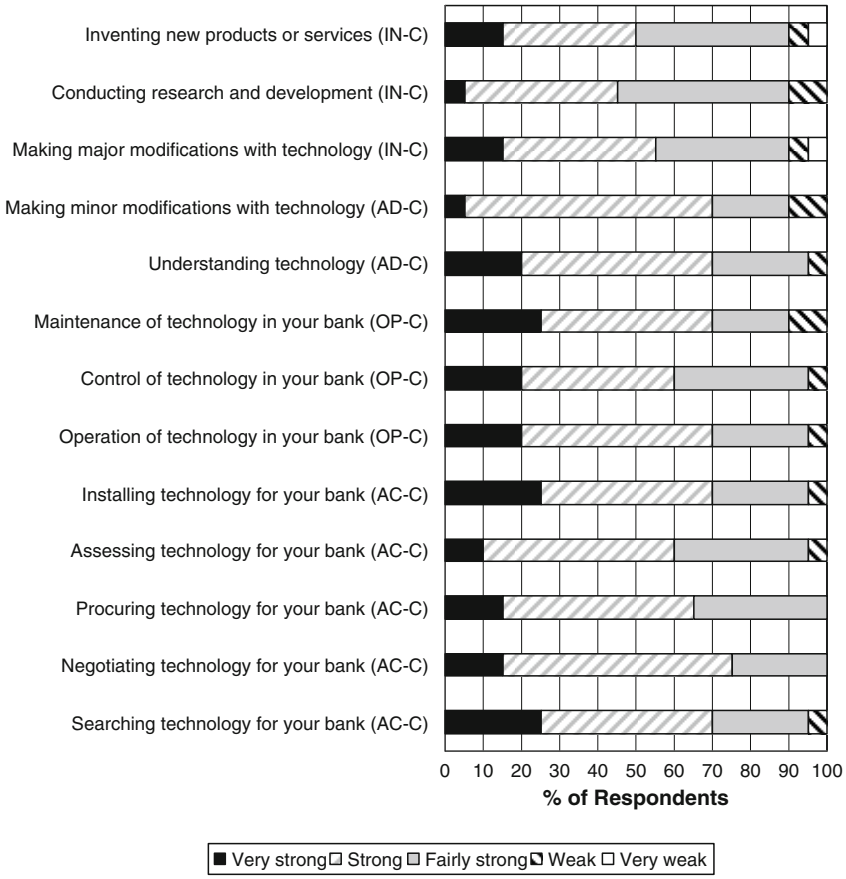

Fig. 6.10 Sources of technological capability

equipment efficiently. This also included the provision of quality control in terms of IT standardisation in the commercial banking industry. The operative capabilities of commercial banks were also ranked as strong (45%), particularly in the operation of technology (50%).

The third category was adaptive capabilities (AD-C). This indicated a commercial bank's ability to acquire know-how, absorb technology, and carry out minor modifications of existing information technologies and systems. The adaptive capabilities of commercial banks were also ranked as strong (58%). This includes the abilities to make minor modifications with existing technology (65%) and to understand technology (50%).

The last category was innovative capabilities (IN-C). This indicated a commercial bank's ability to perform its own R&D, and also involves major modifications or inventions to create innovative financial products and services. The innovative capabilities of commercial banks, in contrast to the three preceding types of capabilities,

were ranked as fairly strong (40%). Although the survey results indicate strong capabilities in making major modifcations with technology (40%), the commercial banks remain to have relatively strong R&D capabilities (45%).

The survey results suggest relatively strong technological capabilities in the banking industry. This mainly included the categories of acquisitive, operative, and adaptive technological capabilities. The survey results, however, also indicated relatively weak innovative technological capabilities. Although the banks have strong capabilities in adapting existing information technologies and systems to suit local conditions, such capabilities were limited to minor modifications. Alternatively, the major modifications were constrained, in part, by slightly strong R&D capabilities.

In sum, the survey results suggest the following. Firstly, customer and competitor sources of information were major factors which contributed towards new product and services development among the banks. Secondly, private and foreign sources of learning mainly contributed towards new products and services development, as compared with government sources of learning. And lastly, the banks have relatively strong technological capabilities, except in their innovative capabilities.

6.5 Interpreting the Survey

Our interpretation is based on analysing resource replication in the context of banking and payment systems modernisation. We will first consider the role of IT and payment systems as physical resources, while later discussing the important role of skills in organisational and human resources, as a potential source of sustained competitive advantage among commercial banks.

6.5.1 Replication of Technology

The replication of resources played a major part in influencing innovation in the commercial banking industry. This replication was mainly focused on major investment plans and projects in relation to using IT to increase operational efficiency, improve services, and gain competitive advantage. Table 6.2 summarises how a group of selected medium and small-sized commercial banks have gradually replicated IT, as suggested from a review of each commercial bank's budget.

Theoretically, the rate of replication of physical resources is relatively higher than organisational and human resources. Three major types of replication are illustrated in Table 6.2. Firstly, there is the upgrading and enhancing of computer software to accommodate changes in user requirements, for example, in delivering 24-hour ATM services. Such modifications have been initially introduced by the larger commercial banks, as we will see in the following chapter. Secondly, there is the upgrading of current computer and communications infrastructure which is mainly aimed to support the automation of bank branches. And thirdly, there is the

Table 6.2 Summary of IT investments in selected commercial banks

Bank	Budget (millions of baht)	Period	Type of replication
Bank of Asia	600–700	1997	• Introduction of 5-year re-engineering programme • Upgrading of current computer software and systems in support of retail and information services
Siam City Bank	460	1997–1998	• Improvement of computer network standards • Introduction of business process improvement • Implementation of customer information system • Upgrading of ATM computer software • Upgrading of accounting computer software • Modification of EXIMBILL system
Nakornthon Bank	300	1990s	• Technological improvement programme
Bangkok Bank of Commerce	200	1998	• Changing of current computer and communications infrastructure • Implementation of branch automation system • Implementation of customer information system • Implementation of financial information system
Bangkok Metropolitan Bank	188	1997	• Branch automation • Enhancing ATM systems • Introduction of advanced loan system, telephone banking, and Internet-based banking
Laem Thong Bank	Na	1997	• Planned introduction of Internet-based banking services, call centre, satellites, and electronic information kiosks • Planned installation of 2,000 ATM machines nationwide, covering 240 convenience shops, and 1,500 service stations

Source: Bangkok Post, The Nation, Money and Banking, various issues
Note: na – not available

planned implementation of different types of IS and payment services. The latter two types of replication reflect the imitation of bank re-engineering programmes, which have been successfully introduced by the larger banks to gain competitive advantage.

The homogeneity and mobility characteristics of resources further explain this relatively high rate of replication. If computer hardware and software are widely available and purchasable, they have relatively high homogeneity and mobility.

This implies that commercial banks can purchase IT in the markets to gain competitive advantage. This is the case of Thailand. Alternatively, a commercial bank seeking to gain and sustain competitive advantage will need to acquire IT which is heterogeneous and immobile in the market. Such strategies, for example, may include the development of unique computer software, which is protected by copyright, and difficult to imitate or substitute by competitors. Teece (1986) calls this the "appropriability regime".

The unique commercial banking industry structure also shaped innovation. For example, the relative size of commercial banks influenced their objectives in investing in IT and systems. In Thailand, large commercial banks invested significant financial resources, as compared to their mid-sized and small-sized counterparts. This type of industry structure influenced the creation of technology leaders, whose successfully adopted innovations are replicated by technology followers through routines. The technology followers, which are reluctant to implement costly and risky technologies, adopt, apply, and advance these innovations at a later stage.

The survey results identified the introduction of IT into the major payment routines. This helped assess the preparation of commercial bank payment systems in relation to the development of three major electronic payment systems by the central bank. The survey results indicated a relatively high level of computerisation of payment routines, for which a majority was custom-made and developed in-house, suggesting relatively strong system development capabilities. This was clear in two areas.

First, a majority of payment systems were custom-made to suit commercial bank conditions. This was mainly due to the high importance given to the security and reliability in electronic payment systems which involve the development of confidential encryption systems. The survey results also suggest that the commercial banks acknowledge the inhibiting factors in purchasing packaged computer software or modified software due to the mismatch with local requirements which further indicated commercial banks initiatives in strengthening technological capabilities.

Second, a majority of payment systems were developed in-house. These early indicators suggest relatively strong technological capabilities in developing payment systems, as compared to the purchasing of packaged computer software from external sources. The survey results suggest that the commercial banks have built and strengthened such capabilities through the use of skilled staff who are technically experienced and well trained at the commercial bank training centre. Thus, a majority of commercial bank payment routines were automated. This indicated relatively high-levels of preparedness with regards to the modernisation of the country's payment systems.

The commercial banking industry also experienced structural changes through the impact of IT. Multi-million baht investment plans and projects suggested the potential of medium and small-sized commercial banks to gradually develop and strengthen their technological capabilities. For example, joint-venture partnerships with telecommunications and computer companies were a source of adopting advanced technology and expertise, and provided the necessary infrastructure for introducing innovative payment services. They also strengthened the unique niche positions of the medium and small-sized commercial banks.

Alternatively, the adoption of IT may not be a source of sustained competitive advantage for commercial banks. Some commercial banks may have achieved early mover advantages in the initial periods of introducing an innovative financial service, but such innovations were major targets for replication from competitors which seek to gain a competitive parity in the industry. To further illustrate this replication process, four major developments in the context of payment systems modernisation in Thailand are discussed.

6.5.2 Replication of Payment Systems

The first major development phase was private on-line systems. In the late-1970s, Bangkok Bank successfully installed on-line computer systems for its entire branch network in the capital. Prior to this achievement, the bank pioneered the first use of minicomputers in the mid-1960s, and introduced batch processing retail systems in the early 1970s. This early move to modernise the commercial bank's services helped increase its competitive advantage and banking leadership in the early 1980s. However, Bangkok Bank's major technological breakthrough was soon replicated by other commercial banks who also implemented their own private on-line computer systems.

The follow-up innovation was the development of ATMs. Bangkok Bank, however, did not pioneer this development. Instead, the initiative came from Siam Commercial Bank which was regaining its leadership rankings in the industry after falling from the first position it maintained in the early 1960s. Siam Commercial Bank embarked on an aggressive strategy in its retail operations by introducing ATMs in 1983. This strengthened the use of private on-line computer systems, and once again, was also replicated by other commercial banks. The structure of the commercial banking industry started to change, whereby ATMs provided commercial banks competitive advantages in improved customer services, wider geographic coverage, and reduced investment and operational costs in bank branches.

This point is further illustrated with KASIKORNBANK. In response to these developments, particularly in the introduction of private on-line and ATM systems among the leading commercial banks, KASIKORNBANK adopted an aggressive strategy introducing information systems as a source of competitive advantage (Cash and Mookerjee 1990). The commercial bank studied the use of on-line branch and ATM systems in similar international commercial banks in the 1980s, and contracted a foreign consulting company to seek recommendations and to implement centralised computer systems. This replication of IT from a foreign supplier was seen as a source of competitive advantage during this period, and would later contribute towards bank-wide reengineering programmes.

The second major development phase was co-operative on-line systems. The growth in ATM systems and services, which was provided by different commercial banks, led to the development of co-operative on-line systems. These systems sought to share investment cost in infrastructure, for example in computer hardware,

computer software, and telecommunications equipment. Moreover, the shared network increased the availability and coverage of ATMs to customers of different commercial banks. The two national ATM networks, called Siam Net and Bank Net, were formed by two groups of Thai commercial banks, and provided interconnected ATM services for customers. These changes were considered minor, as banks were only required to make small modifications to existing computer software to provide the interconnection of services.

The third development phase was integrated computer networks. The central bank intervened in the development of a national payment system in Thailand, as commercial banks failed to reach a compromise in the share of investment costs and voting rights in the systems. This was aimed to interconnect the existing computer systems among different payment participants, including commercial banks, non-bank financial institutions, and other related parties. Such changes required major modifications, including significant investment costs in basic communications infrastructure, and the necessary computer hardware and software components.

This introduced three new major payment systems including BAHTNET, Electronic Cheque Clearing System, and Media Clearing (re-named SMART). As a part of its payment system initiative, the central bank further encouraged the TBA to develop an on-line retail funds transfer system. This system permitted commercial bank customers to conduct low-value but high-volume transactions on-line between different banks and branches through the existing ATM networks.

In developing the three major payment systems, the central bank gained co-operation from the leading commercial banks which have acquired early experiences in the implementation of on-line branch and ATM systems. This co-operation helped in designing a high-level payment system policy for the country's banking system and the central bank acquired recommendations from international aid agencies for policy recommendations related to risks and pricing, and also contracted foreign consulting companies to conduct feasibility studies and systems implementation.

The fourth development phase was the introduction of innovative payment services. In this phase, commercial banks have experimented with new delivery channels in providing banking and payment services. This has mainly included telephone banking, home banking, office banking, and Internet-based banking. In Internet-based banking, for example, the large commercial banks have started to conduct electronic commerce pilot projects, as we will discuss in the following chapter. If such developments are successful, they will, again, be major targets for replication by the medium and small-sized commercial banks. However, this may not be the case, as the latter two groups of commercial banks may focus their resources on niche markets, particularly in retail payments, and introduce low-cost, Internet-based payment services.

In sum, increased investments in IT have been perceived as a source of commercial bank competitive advantage. However, they are not a sustained source of competitive advantage. Technological developments in the banking industry suggest that a majority of commercial banks have commonly adopted this perspective. This was translated into IT strategies, which were in some cases part of a broader bank-reengineering

programme. Theoretically, this adoption of technology also suggests that the rate of replicating physical resources was relatively high. In such cases, commercial banks would have gained a competitive parity. In order for commercial banks to identify potential sources of sustained competitive advantage, the replication of skills, which are located within organisational and human resources, have become equally important in the study of innovation.

6.5.3 Replication of Skills

The replication of physical resources partly explained the transfer of tangible forms of technologies and is incomplete without addressing their intangible dimension. In this section, the discussion focuses on the role of organisational and human resources which represent the stock of skills within firms. Changes in commercial bank routines suggest that the routines are a source of innovation. The survey results examined these routines by identifying three major sources of commercial bank capabilities, including sources of information, sources of learning, and sources of technological capabilities.

Theoretically, the replication rate of human and organisational resources is relatively lower than physical resources. The replication of skills is much more difficult to transfer than technology in physical form, involving the replication of re-engineering programmes, which are unique to individual institutions, and the replication of intangible resources, which may have a tacit dimension. This makes skills a potential source of sustained competitive advantage, as they may provide commercial banks with a unique type of resource which is not homogenous and immobile. For example, Mata et al. (1995) argued that managerial IT skills, as compared to technical skills, was a more important source of sustained competitive advantage. More importantly, the role of human resource innovations has become an important factor in adding value to commercial bank services (Keltner and Finegold 1996). Table 6.3 compares and contrasts between relationship-oriented and transaction-oriented strategies among banks.

This comparison further implies the importance of skill-based competition. Transaction-oriented strategies have a tendency to focus on investing large amounts of financial resources to acquire physical resources in the form of IT. Such strategies underplay the importance of human resources as a unique source of competitive advantage. Alternatively, relationship-oriented strategies have a tendency towards investments in human resource development, in addition to IT. Such strategies seek to create commercial bank capabilities in order to gain and sustain competitive advantage.

Bank personnel were a major factor which contributed towards new service and product development among the commercial banks, as suggested by the survey results. This was particularly the case of computer staff. Through their training and travel in the country, and more importantly, in foreign countries and companies, they were exposed to new ideas, and in the process, acquired technical skills and

Table 6.3 Comparison of relationship-transaction-oriented banking strategies

	Relationship-orientation	Transaction-orientation
Competitive principles	Customising and advising 'one-stop' service	Price competition Self-service
Use of IT	Medium investment in IT IT complements human capital	Heavy investment in IT IT replaces human capital
Skill and staffing needs	Broad skills Low employee turnover	Job-specific skills Interchangeable employees
Job design	Broad job responsibilities Non-standard transactions	Narrow work tasks Standardised transactions
Training	Self-directed learning Modularised training programme	Limited frontline training Front-loaded graduate training
Recruiting and promotion	Competence-based career ladders Priority on internal recruiting	Limited upward mobility Heavy external recruiting

Source: Adapted from Keltner and Finegold (1996, p 60, 65)

know-how. Comparatively, the reliance on published information was fairly important, for example through the reviewing of foreign magazines and newspapers.

Theoretically, although bank personnel acquired skills through these learning mechanisms, they are relatively difficult to articulate among individuals. Bank sponsored seminars that are organised to transfer such skills among other bank employees may be partly successful, as unique working experiences may have been acquired through learning-by-doing by individual staff, and moreover, is far more difficult to codify or articulate in simple and well-understood language.

The role of managerial and technical staff in contributing towards commercial bank capabilities was rated as equally important. This was the case of staff who acquired skills from working within the commercial bank, and working in other local and foreign firms. However, the contribution of managerial and technical staff from the government sector was rated as fairly important, and in some cases, such as technical staff who worked with other government agencies, not very important.

Such a situation suggests that the stock of managerial and technical skills within the government sector are relatively less competitive, in terms of professionalism and technological sophistication, as compared with the private sector. Our survey results suggest that personnel movement within the commercial banking industry is relatively stronger among firms in the private sector, as compared to the government sector. However, this may not always be the case, as commercial banks may seek to acquire personnel who have worked within government agencies to strengthen contacts with the government sector.

Thus, the survey results support the importance of skilled staff among banks. Comparatively, the replication of staff skills is much more difficult than IT. Theoretically, the replication rate of human resources is relatively lower than physical resources. This further implies that difficulties in imitating intangible resources may be seen as a potential source of competitive advantage, as compared to their tangible counterparts. The more unique and scarce the skills embedded in bank personnel are, the more heterogeneous and immobile such resources become, which is one of the preconditions for firms seeking to gain and sustain competitive

advantage. Thus, the successful shift from transactions-oriented to relationship-oriented banking strategies would partly depend on the development of human resources.

In sum, the survey results suggest relatively high usage and awareness levels of IT, particularly in the automation of payment systems. The identification of broad-level indicators of innovation further suggests that the banks largely depended on customers, competitors, and foreign sources of information and learning, as compared to company, private, and government sources. Although the replication rate of IT among the commercial banks was relatively high, the potential sources of sustained competitive advantage resided in the imitation of human and organisational resources which is further discussed in the following chapter.

Chapter 7
Capability Development: Commercial Banks

Abstract The competitive strategies of Thai banks during the transformative period brought some successes and some failures associated with payment systems. In this chapter we show how four banks, ranked among the largest in the world, devised and pursued innovation strategies. This allows us to contrast the competitive strategies of first movers, dominant market players, re-engineering leaders, and innovative state banks. The cases illustrate the relationship between innovation and banking leadership in the country. In the final section we assess the common characteristics of these approaches and present some lessons that can be applied by other commercial banks seeking to use IT to gain competitive advantage.

7.1 Siam Commercial Bank

7.1.1 The First Thai Bank

Siam Commercial Bank was officially established in 1906, following its transformation from a 'Book Club' set-up in 1904. The Book Club, which was a private trust, formed the modern basis of the bank, providing basic banking functions such as deposits, loan extensions, and foreign exchange. It was operated by local people and primarily served Thai and Chinese clients in the local business community. The bank became the first Thai commercial bank formed after the first foreign bank, Hong Kong Shanghai Banking Corporation, began operations in the country in 1888. Most importantly, it has served as a model for many Thai commercial banks in the early and modern periods. In 1996, the bank was ranked the fourth largest Thai commercial bank in terms of total assets, and the 211th largest international commercial bank (KTB 1997; The Banker 1997). The world rankings of international commercial banks are based on Tier One capital as defined by the BIS (www.bis.org). Tier One includes common stock, disclosed reserves and retained earnings, but excludes cumulative preference shares, revaluation reserves, hidden reserves, sub-ordinate and other long-term debt, which are defined as Tier Two capital.

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Siam Commercial Bank was an early experiment in Thai commercial banking. Prince Mahisararajaharuetai, a Royal Treasury Minister, introduced modern ideas acquired from Europe during the early 1900s in the Book Club. The prince initiated a pilot project to learn banking operations, for example in book keeping, credit extension, deposit taking, account clearing, funds transfer, and payment through cheque order. As a result, the bank pioneered a range of financial instruments, including the use of cheques, savings bank deposits, deposit at calls, and shipping guarantees.

The bank's formation years were characterised by skill acquisition. Thailand lacked banking experts, and more importantly, banking know-how. The building of managerial capabilities and skills in banking were learned and applied accordingly. During the transformation years, foreign commercial banks were invited to hold shares in a newly proposed commercial bank which was aimed at acquiring foreign technology to support international banking businesses. Among them included the Deutsch Asiatische Bank of Germany and the Den Danske Landmancls Bank of Denmark, which were invited to hold 330 shares and 240 shares respectively, of the total 3,000 shares in the new commercial bank.

The acquisition of banking know-how continues with the learning organisation concept adopted by the bank's chief executive officer (Senge 1990). This is further supported by the bank's strategy in developing knowledge workers who are 'enknowledged personnel performing quality work to best serve our customers' (SCB 1997). Bank restructuring based on the principle of customer-based business process management, has also contributed to a flatter organisation with small business teams capable of responding rapidly to customer needs.

7.1.2 Role of IT

Siam Commercial Bank has been progressive in the use of IT through senior-level management support which has helped shape its visions and strategies. For example, the active involvement of the chief executive officer has led to investments in data warehousing technology to learn more about the bank and, more importantly, customer information (The Asian Banker 1997b). Furthermore, the chief executive officer has clearly defined two main objectives in the use of IT: (1) to facilitate daily banking activities between the bank and customers, and (2) to develop new methods in delivering financial services (SCB Technologies 1996a).

More interestingly, the bank surprised the banking community in early-1998 by announcing an increased investment in its IT budget by 2–3% over its 900 million baht investment in the previous year (Bangkok Post 1998b). This was despite the country's financial crisis which caused a change in the exchange rate regime, the devaluation of the local currency, and the cutting of costs across companies. In response to the financial crisis, the bank established a non-profit organisation to serve as a job placement centre for potential employers and employees, while also providing language and computer training for unemployed IT professionals (Bangkok Post 1997n).

Such an aggressive strategy was well supported by the bank. For example, the bank's first executive vice president for technology suggested that the organisation's continued investment in IT was based on the transformation of problems into opportunities, particularly during the period of financial crisis in the country. In support of this argument, the bank noted that the development of an Intranet and inventory control system helped reduce internal expenses to approximately 13 million baht annually and helped reduce non-performing loans to approximately 6% (Bangkok Post 1997o).

Bank functions related to IT are mainly organised in the technology group. In addition, the information system audit department located within the human resource and control group also has a technological role. The technology group, following the initiation of ideas in the early-1980s and a reorganisation in 1996, reports directly to the bank's chief executive officer, and is divided into five main units (SCB Technologies 1996b).

Firstly, the technology policy division overlooks broad technological developments and provides a centre of co-ordination. It prepares and monitors policies, plans, and the bank's expenditures in IT. Secondly, the system engineering department develops, implements, tests, operates, and maintains the bank's computer systems. Thirdly, the technology and process engineering department overlooks the management of the bank's two main computer centre, controls the operating systems, and manages the bank's data warehouse located in mainframe computers. It also overlooks the purchase of computer equipment. Fourthly, the business relations department manages the bank's call centre, promotes the use of IT in the bank and to the public, and finally, overlooks the bank's customer information facility system, credit monitoring, and collection system, and black list system. And lastly, the applied technology department conducts research into the use of new information technologies, maintains computer software, and manages computer hardware, software, and communication standards. This last function has played a particularly important role in building and strengthening bank capabilities and is discussed later.

7.1.3 IT Development Plans

In 1983 the bank prepared two major technological development plans. The first nine-year plan covered the period between 1983 and 1991, and the second six-year plan between 1992 and 1997. The first plan was divided into three phases, each covering a three-year period. The first phase was aimed to improve customer services with IT. During this phase, the bank introduced the first ATM in Thailand in 1983. This major development became a very successful innovation as the bank's customer base expanded and market share increased. This later required central bank co-ordination of ATM-related activities introduced by other Thai commercial banks accordingly.

In the second phase, the bank used IT to automate routines and to increase productivity. In bank automation, paper documents, work processes and the required

time to accomplish tasks were reduced. While work processes were shortened, this increased the speed in delivering customer services. This was further supported with an office automation project aimed to facilitate the flow of information within various working units in the bank. In the third and last phases of the first plan, the bank prepared plans to position itself in the information society. IT projects were aimed to strengthen the bank's overall technological infrastructure further. For example, a management information system was developed to connect four main sub-systems related to customer, financial, marketing, and personnel management. Additionally, the bank co-operated with large computer vendors, such as IBM, to modernise its hardware and software technologies.

The second plan is also divided into three phases, each covering a two-year period. In the second plan, efforts were directed to strengthen existing technological infrastructure of the bank, including the upgrading of computer, telecommunications, and database technological capabilities to support ongoing and forecasted expansion of banking activities.

7.1.4 Bank Automation and Innovation

Computers were first introduced in 1975. This mainly supported deposit functions located at the bank's head office. Early use of IT was extended to more sophisticated bank operations, and financial products and services. The pioneering ATM provided a new method of delivering payment services and was widely adopted by other local commercial banks which diffused nation-wide accordingly. In the 1990s, the bank once again became a pioneer in introducing on-line electronic banking communications in Thailand, particularly in tele-banking and info-banking systems.

The bank introduced two major changes in the early 1990s. They were the adoption of customer-based business process management and organisational restructuring at the bank's head office. Price Waterhouse was contracted to advise on improving the bank's commercial lending and counter services, for which the consultants studied customer requirements and modified the bank's work processes to help address their needs. This partly resulted in the increased use of IT.

A project called "relationship banking 2020" (RB 2020) was initiated jointly with IBM to help shift the bank's focus from an account-based to a customer-based system. RB 2020 restructured the way retail banking was delivered to bank customers since the early 1970s, and pioneered an analytical capability that assists in identifying the most suitable services for a specific target group of customers. This project, introduced in early 1996, was to be widely diffused and installed in over 400 bank branches nation-wide.

The bank also adapted and applied object-oriented technology to support the delivery of financial services. For example, loan authorisation systems were built based on expert systems which has decision-making capabilities based on a 100-points scale. If a loan application scored high points, the computer approved

the loan. Otherwise, an average or low score further considered or rejected the application accordingly. Furthermore, the bank built a mobile loan authorisation system which efficiently analysed and approved a customer loan application data, following on-line verification by portable computers with its head office. Such services provided new channels for delivering financial services and improved customer convenience.

Information technology was also applied to improve personnel management and staff promotion (SCB Technologies 1996c). In 1994, the bank's human resource and control group introduced a personnel IS that recorded all personnel particulars including education, work experience, and training. Thereafter, an employee promotion system was successfully introduced in 1995. This was aimed to support the bank's concept of a learning organisation. The second system was later enhanced to support decision-making in personnel promotion, and was aimed to make personnel information widely available to specific bank departments and branches located nation-wide.

7.1.5 Sources of Innovation

The sources of innovation can be grouped into five main areas. The first source is from the bank's applied technology department (SCB Technologies 1996d). This department, established in 1996, conducts R&D into the application of new IT in financial services. Departmental tasks are grouped into five different teams – IT standards, technology selection, R&D, prototype, and support services. After the R&D team creates a new innovation, it is tested by the prototype team and considered for bank-wide diffusion by the systems engineering department.

The department, for example, introduced a pilot electronic commerce project using the Internet and a newly established transaction centre in late 1997 (The Nation 1998a). As a result, the bank became one of the earliest commercial banks in the country to provide Internet-based banking services, in the form of 'SCB Cash Management' for retail customers which provides account and statement inquiries, funds transfers, and bill payment services (The Nation 1997f). As of mid-1999, the department continued to develop innovative payment processes and this is clearly illustrated by the bank's plan to introduce the first financial EDI service in the country (The Nation 1999c). The bank's first executive vice president (EVP) for technology describes the role of the Applied Technology Office.

> In our applied technology office, staff would observe new products and examine what is appropriate for the bank. We try to recruit new staff who have recently completed their university studies and not rely on recruits with old working experiences. These recruits can be out-of-date easily. For example, the head of our applied technology office has a recent doctoral degree from a Japanese university with several months of working experiences acquired from that country. We try to attract new people.

The second source is from co-operation with computer companies. Computer firms have introduced many innovative products and ideas to the bank, as suggested

previously in IBM's involvement in RB 2020 development. In 1995, the bank's collaboration with Lines Technology led to the development of electronic systems that helped identify target customers, and provide personalised products and services. This included the introduction of the SCB video banking system that provided individual bank customers on-line financial, business, and stock market information.

In 1998, the bank, in collaboration with a local computer company, jointly developed a smart card system for Chulalongkorn University, and further announced an aggressive strategy of entering into joint-venture partnerships with computer hardware companies (Bangkok Post 1998c). Then, in response to the country's financial crisis, increased investments in IT were focused on the development of software with computer software companies. In co-operation with IBM, the bank planned to develop the first Workspace on Demand pilot project in Asia which aims to reduce the ownership cost of IT by shifting from a personal computer to network computer working environment, resulting in a "Zero Administration Environment" (Bangkok Post 1998d).

The third source is from bank-affiliated companies. Such companies created management and technological capabilities, and served as a consulting arm to strengthen the bank's competitiveness. In 1991, an affiliate company called Siam Information and Processing Company Limited (SIPCO) was established, mainly for the purpose of processing air tickets for the International Air Transportation Association. Thereafter, this company expanded its activities to outsourcing services, consulting services, and developed advanced software applications for the banking and financial services sectors which also became beneficial for the bank. Most interestingly, the company provided a packaged banking solution software, which used modern software development tools, such as object orientation and rapid prototyping.

In 1994, the bank established Siam Commercial Link (SCL). The aim was to aid the development of new value-added industries through the transfer of technology. SCL includes two divisions. The first is a 'technology link', which serves to form international business collaborations, and the second is a 'management link', which aims to handle the recruitment of mid-level and top-level managers. In 1996, the bank entered a joint-venture agreement with NSTDA. As a result, SCL was renamed as Science Commercial Link. This served as a source of venture capital for domestic and overseas companies seeking to enter into partnerships or invest in technology-related areas in Thailand. The bank was also innovative in other areas. In 1995, SCB Business Services installed new software and security systems that permitted MasterCard customers to obtain cash advances from worldwide Cirrus-affiliated ATMs.

The fourth source is from the strengthening of staff capabilities. A major source of technology originated from bank personnel. Senior-level management, particularly the bank's chief executive officer, has driven much of the bank's technological initiatives. Bank employees are sent to international seminars and computer trade exhibitions to learn of, acquire, and transfer new sources of skills and technology to the bank. The bank's first EVP for technology further described the importance of skilled staff.

> We do not hire or have a high degree of dependency on consultants. A major source of innovation originates from bank staff. We have opportunities to attend seminars, read books or follow related developments. This includes staff in the technology group and other departments. Our managers have the opportunity to undertake training and make

> bank visits. This is similar for other employees. Every year, our employees have the opportunity to attend overseas seminars and computer shows such as COMDEX and CEBIT. Over ten of our staff attend these exhibitions every year. So the sources of technology comes from these managers and staff.

The bank endeavoured to train and retrain employees on a continual basis. Two training centres provide general programmes that help educate and train staff on the bank's background and specific skills in banking. Video-conferencing systems also help in inter-office communication, meetings and information exchanges. The bank has planned agreements with local technological universities to offer computer courses at its premises. Upon completing such courses, employees obtain postgraduate degrees either in management IS or computer science. The bank's first EVP for technology also notes the importance of staff development programmes.

> The training centre is only a tool for improving the quality of staff on a continuous basis. The centre is not aimed to increase the number of employees. I think that what is more helpful is the organisation of a postgraduate course for our staff. For example, the quality of entry-level staff varies from different disciplines and educational institutions. Technology is rapidly changing. The postgraduate course can help upgrade them. Our employees are very interested in this project and have a positive demand for it.

The last source is consultants. However, the degree of dependency is minimal, as mentioned. Computer software for minor programmes, such as in client-server related projects, are developed in-house. To leverage such capabilities, the bank readily consults its in-house R&D department or affiliated companies. However, for major programmes that are unavailable in the market, software packages are purchased from outside sources and later modified to suit the bank's requirements. The bank maintains that this principle is necessary, as the organisation cannot continually depend on consultants. The bank builds its own capabilities by using purchased software packages as basic programme structures which are then adapted to changing user requirements. It also changed working processes by outsourcing selected technology functions to overseas companies thereby focusing on more important and efficient areas. For example, this included the replacement of old methods of developing software from COBOL to object-oriented computer languages.

In sum, strong senior-management support in IT suggests that the bank has become a leading and forward-looking financial institution in the country and perhaps in Asia. Apart from investing heavily in IT, the bank also gradually created capabilities through the set-up of an in-house R&D capability, the development of human resources, the co-operation with computer companies, and the set-up of bank-affiliated companies.

7.2 Bangkok Bank

7.2.1 Thailand's Largest Bank

Bangkok Bank was established by the Sophonpanich family in 1944 and is the largest Thai commercial bank, enjoying wide recognition regionally and internationally. In 1996, it was ranked the largest Thai commercial bank in terms of total

assets, and the 121th largest international commercial bank (KTB 1997; The Banker 1997). The bank was also recognised by IBCA, a leading rating institution in Europe, to be the world's second most profitable bank in 1994–1995. In 1995, the bank was presented with an award for excellence as the "Best Domestic Bank" in Thailand (Euromoney 1995), having been the largest commercial bank in Southeast Asia, and having expanded its international operations, particularly in the Indo-Chinese region and in the People's Republic of China.

The bank's twofold vision is "to continue to be a quality full-service bank and to become one of the leading international banks in Asia, providing world-class services to all its customers". In order to achieve this vision, the bank focused on the development of human resources, operational efficiency, and technology. Technology has been particularly important for the bank since it started using computers in the early-1970s which advanced towards the use of on-line computers connecting over 450 bank nation-wide branches. Since the mid 1990s the bank has set up electronic connections with its overseas branches through a global communications network. As of 1996, this included 27 branches and representative offices located around the world, with a majority of 23 situated in the East and Southeast Asian regions.

7.2.2 Role of IT

Bangkok Bank's chairman, together with senior-level management, have clearly defined the bank's future theme as being focused on electronic banking and IT which is in support of providing innovative financial services and generating fees-based income (Bangkok Post 1997p). Such a technologically oriented theme was well supported with regular five-year technological improvement plans. For example, an approximate sum of 400–500 million baht was allocated, as of 1998, for the replacement of computer hardware and software among the bank's nation-wide branches. Nevertheless, the bank's senior vice president (SVP) for systems development suggests that the support of such a strategy involves not only investments in IT.

> I think the bank's new growth strategy (which is based on fees-based income) is the trend in the commercial banking industry, as the profit margins from interest have been decreasing. The financial service area supplements this fall in income by differentiating services to customers. However, product differentiation is more important than the use of new technology. This is where we can provide value-added products and services to customers. One example is the clearing of provincial cheques, which originally took around one week to clear. This may take one day with electronic banking. Realistically, it takes the bank three days to clear provincial cheques, increasing the turnover rate.

IT related functions of the bank are located within a technology division which is part of broader support service operations. This includes other 'housekeeping' divisions like financial information services, operation, general service, and personnel. In the technology division, there are two departments headed by an executive vice president in charge, including the system development, and information-processing departments, which are, in turn, headed by senior vice presidents and managers.

Bangkok Bank pioneered the use of IT in many areas (Bangkok Bank 1994). For example, it was the first Thai commercial bank to install supercomputers for data management, the first to develop and to integrate a computer software programme based on Thai characters into the bank's on-line computer system, and the first bank in Asia to connect personal computers to UNIX-based computer systems. In other areas, the bank initiated the installation of MICR encoder and reader machines for processing cheque among its branches. Most interestingly, it pioneered the use of satellite technology in banking. The bank's senior executive vice president (EVP) for support service operations explains the early use of satellite technology.

> In the early days, the bank's computer on-line functions were concentrated in Bangkok. However, there were problems with the telephone lines, especially in provincial areas where Bangkok Bank was the first commercial bank to expand operations. This was supported with a policy that every branch should go on-line, being able to link with one another. However, there were not enough telephone lines in the provinces. In the first stage, there were no satellites yet. We contacted the Telephone Organization of Thailand to use microwave technology and thereafter, we began to use satellites. Using microwave was like using telephone lines, being out of order or even damaged sometimes. The satellite became an alternative.

The application of satellite technology supported branch banking in the provincial areas. In addition, this supplemented the use of telephone lines in such remote areas which were inadequate in number and were also relatively unreliable. Therefore, the bank innovated by combining two types of technologies – satellite and microwave technologies. The bank's senior EVP for support service operations further explains the potential and problems in this choice of innovation.

> We learned about the use of satellites and examined the various costs. The use of satellites did not depend on distance as compared to using microwave technology. For example, using microwaves between Bangkok and Ayudhya (a province in the central regions) incurs a small cost. However, there was an increased cost between Bangkok and Maehongson (a province in the northeastern region). But satellites are the same price. There are both pros and cons. Satellites are prone to weather such as storms, rain and to sunspots, which may cause increased error rates. So, we are using both satellites and microwave. However, we use it differently from other banks. Other banks used satellites as a single route and for backup functions. Bangkok Bank thinks that using it for backup purposes is a waste of financial resources. Waiting for satellites to face sunspots then using microwave is not practical so we use both of these technologies. We have a network management system, which is similar to a traffic controller. This distinguishes the two types of technology and helps balance the workload.

7.2.3 Pioneer in Re-engineering

Bangkok Bank also pioneered bank re-engineering in Thailand. This preceded KASIKORNBANK which introduced bank reengineering in the early 1990s. However, due to the latter's wide publicity, the bank is usually credited as the first Thai commercial bank to reengineer. The first re-engineering exercise at Bangkok Bank was introduced in the early 1980s when the bank adopted computer machines

for bank tellers. As a result, the bank improved its time in dealing with customers from approximately 20 to 30 minutes. The bank teller was also given greater responsibility, reducing the work of seven bank staff to only one person. Otherwise, non-routine task or transactions were co-signed by another supervisor.

Early re-engineering exercises taught three lessons. Firstly, it improved the efficiency of bank and customer services. Secondly, it minimised staff. Prior to the 1980s, the bank's work process involved, for example, a bank slip that passed through seven persons and the data was keyed into four or five available on-line terminals in the bank's back office. Reengineering permitted a one-stop service with the use of computers by each bank teller. And thirdly, the bank re-designed its human resources development and training programmes completely.

The bank strengthened staff capabilities accordingly. Its retraining programmes in 1979 were in preparation of bank re-engineering in the early 1980s. Approximately 7,000 staff were relocated, retrained, and reallocated back to various positions and functions. Thereafter, the bank monitored and managed expected improvements in staff performance in two ways. Firstly, employees were required to work in achieving a 'service level agreement'. This agreement included the maximum and approximate amount of time required by employees to deliver a specific type of transaction to customers, for example, in the issuance of a letter of credit.

Secondly, the measurement is matched with cost accounting. A specific job function or service incurred increased costs when it required more time to accomplish from employees. Therefore, each division in the bank was measured to help reflect cost accordingly. Such measurement is tied to productivity. If staff salary were to increase 8-9% a year, this implied an increase in their productivity. To support such skill development, over 200 basic training courses were provided to over 25,000 employees, and the bank's on-the-job training and special overseas courses were made compulsory for employees at key managerial positions.

The improvement of bank operations was aided by the adoption of information technologies, which especially facilitated in examining alternative channels for delivering services, resulting in the expansion of new and improved businesses. This included providing financial services through delivery channels unconstrained by time, for example, in telephone banking, home banking, and ATMs.

7.2.4 Sources of Innovation

The sources of innovation can be grouped in four main areas. The first and most important source is bank personnel. At the organisational level, the bank introduced a range of policies and programmes aimed at promoting the quality of staff and services. For example, personnel development was supported through programmes such as 'Star', 'Quality Persons' scheme, the brain bank project, 'QC Circle', and '5S activities' (Bangkok Bank 1994).

Since the bank began to use computers in the early 1970s, employees working in a particular department became familiar with their tasks, leading to user-driven

innovation. Departmental employees, who are owners of specific job functions, gained familiarity with particular routines and used them as a basis for defining user requirements. The bank's senior EVP for support service operations emphasised this point.

> Today, the decision of whether or not to use a particular type of technology, or how much to invest, rests with the user. We need to seek their opinions. For example, employees working in the export and import division since the early 1970s have probably been promoted to managerial positions today. As a result, they have grown very familiar with their work and know how computers, introduced in the bank in 1970, can facilitate their tasks. These users, not the technology group, are the owner of such tasks and are fully responsible for them. Thus, there is no way information technology staff would know everything.

This suggests that the technology division plays a supporting role to other departments. As the decision to use or to invest in a particular type of technology remains with the user, the search for new IT rests with users. For example, staff from specialised bank divisions may request for technology after learning about new applications from overseas travel and training.

The bank also initiated a project to improve IT literacy, aimed at educating and training bank employees with basic computer knowledge and skills. The bank's successful training centre teaches 3-week basic computer courses year-round for a group of 50 people. Innovation in different departments was also encouraged with an Intranet project, whereby individual departments compete in creating home pages to provide information. Senior-level employees are strongly encouraged to use electronic mail instead of communicating with the telephone. The bank's SVP for systems development describes the approaches to technological skill improvement.

> The minimum entry requirement for employees is a first degree in disciplines such as computer science, mathematics, and statistics. We have an annual training programme, including internal training conducted by our experienced senior-level staff. For example, this includes a two months training on our methodologies and training on the control of our documents. We also have external training programmes which includes special classes arranged with computer vendors.

The second source, computer companies, is a result of such outward-oriented training programmes. For example, this has included training with computer companies such as IBM which provided courses on project management and programming skills. In addition, the bank organised training courses with Microsoft at the bank's premises and at the software firm's authorised training centres. Such courses have specifically included server administration which is a required skill in non-mainframe technology and has become an emerging trend in the country, particularly networking in local and wide area environments.

In some cases, the bank acquired technology from computer companies through staff involvement. For example, one of the bank's recent project with Digital involved the upgrading of existing computer systems to Windows-based operating systems which engaged employees of both organisations developing a pilot project. Such co-operation, in the form of prototype development, enabled the bank's employees to acquire capabilities, within the period of 2 months, from the research unit of the computer firm. In other cases, computer vendors provided training in computer software

packages which helped the bank make minor modifications. The bank's SVP for systems development illustrates this capability to cater to local conditions.

> We develop system enhancements to suit the domestic market. In the case of BankTrade, our computer vendor would train us on their system, particularly in the programme structure, programming, and database techniques. This learning of the product knowledge is considered in terms of what functions are related to end-users and other technical areas. We try to avoid enhancing the core part of the system which would have been the responsibility of the computer vendor.

The third source is the systems development department which has been behind the bank's pioneering use of IT. As the bank was the first to develop computer on-line systems in the country, it enjoyed an early mover advantage, and more importantly, acquired and build-upon these early technological capabilities. The bank's SVP for systems development further suggests that such capabilities may be partly attributed to the systems development department, which has focused its strengths, for example, in the development of retail payment systems.

> I think we were the first commercial bank to develop salary and utilities payment systems, since we pioneered on-line computer systems. This started with simple batch processing systems, whereby we received data from our customers. In the mid-1990s, we changed this process to file transfer systems, whereby our customers send data directly from their offices to be verified with our bank branches. We have also developed money transfer systems between 1982 and 1984 when our provincial branches went on-line. These are the payment systems that were developed in-house.

The department further demonstrated its capabilities through the implementation of an electronic securing system. This system, which uses electronic workflow and imaging technologies, focuses on the establishment of a cheque-processing centre to replace work previously done by different banks or bank branches (Bangkok Bank 1996). As a result, the centre will receive and verify customer cheques and update their accounts accordingly. Such capabilities suggest that the department is relatively strong in retail payment system development, as compared to wholesale systems. In the latter case, the bank has purchased software packages, for example in support of investment banking and treasury functions, as it lacks the know-how, and since most products are readily available from foreign sources.

The fourth, and least important source, is consulting companies. During the re-engineering of its work processes, the bank contracted consulting firms, for example Booz Allen and Hamilton, to assist in developing new credit processes, credit lease management, and credit workflow systems. Although such firms have served as the bank's idea catalysts and informer of market and technology trends in banking, such sources of knowledge have provided a limited contribution. The bank made two reservations. Firstly, although foreign firms were more experienced, as compared to their local counterparts, this did not suggest that all foreign consultants were experts. Secondly, foreign firms merely made recommendations but faced difficulties in implementing project details. Thus, the bank strongly supports self-reliance and self-judgement, and even argued that 90% of consultant recommendations were widely available in textbooks.

In sum, the bank embarked on an ambitious plan to utilise IT to generate fees-based income through innovative financial services. Relatively strong support and

a clear direction from senior-management were contributing factors. The sources of innovation was mainly derived from strengthening staff capabilities, co-operating with computer companies, and developing retail payment systems to suit local conditions. Alternatively, the role of consulting firms played a limited role.

7.3 Kasikornbank

7.3.1 Catalyst of Bank Re-engineering

KASIKORNBANK (formerly Thai Farmers Bank) was founded by the Lamsam family in 1945. Apart from gaining wide publicity for its proactive bank re-engineering programmes, the bank's successful use of IT to gain competitive advantage in the 1980s also attracted international attention, resulting in a case study conducted by the Harvard Business School (Cash and Mookerjee 1990). At the organisational level, the bank set a mission of "the spirit of excellence", as well as the philosophy of "dedication to banking excellence", which aim to provide high-value added financial services and support to clients, while balancing societal and national concerns (Thai Farmers Bank 1995). In 1996, the bank was ranked as the third largest Thai commercial bank in terms of total assets, and the 182nd largest international commercial bank (KTB 1997; The Banker 1997).

Innovation has become a major factor contributing to the bank's leadership. Bank re-engineering, in particular, helped strengthen the bank's capabilities and competitiveness, and further prompted preparations for more efficient working processes that are comparable to and competitive with international banking standards. Most importantly, the bank's senior-level management has played a key role in initiating the use of advanced IS and supporting the reengineering of bank branches nation-wide. In 1984, the bank's chairman demonstrated his complete support to the senior vice president of the computer department in adopting ATMs which followed recommendations made from a study of such machines at Banco International, Mexico's fourth largest commercial bank (cited from Cash and Mookerjee 1990).

> I still want to see the first Bangkok branch go on-line by the year-end, most of the others by the end of next year, and also 15–20 up-country branches. Siam Commercial Bank already has on-line branches and over 50 ATMs in Bangkok. Unless we catch up fast, they will capture a significant portion of our market share. You will have to manage a turnaround. I know you can do it. You have my total commitment of the bank's resources for this project.

7.3.2 Role of IT

The bank's computer department was established in 1975. As the department head was technically-oriented, there was a weak link with business strategy and there was an emphasis on batch retail processing systems, without considering the

emergence of on-line systems being introduced by competitors (Cash and Mookerjee 1990). This changed in 1983, when the bank's chairman became involved in technology planning, established a high-level technology committee, and contracted a consulting company called Peat Marwick. As a result, the bank wrote-off its existing systems and considered the installation of IBM mainframe computers to support on-line computing.

As of 1997, the bank's use of IT was focused on four main areas. Firstly, the IS processing department overlooks banking operations, including the gathering of input data, the processing of output information, and the backing-up of information on a 24-hour daily basis. Secondly, the IS engineering department develops the bank's computer software. Thirdly, the telecommunication department supports inter-bank functions. And lastly, the newly established research and process development department, which studies and advises on the improvement of the bank's business processes, conducts research related activities.

The bank's president started and supported re-engineering in the early 1990s. In 1993, the president, who is a Harvard Business School graduate, attended a seminar on re-engineering organised in the United States by Michael Hammer (Hammer and Champy 1993). As a result, such ideas formed the basis for organisational reforms, a change which was not only radical for the bank, since it was established in the mid-1940s, but also to the local banking community. Nevertheless, the bank's president was capable of communicating and convincing employees the main concepts and contributions behind re-engineering.

Firstly, foreign consulting firms helped the bank re-think. In 1992, early feasibility studies conducted by Booz Allen and Hamilton suggested a focus on retail banking businesses. Two more consulting companies were contracted, Immacon focusing on bank restructuring, and Andersen Consulting concentrating on IT strategies. In 1993, a joint team of 11 employees, between the bank and IBM, helped develop a new computer system to pilot the bank's first re-engineered branch. Together, these gradually build the bank's managerial and technological capabilities, and have led to re-engineering without the use of foreign consulting companies (The Economist 1997).

Secondly, the bank learned to re-design itself. The bank's president took a progressive position towards re-engineering by selecting six bank staff to work jointly with the consulting companies. This included research and analysis into the problems of the bank's current business processes and a comparative study of financial service delivery between Thai commercial banks and their foreign counterparts. The results suggested that Thai financial institutions were constrained by multiple working processes which unnecessarily slowed the time to provide customer services. As a result, this early work materialised in the establishment of the bank's own research and process development department.

The bank re-designed its branches and business processes. For example, the front and back offices were rearranged to increase customer services areas to 80–90%. Financial services were grouped into five main service stations – cash services, personal services, general services, loan and marketing services, and electronic services. In electronic services, for example, this included the automation of

routines such as in the updating of bank balances or in the depositing of cheques. Furthermore, the bank restructured its branch services, foreign service centres, liabilities, credit authorisation, funds transfer, and credit card services.

Lastly, IT helped the bank re-tool. This included the development of new computer systems and self-service machines for customers. For example, computer software was re-coded, and personal computers replaced dumb terminals, which connected the computer file servers located among branches and the bank's communication networks. In addition, bank tellers working with personal computers were empowered to authorise transactions within a predetermined sum of money, without seeking prior supervisory approval which helped provide improved customer services and reduced overall cost.

The results of re-engineering suggested successful operating performances. This is based on the comparison between the time required to deliver a specific service before and after branch re-engineering. Generally, the average time in providing financial services required approximately 60–72% time (Thai Farmers Bank 1995). For example, the maximum and minimum time which was required to cash a cheque was approximately between 5 and 10 min before re-engineering, as compared with approximately 1.6–5.2 min after re-engineering (Thai Farmers Bank 1995). As of 1997, the bank claimed that re-engineering has reduced annual remuneration by 6.36%, when compared to figures in the previous four years and has also reduced the number of employees to 15,740 persons, as compared to 16,400 persons in 1995 (Bangkok Post 1997q).

The re-engineering programme was seen as progressive and sequential. The performances of the first re-engineered pilot branch proved successful. Thereafter, the bank aimed to re-engineer all remaining branches located nation-wide by 1996 with an average of 30 branches per month. The bank benefited from both managerial and technological innovations. For example, the adoption of a unitary queuing system meant that a single file of customers waited for the first available position, in contrast to standing in several queues and bank tellers were empowered with modern computer systems to authorise basic financial transactions.

7.3.3 Sources of Innovation

The sources of innovation can be grouped into four main areas. The first and most important source is bank personnel. Personnel development was one of the bank's priority, as it once experienced a shortage of skilled staff since the early 1980s. During this period, the bank was required to strengthen the capabilities of the computer department, in order to support ATM development plans, by recruiting employees experienced in data communications and on-line system skills. Although the bank experienced the problem of 'brain drain', whereby the turnover of employees in the computer department was less than 5% annually between 1975 and 1983, the chairman strongly emphasised the importance of developing personnel who are well qualified and educated (cited from Cash and Mookerjee 1990).

> My top priority over the next two decades was to build a cadre of high-quality professional managers in the bank. I decided to develop people in the bank rather than shop around for people from outside. We gradually raised salary levels to match Bangkok Bank, to attract bright, young people. We also set up a scholarship to sponsor a few Thai Farmers Bank employees each year for advanced degrees at U.S. schools. These students had to sign a bond to work two years at Thai Farmers Bank, for each year of schooling. Many of them are still with us. Today we have the most qualified people in the industry: many of our managers have MBAs from Harvard, Wharton, Chicago, etc.

The policy towards retaining and training employees, rather than recruiting, was also adopted during the period of bank re-engineering. In some bank branches, although re-engineering affected 70 of the 200 employees, or one third of the workforce, unemployment did not increase (The Economist 1997). Alternatively, the bank reduced the recruitment of new employees and strengthened the skills of existing employees by retraining and reassigning them to newly established branches. Such was the case for employees who were affected by the automation of cheque processing routines whom were retrained.

The bank resolved redundancy caused by re-engineering in several ways. This included the set-up of marketing teams, the conducting of research into bank customers, the building of computer databases, and the retraining of staff. The bank expected employees to be regularly trained or retrained twice a year at its learning centre. This centre, a simulated bank branch environment, provided training courses ranging from the improvement of foreign language proficiency to IT skills. Employees are trained to understand the bank's working processes so that they were familiar with each departmental requirement and would also help facilitate them to work more efficiently.

In addition, the bank encourages employees to undergo local and overseas training. For example, the bank acquired training from computer vendors in a project connecting electronic mail, included in the Lotus Notes software package, with the Internet. In other areas, the purchase of a specific computer software from an overseas company may involve the set-up of a team which travels overseas to examine the software and learn possibilities in modifying them to suit the bank's requirements. In return, the team reports and presents the materials acquired from the international software firm to other employees.

The second source is the management of information. Apart from supporting technological improvement programmes, the bank's president also initiated innovative ideas which manages the use of information. For example, in responding to the country's financial crisis, the president has initiated an information-based internal risk management division in the bank which is in addition to a 'command centre' previously set-up to monitor world news through electronic media for senior-level management (The Nation 1998b). The bank's first vice president for IS processing, illustrates how information, in addition to IT, has become the bank's source of innovation.

> In the past, Thai Farmers Bank relied on employee experiences to make adjustments to every specific situation. Today, we give increased importance to information. We examine and analyse information such as the bank's budget. That is why my department was renamed from the computer processing department to the information systems processing

department. Being a computer centre is not well defined. Thai Farmers Bank has given great importance to information in evaluating everything.

The third source is the research and process development department. Early re-engineering experiments led to the development of this department which gradually acquired skills and know-how from working co-operatively with consulting companies. As a result, the department has served as the bank's consulting arm in re-engineering related areas. As one function, the department initiated plans to introduce an Internet-based banking service which is an investment of approximately 10 million baht awarded to a local computer company (Bangkok Post 1998d). From 10 corporations co-operating during the pilot phase, the department expects to provide such services to all 1,500 corporate customers of the bank.

Furthermore, the department works on the identification of innovative ideas from senior-level management. After idea generation, a research group, consisting of relatively young employees aged below forty, some holding doctoral degrees, studies the bank's current business processes, searches for new computer software, and suggests alternative approaches for improvement. One outcome of this process was that the loan approval process was studied and an approach was suggested to shorten the approval time from 1 month to 7 days. In other areas, research projects have considered the improvement of bank branches, international trading activities, credit scoring, and the analysis of consumer behaviour.

The fourth, and perhaps an increasingly unimportant source, is consulting companies. Through such contacts, the acquisition of managerial and technological capabilities was made possible, and later served as a basis for building company capabilities. As re-engineering has continued without the presence of foreign consultants, the bank remains relatively independent for such sources of know-how. This may be seen as the specific reason behind the set-up of an internal research and process development department which acts as the bank's own consulting arm. For example, the bank's policy in computer software development is relatively flexible. They are developed in-house, provided that there is an adequate source of skills from staff, as experienced by the joint-development of a new computer system with IBM employees for the bank's first pilot re-engineered branch. Otherwise, the bank purchased and modified an internationally well-known software package which has already been the case for supporting international trading and financial management.

In sum, although the bank was not a pioneer of re-engineering, it was a major catalyst for such radical changes. Through relatively strong senior-level management support, the bank demonstrated that IT played a key role in gaining competitive advantage back in the early 1980s, and more importantly, has shown that this potential relied on personnel development. In addition, other important sources of innovation included the set-up of an in-house research and process development department, and the innovative management of information. Although consulting firms were a main source of innovation in the early periods of re-engineering, recent changes suggest a decrease in their dependency.

7.4 Krung Thai Bank

7.4.1 Innovative State Bank

Krung Thai Bank was established in 1966 as a state enterprise after a merger between the Agricultural Bank and the Provincial Bank. This status slightly changed in 1989 when the bank became the first state enterprise to be listed on the stock exchange, and again in 1995, when the government categorised the bank as a "Group 1 State Enterprise". This permitted the bank to increase operational independence and involvement in innovation. For example, the bank was allowed to establish affiliated companies which provided more comprehensive customer services in competition with other commercial banks. In 1996, the bank was ranked the second largest Thai commercial bank in terms of total assets, and the 209th largest international commercial bank (KTB 1997; The Banker 1997).

The bank also played a leading role in branch expansion. In 1988, it became the first Thai commercial bank to operate 288 branches spread throughout all 73 provinces, and this was followed with the nation-wide installation of ATMs (KTB 1995). The bank also expanded internationally by being the first foreign branch of a Thai commercial bank, to set-up in New York in 1982, and this was followed with the establishment of 12 foreign branches and representative offices by 1996.

7.4.2 Role of IT

The bank's computer group reports to the executive vice-president and is divided into five main departments. These departments include computer co-ordination, computer operation, consumer finance, credit card, and electronic banking. One of the most recently established departments is electronic banking, which was set-up in the mid-1990s, and aims to support increases in bank customers and work volumes. For example, the bank increased the number of employees to support the introduction and subsequent expansion of ATMs from 10 to 700 machines.

At the organisational level, senior-level management has strongly supported the introduction of IT as part of bank re-engineering. In 1995, the bank contracted the Boston Consulting Group to conduct a study to examine customer needs and branch operations. As a result, the research recommended that the bank's branches should be increasingly specialised, restructured, and most importantly, improvements in working methodology were essential, with increased support through computers to increase efficiency and accuracy (KTB 1995). This research led to a re-engineering programme scheduled for implementation between 1996 and 2000, and involved the increased use of IT as a core component. For example, in late 1995, the bank introduced new computerised systems including pilot projects on the dealing room

system, the trade finance system, and the credit management system. In 1996, a loan origination system was introduced to facilitate loan applications and approvals (Money and Banking 1996).

The bank formulated policies aimed at providing value-added services for 1996. For example, this included the introduction of modern management ideas such as the network organisation. This involved the planned introduction of new computer software which enhanced existing system capabilities, and provided 24-hour ATM services without disruptions or operational failures during peak periods. Other plans included the centralisation of three main computer centres to provide efficient services and the improvement of corporate decision making.

Many innovative services were also introduced. For example, telephone-banking services allowed customers to inquire about their personal bank account information, to purchase and sell open-end funds, and to register for academic studies in selected universities. The bank also introduced Krung Thai Information System, permitting customers to use an on-line personal computer to retrieve personal financial information from the bank's computer database, including the transfer of funds between bank accounts, the payment of public utility bills, and the retrieval of supplementary services.

The bank also innovates through affiliated companies. In 1994, Krung Thai Computer Services (KCS) was established, for which the bank held a majority of shares. KCS, which is chaired by a member of the bank's senior-level management, is organised into nine departments dealing with different operations, namely computer audit, front office, electronic banking, head office, international business, self-service banking, technical support, data communication, and finance and administration. The main objective of this new company was to support the bank's working units and subsidiaries through IT which also covers consulting services concerned with organisational development and enhancement. The company has long-term plans to provide consulting services to outside organisations.

The bank builds consulting capabilities through KCS. The range of services provided by the company is similar to consulting firms. This particularly includes system development work, covering IT strategy planning, feasibility studies, system maintenance, system integration, computer procurement, computer auditing, and technical training. Such areas assist the strengthening of managerial and technological capabilities, and furthermore, serve as a potential source of competitive advantage in generating innovative financial services.

Krung Thai Card is another affiliated company. This firm provides a range of card-based services to customers, and in some cases, co-operates with non-banking institutions in introducing innovative card-based services, for example, for use in entertainment companies and educational establishments. Krung Thai Bank became the first commercial bank in Southeast Asia to develop an Internet-based, 24-hour ticket-less reservation system, a co-operative service jointly developed with the country's national airline which aims to permit members to reserve, change, or cancel their flights through the Internet (The Nation 1997g).

7.4.3 Sources of Innovation

The sources of innovation can be grouped into three main areas. The first source is consulting companies. The Boston Consulting Group was contracted to advise on bank re-engineering and re-organisation, and this resulted in a four-year programme which plans to increase the use of IT to improve current working processes. Such an approach to re-engineering may have been in response to competitors which have embarked on similar programmes. This was not the only case of large commercial banks, but also their mid-sized and small-sized competitors, as was illustrated in the previous chapter. However, the bank created its own 'consulting' team which worked closely with the management consultants. As a result, this led to the creation of the bank's own computer and consulting company, KCS, which has become a potential source of competitive advantage.

The second source of innovation, which may perhaps downplay the importance of consulting firms in the future, is affiliated companies. Bank affiliated companies provide a strong base for innovation, a direct result of the bank being upgraded to a 'Group 1 State Enterprise' in 1995. For example, the establishment of KCS in 1994 helped the bank retain skilled staff who otherwise may have searched for better employment prospects in other companies, providing higher remuneration. The bank's senior vice president for electronic banking, describes how KCS resolved previous problems in retaining skilled employees.

> In the past, we experienced a brain drain. Our former employees moved to other companies which offered more attractive benefits. This resulted in a severe lack of human resources. As a result, when we developed computer software in-house and encountered problems with staff, it was devastating. Alternatively, if we purchased software, we needed to depend on other people. Therefore, we established a computer company to compete with the outside labour market. We are now stable.

This approach helped the bank provide more competitive salaries to staff. Otherwise, the bank, which is a state enterprise and provides an equivalent of government-level salary, faced loosing experienced and highly skilled employees to other financial institutions which provided more attractive remuneration packages. Since the company was established in 1994 with 71 employees, there was an approximately fourfold increase in the number of personnel to 317, as of 1998 (KCS report). In principle, the bank can create companies that will contribute to overall competitiveness, and this has helped prepare the bank to compete with local and overseas financial institutions which have also initiated similar strategies.

The third source of innovation is personnel development. Krung Thai Bank is among a very few commercial banks in the country which has established a clear position in promoting human resource development. At the national level, the bank has continually emphasised the need for the government to take proactive policies and measures towards its human resources skills development plan for 1995–2001. In addition, the bank attempted to establish an overseas working loan project jointly organised with the Department of Employment, although the project faced start-up problems, concerning collateral and the duration of loan repayments (KTB 1995).

At the organisational level, educational scholarships were provided and seminar attendance was supported. In recent years there were 417 training courses involving more than 14,000 employees, and educational scholarships were provided for employees and the public, including 44 local and 15 overseas scholarships (KTB 1995). The bank encourages staff training and in 1995 built a new training centre capable of accommodating 250 employees. This centre simulates a bank branch environment and is equipped with modern computer equipment, for example, audio-visual production facilities, computer networks, sound laboratory, and a library. New employees undergo on-the-job training and computer vendors help provide training on new technologies.

However, the problem of staff quality, particularly in computer related functions, remains. Although KCS has been capable of maintaining and retaining many employees, there are specific non-technical skills, an issue noted as a constraining factor to innovation by the bank's senior VP for electronic banking.

> There are no problems with the quantity of staff. However, there are problems with their quality. They lack several skills. Although everyone is industrious and responsible, they may lack general or survival skills in contacting the outside world which may be partly because they are state enterprise staff. They may also be weak in the command of the English language. As technology comes with language, we will be unable to communicate without their full understanding of the language.

These problems are non-technical by nature. The bank views technology as having a life cycle. For example, the bank's computer software are changed and corrected during a 5-year period prior to becoming obsolete. Such importance given to foreign language skills also imply the need to clearly communicate with foreign consultants or computer vendors in designing the bank's IS, and also raises the need to strike a balance between technical and language skills. Such issues concern the replication rate of specific resources which is further discussed in the following section.

In sum, although the bank is a state enterprise, its senior-level management has given support towards innovation, particularly though bank re-engineering. As a result, the bank established affiliated companies which served as a consulting arm to improve current bank functions, and may perhaps downplay the dependence on foreign consulting firms in the future. To support such strategies, the bank has emphasised the importance of personnel development organisationally and nationally.

7.5 Lessons Learned

This section discusses the common characteristics shared by the four commercial banks and draws some lessons for other commercial banks seeking to use IT for competitive advantage. Although there has been widespread developments in IT in the banking sector, major technological developments and trends were initiated by the large commercial banks. Therefore, this group has become technology leaders and their involvement has served as a precedent for, or in some cases as a catalyst to the adoption of new information technologies in the commercial banking sector.

7.5.1 Banking Leadership

The first common characteristic is leadership in banking. The four commercial banks dominated the domestic commercial banking industry's market share in total assets and total deposits. In 1996, the combined market share of total assets and total deposits owned by the four commercial banks were 60.4% and 60.85% respectively (KTB 1997). These figures comparatively outweighed the market shares of both mid-sized and small-sized commercial banks.

The four banks were also among the largest regional and international commercial banks. In comparison with 200 commercial banks in the Asian region in 1997, Bangkok Bank ranked 13th, Thai Farmers Bank 22nd, Krung Thai Bank 25th and Siam Commercial Bank 28th (The Banker 1997). Similarly, in comparison with 1,000 international commercial banks in 1996, the rankings were 121st, 182nd, 209th, and 211th for each respective commercial bank (The Banker 1997). These rankings suggest that the size of commercial banks may have been an important factor influencing their international standings. They may also indicate the preparedness of the commercial banks to compete regionally and internationally. Nevertheless, such figures do not fully explain the relatively strong fundamentals which have come from banking policies directed towards developing resources, particularly in personnel, IT, and bank re-engineering.

7.5.2 Role of Skilled Staff

The second common characteristic is the use of skilled staff. This ranged from skilled senior-level management who help form long-term banking visions and strongly supported the commitment of organisational resources towards investments in personnel development. Such characteristics have helped the four commercial banks acquire, apply, and advance modern management techniques which strengthened their managerial capabilities. The main sources of skilled staff can be organised into two main groups.

The first group of staff is senior and mid-level management executives. A majority of senior-level bank executives from the four commercial banks were educated in foreign universities and hold high-level positions such as president, chairman, and chief executive officer. This includes personnel who have earned academic degrees ranging from economics to business administration from some of the world's most outstanding universities. For example, the president of KASIKORNBANK, who was a catalyst behind branch reengineering and bank computerisation, studied at the Harvard Business School (Thai Farmers Bank 1995). The president and chief executive officer of Siam Commercial Bank, who is a former central bank official, is an economics graduate from the University of Pennsylvania and the Massachusetts Institute of Technology (Siam Commercial Bank 1995). Krung Thai Bank's chairman, who was a former Finance Ministry permanent secretary, read mechanical engineering and economics at Cambridge

University (KTB 1995). Such high educational qualifications were also common characteristics shared by a large number of mid-level managers who overlook senior vice-president positions.

The board of directors also played an important role in the four commercial banks. This includes individuals who have become influential figures in the country's political and economic affairs. For example, the board of directors of Bangkok Bank includes a former Foreign Affairs Ministry minister and the Board of Investment secretary general (Bangkok Bank 1995). Similarly, Siam Commercial Bank has a former Prime Minister and a former assistant central bank governor represented on its board (Siam Commercial Bank 1995). As for Krung Thai Bank, the bank's board of directors include an attorney general and two assistant central bank governors (KTB 1995), while a former Police Department director general is a board member at the KASIKORNBANK (Thai Farmers Bank 1995). In these cases, although the commercial banks may not have benefited directly from bank-specific skills, the political skills and connections possessed by such influential individuals provide a potential source of competitive advantage which is necessary in conducting the bank's affairs with other key figures in both the public and private sectors.

A large number of senior-level bank executives also have prior professional banking experiences. One key institution that is a source of skilled staff is the central bank which has adopted a long-standing policy in promoting human resource development. Since the early 1950s, the central bank scholarship programme has provided financial assistance to educate eligible Thai students in leading overseas universities, for which this group of students return to work for the central bank upon completing their studies.

In some cases, central bank officials are sought after by Thai commercial banks. In other circumstances, they are a source of skilled staff. The chief executive officer of Siam Commercial Bank, for example, has worked as the central bank's director of the financial institution supervision and examination department, prior to joining the commercial bank. Similarly, Bangkok Bank and Krung Thai Bank have senior-level management executives with prior working experiences with the central bank (Bangkok Bank 1995; KTB 1995).

The second group of staff is lower-level personnel. From early-1990s to mid-1990s, the four commercial banks invested in the building of staff training centres, which provided a simulated branch bank environment. Entry-level employees were trained on basic banking knowledge and on improved working processes, which are supported through modern computer-based IS. In other cases, the training centres provided experienced employees to update their skills through training seminars. In addition, the training centres also provided re-training programmes. Although many bank personnel may have been made redundant through re-engineering, bank policies were aimed at reducing the recruitment of new employees, and increasing the efficiency of the current workforce. Such policies were supported through an increased use of IT which empowered bank clerks, for example, in authorising a predetermined amount of cash withdrawal or loan application.

In sum, skilled staff was a major factor influencing innovation among the four commercial banks. Firstly, senior-level management demonstrated relatively strong support to strengthen managerial and technological capabilities. Bank managerial capabilities, for example, were strengthened with the acquisition of former central bank officials and the appointment of influential individuals in the bank's board of directors. Secondly, lower-level employees received training, and in some cases re-training, according to bank policies promoting personnel development. The four commercial banks were committed to human resource development through the set-up of specialised training centres which provides training on foreign languages and basic computer skills. Bank personnel also received re-training, particularly in cases which responded to reengineering programmes which was aimed to prepare them to work with improved business processes and computer systems.

7.5.3 Role of Re-engineering

The third common characteristic is the introduction of re-engineering programmes. Such changes have been a response to increased competition in the Thai banking system, resulting from financial liberalisation initiated in the early 1990s. For example, local and foreign commercial banks were allowed to operate international banking facilities, increasing the availability and flow of foreign capital in and out of the country. The four commercial banks faced competition from non-bank financial institutions, for example, finance firms, securities companies, and insurance companies, which were allowed to provide a range of similar, and in some cases, more competitive and innovative financial services.

Re-engineering began with the contracting of consulting companies. This ranged from foreign firms providing management and IT consulting. The main management advice was aimed at organisational restructuring, for example, to create flatter organisational levels, and to promote teamwork among bank personnel. Additionally, consulting companies helped formulate IT strategies, and in some cases, assisted the development of computer-based information systems.

Re-engineering was aimed to improve current business processes. Routine functions in current working processes were identified and modified accordingly which was followed with use of IT to increase operational efficiency. Re-engineering started at bank head offices as pilot programmes, and thereafter, the operational results, before and after the programme were evaluated and diffused to bank branches located nation-wide accordingly. In some cases, bank personnel were also retrained to learn changes in working practices.

There were, however, reservations to re-engineering. Although the four commercial banks realised the importance of consultants in re-engineering, they have initiated projects to decrease the dependency on consultants. For example, two commercial banks in the cases created their own teams to work closely with consultants, and as a result, this joint-team effort helped the two commercial banks learn more about re-engineering in general and about their current problems in

particular. Furthermore, one of the commercial banks established a new research and process development department to support re-engineering, while another set up an independent company serving as the bank's own consulting unit. Such initiatives increased their indigenous capabilities in re-engineering and reduced their complete reliance on consultants.

7.5.4 Role of IT

The fourth common characteristic is the increased use of IT. The cases illustrated how the four commercial banks pioneered the use of IT in banking in their own unique ways, including the introduction of ATMs, satellites, or specific Internet-based banking applications. As a result, such early mover advantages have positioned them as technology pioneers, leading both mid-sized and small-sized commercial banks in major technological applications. Large and risky investments in IT projects were initiated by the four commercial banks to test the market, and if the pilot project are successful, they are generally replicated by the two latter groups whose aims are to catch up in technology to gain competitive parity. Nevertheless, the large commercial banks have committed significant investments in IT, partly to maintain their market shares in the sector.

The four commercial banks maintained their dominant market share in ATM units since the late 1980s. However, their growth rates in ATM units were increasingly lower than the mid-sized and small-sized commercial banks categories. In 1989, the figures were 17% for each large, mid-sized and small-sized bank group. By 1996, the difference in growth rates widened, being 29% (large banks), 41% (mid-sized banks), and 31% (small-sized banks) for each group respectively (KTB 1997). Such changes indicate the relatively high rate of replication in ATM technology which further suggest that IT may not become a potential source of competitive advantage.

There were also clear IT strategies and plans. By forming strategies through the assistance of consulting companies, senior-level management has helped in preparing plans which ranged from long-term to short-term periods. Such plans formed the basis for bank computerisation through IT investments, and served as early exercises, whereby the four commercial banks were required to invest in human resource development, particularly in the retraining of bank personnel to suit new and increasingly efficient working processes.

In addition, the four commercial banks pioneered the use of IT in banking. Bangkok Bank pioneered the use of satellite technology for provincial banking, while Siam Commercial Bank successfully introduced ATMs. Although not the pioneer of re-engineering, KASIKORNBANK was a catalyst behind the change which was widely popularised in the country. Krung Thai Bank, in co-operation with the country's national airline, introduced the first Internet-based, credit card ticket-less reservation system in Southeast Asia.

The four commercial banks promoted the use of IT in two main areas. Firstly, this was to automate bank routines. This formed a part of wider programmes in branch re-engineering, including the use of new computer systems connected to terminals located in the front office. In addition, this empowered bank clerks and increased the physical area for serving customers, shifting non-customer related work to the back offices, which, in turn, used computers to process routine transactions. Secondly, this was to improve customer services and satisfaction. While IT improved current working processes, it also increased efficiency in delivering banking services to customers. In addition, IT was applied to support a range of financial services, including, for example, the authorisation of loan applications. Other innovative services, for example, telephone-based banking, electronic banking, and Internet-based banking, were introduced accordingly.

7.5.5 Replication of Resources

In cases where commercial banks shared common characteristics, there may be competitive parity among firms. Alternatively, some commercial banks may distinguish themselves on the uniqueness of specific resources which may become a source of sustained competitive advantage. Such uniqueness may vary in their rate of replication which is further influenced by a set of attributes characterised in physical, organisational, and human resources.

Firstly, the replication of physical resources is relatively easy to carry out as compared to organisational and human resource replication. The case studies suggested that IT, which is a physical resource in form, were being increasingly acquired, applied, and advanced by the large commercial banks. The ATM provides one illustration. Although Siam Commercial Bank enjoyed early-mover advantages in the early-1980s when it pioneered ATMs, other commercial banks replicated such technologies. KASIKORNBANK was one of these earliest competitors which rapidly responded by developing telecommunications and on-line computer capabilities to catch up with the technology leader. There were more interesting changes in the 1990s, as suggested by the growth rates in ATM units among mid-sized and small-sized commercial banks outgrowing their larger counterparts. Although this may be partly due to the initiation of co-operative computer networks among a group of commercial banks, it also suggests that the smaller firms have focused and expanded their banking activities into the retail market. This high rate of replication in ATM technology further suggest that such physical resources are a weak source of competitive advantage, as they are homogenous, mobile, and readily available for purchase in the markets.

Nevertheless, some interesting developments have been emerging. For example, commercial banks have developed and modified their own computer software to support ATMs, as compared to purchasing them. This suggests the building of software development capabilities, and more interestingly, commercial

bank affiliated companies are increasingly becoming an important source of innovation. Such affiliated companies can develop, in the long-term, innovative financial products and services which are unique. Furthermore, if successful, the company can create an appropriability regime to protect such innovations which may potentially become a source of sustained competitive advantage (Teece 1986).

Secondly, the replication of organisational resources is moderately difficult. Although commercial banks have the resources to invest in IT, the linkage with company strategy is equally important. The case of re-engineering provides one illustration. Through recommendations made by consulting companies, commercial banks have learned to a great extent about their working processes, and more importantly, how to improve them. However, the application of recent re-engineering concepts and modern management techniques may not suit each commercial bank similarly, as their organisations have unique characteristics. In order to address such issues, some commercial banks have initiated an in-house research unit to work closely with consultants, expecting to learn more about their organisations themselves, and most importantly, to be capable of initiating the re-engineering of other potential processes on their own. For this research unit to be a source of sustained competitive advantage, however, there is a need for skilled bank personnel to conduct studies, analyse alternatives, and make recommendations.

Finally, the replication of human resources is relatively difficult to carry out as compared to physical and organisational resource replication. For example, since specific skills residing in bank personnel are intangible, they are not well-coded and difficult to transfer. Such expertise in designing an information system relies on tacit knowledge and may be difficult to articulate. Thus, the education and training of specific individuals become an organisational routine or the repository of knowledge for the organisation.

This stock of skill is one of the most important sources of innovation an organisation could use to gain or sustain competitive advantage. Therefore, it is not surprising that the commercial banks committed resources in this area by investing in training centres and the supporting of further education for bank personnel. Such strategies seek to develop and support employees in specific technical skills, and who are familiar and trained to work with computers and re-engineered working processes.

Most importantly, however, is the acquisition of personnel at the senior-management level. Although such policies are not explicit, it has become one of the common characteristics among the commercial banks. Such individuals have been recruited, or in some cases appointed, to acquire managerial skills and senior management was actively involved in setting IT strategies. In Thailand, where a large number of commercial banks are family-controlled, there has been the appointment of influential figures in the country to key organisational positions. This has largely been to gain and maintain political and social connections in government and business. Thus, such invisible human resources are unique and difficult to transfer, but would provide a potential source of competitive advantage.

In sum, the combined four case studies helped identify the major sources of innovation which contributed towards banking automation and payments system modernisation. Although such sources included skilled staff, IT, and re-engineering, their potential as a source of sustained competitive advantage varied. In order to develop and provide innovative products and services, commercial banks increasingly depend on the development or acquisition of skilled bank personnel, in contrast with increased investments in IT, or even in bank re-engineering.

Chapter 8
Future Challenges

Abstract The modernisation of payment systems is an evolutionary process. It involves adaptation to changes in the socio-economic environment, regulatory developments and technological innovation among others. Schumpeter's gales of creative destruction manifest themselves as new business models from non-bank payment service providers that have challenged the traditional payment services domain of banks. At the same time, the rapid pace whereby these new innovations are introduced may also pose risks to consumers and the wider financial system if not properly regulated and supervised. Thus, the challenge is to strike a balance between fostering new innovations and maintaining proper oversight of the associated risks to avoid stifling innovation itself. We conclude with a discussion of the major forces that will present challenges to the continuing modernisation of payment systems. These include financial stability, financial integration, trade liberalisation in financial services, and continuous technological innovation.

Financial stability can be broadly defined as 'the avoidance of financial institutions failing in large numbers and the avoidance of serious disruptions to the intermediation functions of the financial system: payments, savings facilities, credit allocation, efforts to monitor users of funds, and risk mitigation and liquidity services' (World Bank and IMF 2005). In particular, the design and operation of payment systems and securities settlement systems, among other financial market infrastructure and financial policy operations, affects liquidity management by financial firms. (IMF and World Bank 2002).

In an initial assessment of payment and settlement systems against their observance to the BIS core principles for systemically important payment systems, findings suggest that there were weaknesses in many of the 57 payment systems (in 42 countries) that were assessed between 1999 and 2001 under the IMF/World Bank Financial Sector Assessment Program (IMF and World Bank 2002). This was the case for payment systems in developing countries more so than in advanced and transitional economies, and included vulnerabilities ranging from credit and liquidity risks to the lack of strong legal foundations, oversight and governance arrangements. Thus it remains a challenge for the former

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group of countries to improve their observance of international principles to help maintain overall financial stability.

Due to their central role in the payments system, particularly in providing final settlement assets, central banks have given great attention to their linkages with financial and monetary stability. Some research studies have examined issues ranging from intraday liquidity needs, optimisation of liquidity usage and settlement speed, gridlock resolution and bank failures, systemic risks, operational disruptions, the role of non-banks, and system interdependencies (European Central Bank 2008; Leinonen 2005).

The latter point, on the interdependencies of payment and settlement systems, received great attention from central bank policy makers as they grapple to reduce risk in the international financial system after the fallout the U.S. sub-prime mortgage market crisis that had global repercussions (BIS 2008). 'These challenges include: (1) adopting broad risk management perspectives; (2) having risk management controls that are commensurate with the system's, institution's or service provider's role in the global infrastructure; and (3) implementing wide coordination among interdependent stakeholders' (BIS 2008).

Financial integration, particularly in the European Union, is another area where remaining challenges lie in the integration of cross-border retail payment systems (Koskenkylä 2004). The integration of cross-border retail payment systems, as contrasted to their large-value counterparts, has proved more challenging. While the latter group of systems involved the inter-linkage of 15 European national real-time gross settlement systems and the ECB payment mechanism (as of August 2004) to support the single monetary policy of the euro area and the launch of the euro as scriptural money in 1999, the integration of cross-border retail payment systems have faced obstacles in integration as the current systems then were based on correspondent banking networks that were created to support currency exchange operations before the euro cash changeover was introduced in early-2002 (Snellman 2004).

Moreover, following the view from the European Commission that cross-border retail payment systems required efficiency improvements and further price reductions, this led to the formation of the European Payments Council in June 2002 by banks, and the plan to establish the Single Euro Payments Area (SEPA) that has helped create a Pan-European Automated Clearing House (PEACH) called STEP2. As Snellman (2004) argues, it will be interesting to see how events unfold as the cross-border payment systems would need considerable scale economies to be operating efficiently and successfully. This may require the further consolidation of national retail payment systems. Nevertheless, this remains a challenge as previous initiatives to create a global ACH, such as the Worldwide Automated Transaction Clearing House (WATCH), has yet to gain worldwide popularity.

Europe's experience provides lessons to the challenges other regions may face in their integration plans. Such challenges include creating buy-in from the banking industry, harmonising standards, and consolidating systems to achieve scale economies, efficiency, and competitive prices. Moreover, there may also be political sensitivity behind the idea of consolidating existing national payment systems and deciding on the geographical location of a new payment system, which may be seen as the creation of competitive advantage in one country over another.

Financial services trade liberalisation touches upon the opening up of financial markets and this includes the provision of payment, clearing and settlement services. Apart from unilateral liberalisation, it is also a part of the wider effort to free up world trade through multilateral, regional or bilateral trade agreements. The WTO General Agreement on Trade in Services (GATS) establishes the global rules whereby member countries commit themselves to opening up their markets to foreign players on a non-discriminatory basis by improving their national treatment and market access conditions.

The various types of financial services are clearly defined in the Annex on Financial Services. For payment-related services, this includes (1) payment and money transmission services, including credit, charge and debit cards, travelers cheques and bankers drafts; (2) settlement and clearing services for financial assets, including securities, derivative products, and other negotiable instruments; and (3) provision and transfer of financial information, and financial data processing and related software by suppliers of other financial services (Kono et al. 1997). Although a great deal of achievement was made in financial services liberalisation under the Uruguay Round, there remained many challenges in the most recent Doha Round (Key 2003, 1997).

This largely stemmed from the suspension of world trade talks in July 2006 due to differences in agricultural subsidy reductions between developed and developing countries. Moreover, the financial services sector itself is a sensitive and strategic sector as it plays an intermediating function in the economy. If financial services liberalisation was to move forward, this needed to be properly sequenced with country preconditions, as rapid liberalisation may pose potential macro-prudential risk, especially for transitional and developing countries, and as evidenced in the Asian financial crises of the late-1990s (Mattoo 2000).

While multilateral trade talks under the Doha Round were suspended, there has been the proliferation of regional trade agreements (RTAs) (Fiorentino et al. 2007; Roy et al. 2006). As of July 2007, there have been some 380 RTAs that have been notified to the GATT/WTO.[1] Such agreements provide a channel for speedier and deeper trade liberalisation and often require countries to make commitments beyond their GATS obligations. For financial services, this often includes the adoption of the WTO legal text on 'Understanding on Commitments in Financial Services' which requires the broadening of commitments such as permitting the cross-border supply of financial services by non-residents, offering of any new financial services, and access to payment and clearing systems operated by public entities, and to official funding and refinancing facilities available in the normal course of ordinary business. For example, this may include the supply of competitive payment, clearing and settlement services from a major exchange company located in Europe to financial firms located in Asia.

Although such 'fast track' liberalisation commitments supports the principles of free trade, it helps to understand that most countries that have adopted such commit-

[1] See http://www.wto.org for an update on the number of regional trade agreements notified to the GATT/WTO.

ments have well-developed banking and financial systems to start with. As such, countries with underdeveloped banking systems would need to examine the opportunities and risks from embarking on deeper and faster liberalisation. Among the factors to consider are the impact on domestic competition, consumer protection, existing regulatory and oversight arrangements, and ultimately financial and monetary stability. More importantly, this should be apart of a wider programme of sequencing financial sector reforms, which cover market and product developments, risk mitigation, financial system infrastructure, financial institutions restructuring and recapitalisation, and capital account liberalisation (World Bank and IMF 2005).

Technological innovation opens up both opportunities and risks. This includes the trend towards internationally standardised network-based services, real-time payments processing, and mobile phone banking (Leinonen 2008). While new business models providing competitively priced payment services emerge, they may well pose as risks if there is an inadequate level of consumer protection and regulatory oversight. While outsourcing and off shoring of various functions along the payment value chain may help business and financial firms reduce costs, it may also create unemployment at the original payment facility. Loss of managerial and quality control may also lead to customer dissatisfaction and reputational risk. The same can be said of consolidation of payment facilities to create scale and scope economies as competition intensifies or regulatory requirements dictate. The rise of automated and algorithmic trading in highly sophisticated financial markets has also posed challenges to having adequate risk management arrangements. Thus, the challenge from technological innovation would be ensuring that an appropriate legal and regulatory framework is put into place to ensure safety and soundness in electronic finance and in emerging innovations created for mobile and wireless environments (Glaessner et al. 2004; Kellermann 2002).

Technological innovations would no doubt continue to re-shape the world's financial landscape, particularly in developing countries where there may be possibilities to leapfrog to the latest technologies (Claessens et al. 2000, 2001). This is particularly relevant for countries that have a weak financial market infrastructure where financial intermediation functions and financial access provided by financial institutions are limited. The use of mobile phones, in particular, has been a useful tool in making domestic money transmission and international remittances (BIS and World Bank 2007).

Will the use of the mobile phone for making payments serve as Schumpeter's next steel hawser? As highlighted throughout this book, this would require a full understanding of the dynamics of innovation and their relationship with efficiency gains, innovation diffusions, and capability development. While one payment innovation may work well in one environment, its success story may not be relevant in another context due to their unique differences and circumstances. The modernisation of payment systems will continue to evolve in response to rapid technological developments, trade liberalisation and socio-economic changes.

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