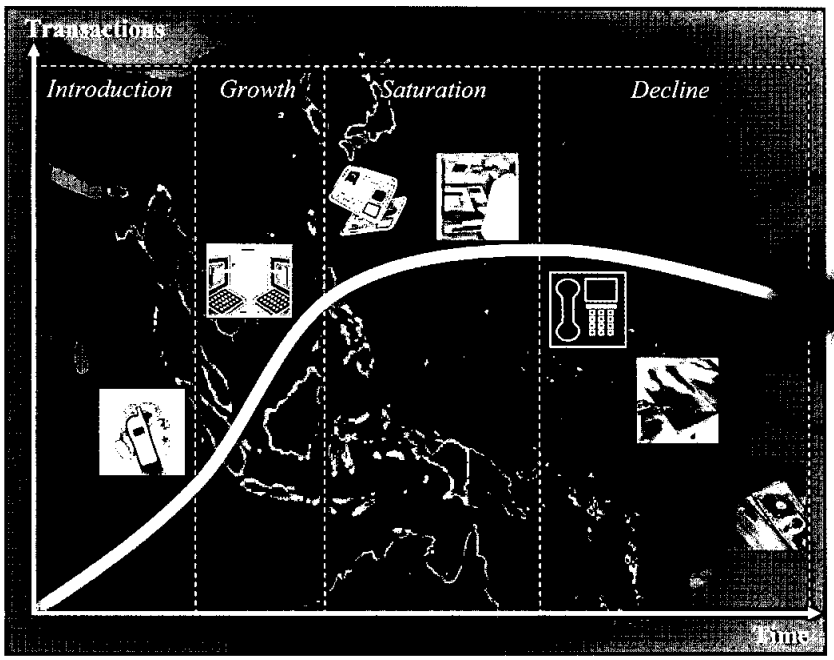
The South East Asian Central Banks (SEACEN)
Research and Training Centre

POLICY APPROACHES TO PAYMENT SYSTEMS EFFICIENCY IN THE SEACEN COUNTRIES

Tanai Khiaonarong



The SEACEN Centre
Kuala Lumpur, Malaysia

POLICY APPROACHES TO PAYMENT SYSTEMS EFFICIENCY IN THE SEACEN COUNTRIES

by

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FOREWORD

A country's payment costs can be substantial at 3% of GDP, as suggested in recent research studies. Cost-savings of 1% of GDP, however, can be realised if a country shifts from a fully paper-based to a fully electronic payment system, where costs are estimated to be between one-third and one-half of paper-based instruments. The topic of payment systems efficiency has become a key issue for many central banks that pursue the public policy objective of promoting efficient and safe payment systems. This has become particularly relevant in a majority of SEACEN member countries where cash remains the dominant means of payment. As the policy approach to payment systems efficiency may differ across countries, this report aims to provide some insights into the use of payment instruments and their implications for payment systems efficiency; the pricing policies of central bank payment services; and measures to enhance efficiency in the long-run.

This research project was prepared by Mr. Tanai Khiaonarong, Visiting Research Economist of the SEACEN Centre seconded from the Bank of Thailand. The author wishes to thank central bank officials from the SEACEN member countries for responding to the survey questionnaire and for providing comments on an earlier draft. Their names and affiliations appear in Appendix 1. Comments and suggestions from Mr. Masashi Nakajima, Member of CPSS Secretariat, Bank for International Settlements; Mrs. Kanaengnid T. Quah, Acting Assistant Director (Research) and Mr. Vincent Lim Choon Seng, Senior Economist, from the SEACEN Centre; and participants at the 3rd SEACEN-CPSS Course on Payment and Settlement Systems hosted by the Ministry of Finance in Bandar Seri Begawan, Brunei Darussalam, are gratefully acknowledged. The views expressed in this paper are those of the author and do not necessarily reflect those of member central banks, monetary authorities, or the SEACEN Centre.

Dr. Subarjo Joyosumarto
Executive Director
The SEACEN Centre
Kuala Lumpur

November 2004

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EXECUTIVE SUMMARY

This study examined policy approaches to payment systems efficiency in the SEACEN countries. 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. 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; increase in ATM terminals was negatively corelated 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 USD 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 USD 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 USD 3 to USD 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 public goods, 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 two-fold. 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 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.

1 Introduction

1.1 Objectives

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 with 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, b). 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 subjects of 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. Studies on central bank and payment systems efficiency have recently emerged (Blix et al., 2003; Bergman, 2003).

The research objectives of the current study address efficiency in central bank payment services and are fourfold: to present a framework for analysing payment systems efficiency; 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 recommend measures to enhance efficiency in payment systems.

1.2 Scope of study

The study covers 13 SEACEN member economies as follows: Brunei Darussalam, Fiji, Indonesia, Korea, Malaysia, Mongolia, Myanmar, Nepal, the Philippines, Singapore, Sri Lanka, Taiwan, and Thailand. Large-value and retail payment systems owned and operated by the central bank are included, particularly real-time gross settlement systems, cheque clearing systems, and automated clearing house systems. Securities settlement and foreign exchange settlement systems are excluded. Payment and settlement systems owned and operated by the private sector, such as credit card systems, debit card systems, ATM systems, and others, are also beyond the scope of this study.

1.3 Data and methodology

Survey questionnaires were distributed to member central banks and monetary authorities that owned and operated payment systems. This follows a similar approach taken in two earlier studies by the Committee on Payment and Settlement Systems of the Bank for International Settlement Systems (BIS, 2002) and the Working Group on Payment and Settlement Systems of the Executives' Meeting of East Asia-Pacific Central Banks and Monetary Authorities (EMEAP) in March 2004. The questionnaire is organised into four sections, covering basic information, pricing methodology, payment system fees and central bank services, and costs and revenue data (Appendix 2). Minor changes to the original questionnaire included request for information on transaction volumes and values in 2002, investment cost, operating costs, and operating revenue.

Statistical data on transaction volume and values were obtained from secondary sources (BIS, 2003; EMEAP, 2002; Torreja, 2001a, b) and retrieved electronically from central bank websites where available. Economic data required for making cross-country analysis were obtained from *International Financial Statistics*, *World Development Indicators*, and from the website of the Asian Development Bank.

Methodological issues are also considered due to differences in the maturity of banking systems, and hence payment systems, across member economies. Published statistical data on payment systems across SEACEN member economies is limited. Available data on transaction volume and values are not regularly compiled and updated. At this moment, the Monetary Authority of Singapore, for example, is the sole SEACEN member that publishes payment

statistics annually (BIS, 2003). The Bank of Thailand publishes payment statistics in an annual report on payment systems (Bank of Thailand, 2004). Operating cost and revenue data on payment systems, if available, are also limited and based on internal accounting rules. Section 4 discusses the different accounting rules used across the central banks. Appendix 3 discusses the data assumptions and notations used in regression analysis.

1.4 Overview

The paper is organised as follows. Section 2 presents four types of frameworks for analysing payment systems efficiency: risk-cost frontier, settlement delay-liquidity usage, economies of scale, and product life-cycle. Section 3 examines the use of payment instruments and the implications for payment systems efficiency. Section 4 compares the pricing policy for central bank payment services in selected payment systems, focusing on pricing methods, payment transactions, fees, costs and revenue. Scale economies are compared in a discussion on the key issues and policy recommendations. Section 5 concludes the paper.

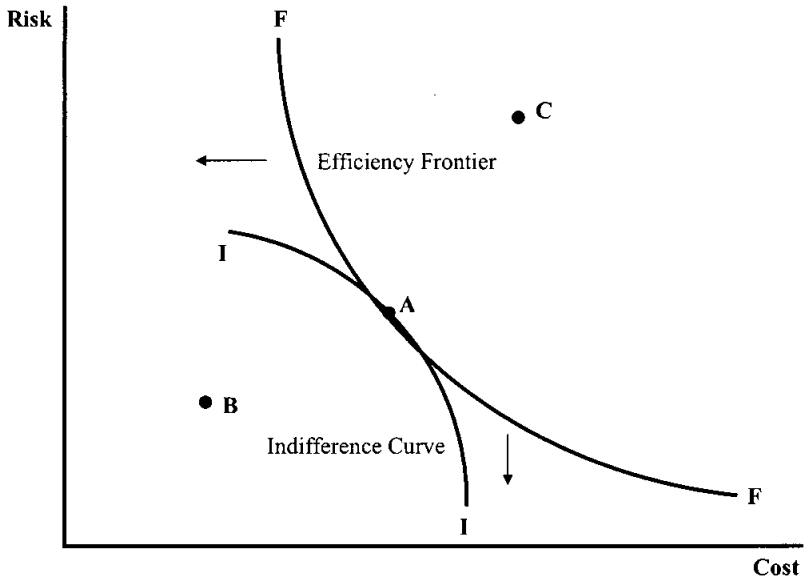
2 Analytical frameworks

2.1 The risk-cost frontier framework

Alternative theories and models for studying payment systems, including efficiency issues, are reviewed by Frankel and Marquardt (1983).[1] Figure 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.

1. Section 2.1 is partly adapted from Khiaonarong (2003).

Figure 1. The risk-cost frontier framework



The framework is based on the risk-return trade-off of the Capital Asset Pricing Model (CAPM)-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 deferred net settlement (DNS) versus real-time gross settlement systems (RTGS) in large-value transfer systems in both developed and developing countries (Fry *et al* 1999, pp. 44–59). Gilbert (1998, p. 137) 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. Its downward slope indicates that 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 later illustrated in section 2.2.

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 progress, 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.

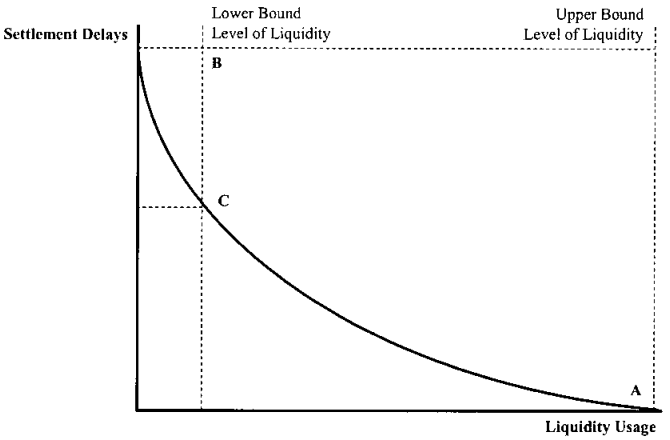
Three types of innovations have potential to shift points on the efficiency frontier. Technological innovations include new payment services that have potential cost-savings arising from lower computer and communications costs, and may include examples such as on-line banking, telephone banking and other 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.

2.2 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 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, such as RTGS systems, which often require the immediacy of funds intraday. Figure 2, Point A represents an RTGS system facing no delays and queues, and requiring an upper bound of liquidity 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.

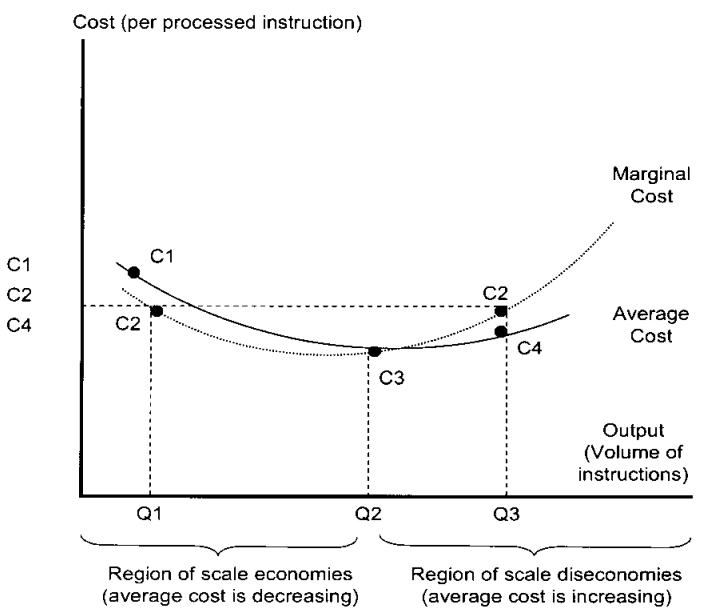
Figure 2. The settlement delay-liquidity usage framework



2.3 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 3 shows the hypothetical relationship

Figure 3. The economies of scale framework



between marginal cost, average cost and the number of instructions processed by a settlement system.

Achieving scale economies require 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.

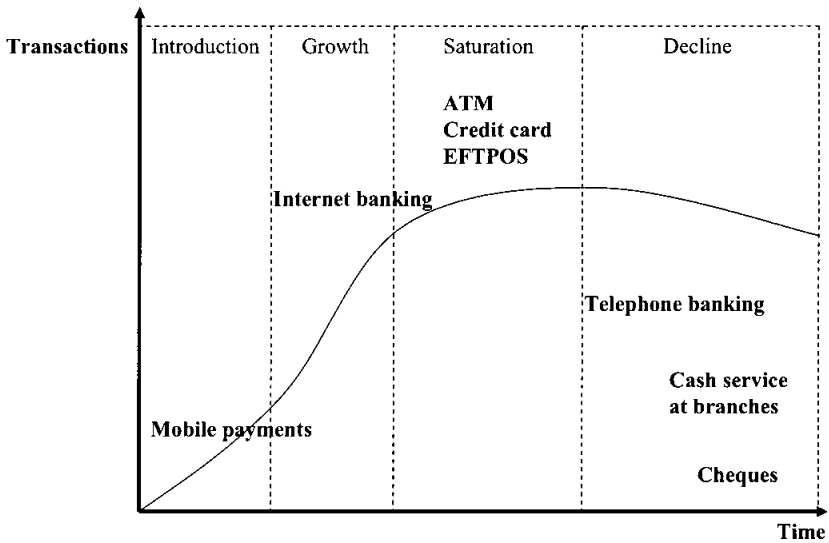
Unit cost decreases between output level Q1 and Q2 from C1 (average cost) and C2 (marginal cost) to C3 with the increase in payment instructions. Further output expansion from output level Q2 to Q3 leads to a U-shaped curve where unit costs rise to C4 (average cost) and C2 (marginal cost). Economic theory suggests marginal 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, or 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 $= 1$.

2.4 The product life-cycle framework

Figure 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 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.

Figure 4. The product life-cycle framework



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 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).

2.5 Literature

Table 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

organized as follows. Macroeconomic-oriented studies have focused on the linkage between 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) develop 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 (2003) 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, 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 in Europe and 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).

Table 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)	– Specialisation 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 check, 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

3 Use of payment instruments and implications on efficiency

3.1 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 versus 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 5 compares the ratio of currency in circulation to gross domestic product (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 at 15 percent. Nepal, Mongolia and Thailand also had relatively high ratios. Korea has the lowest ratio at 3 percent.

Figure 5. Currency in circulation to GDP, in percent, 2002

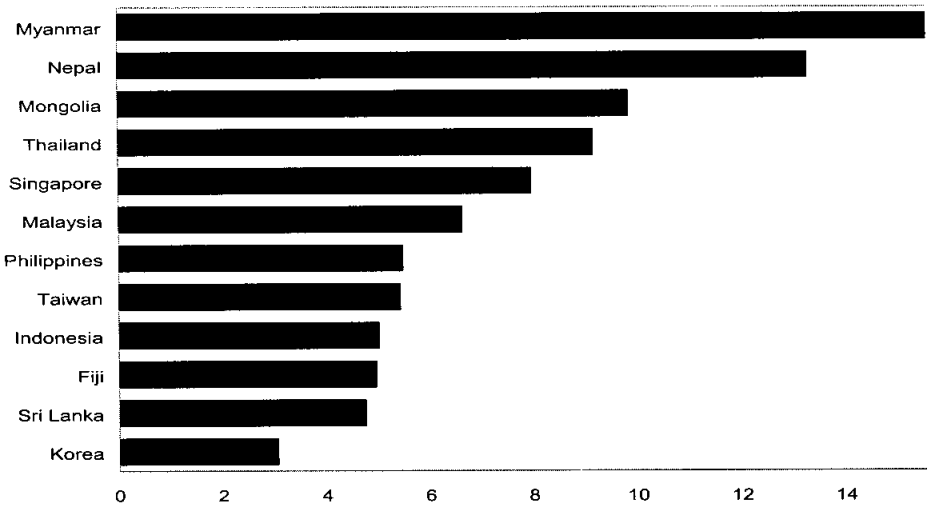
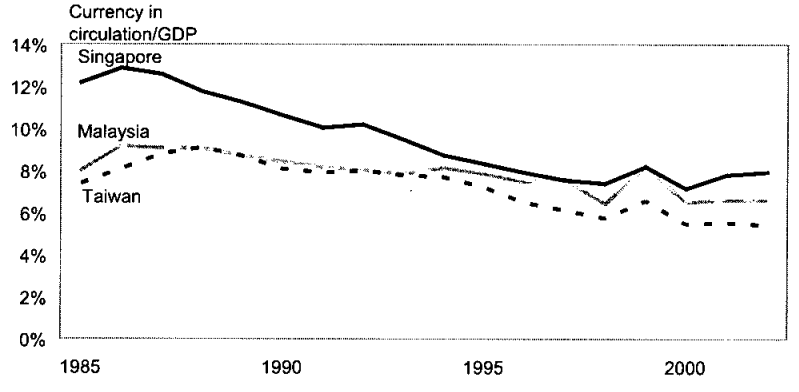


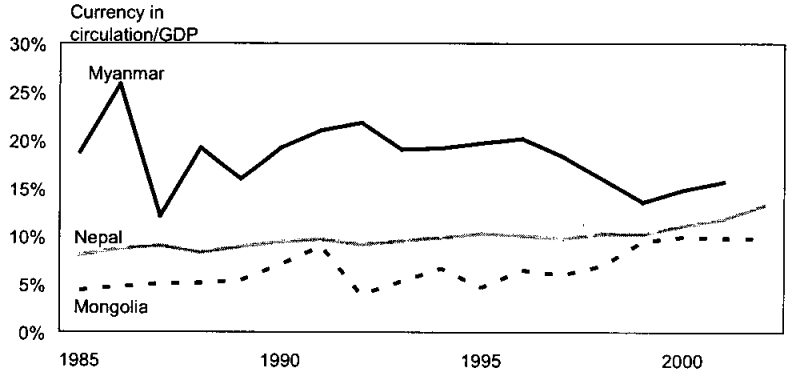
Figure 6 illustrates the ratio of currency in circulation to gross domestic product across the SEACEN countries for the period 1985-2002. Cash transactions experienced a downward trend in many countries such as Korea, Malaysia, Singapore, Sri Lanka and Taiwan. Comparatively, an upward trend in cash transactions 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 6. Currency in circulation to GDP, 1985-2002

(a) Malaysia, Singapore and Taiwan

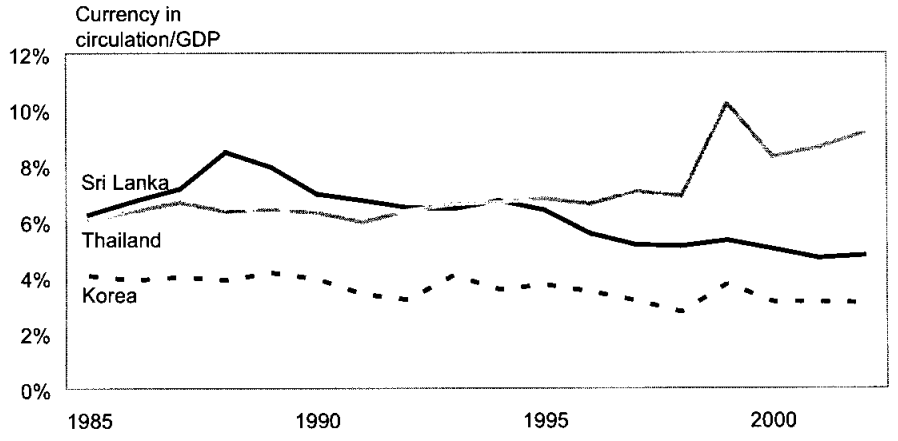


(b) Nepal, Mongolia and Myanmar

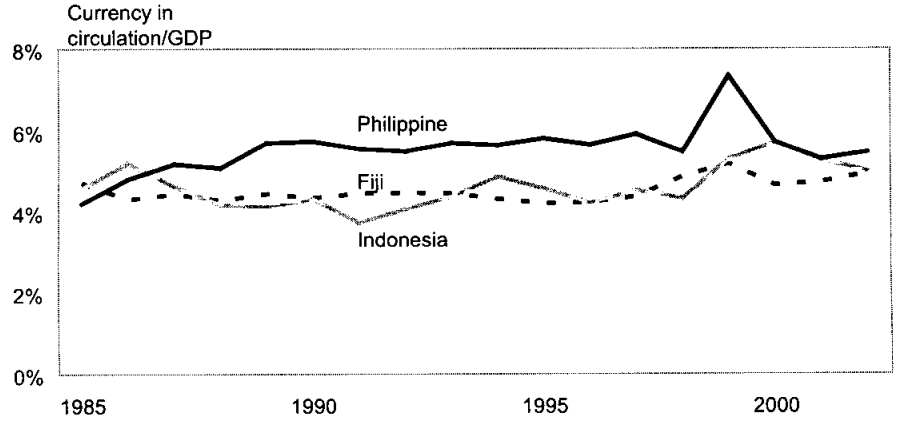


Source: Asian Development Bank
Notes: Figure for 2002 is not available for Myanmar.

(c) Korea, Sri Lanka, and Thailand



(d) Fiji, Indonesia, and Philippines

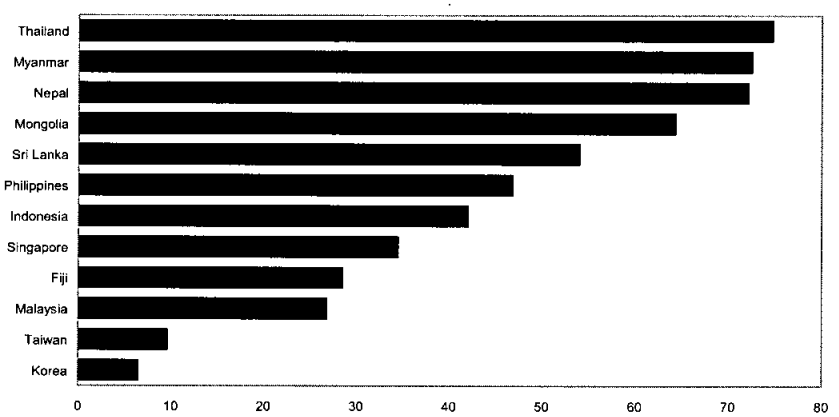


Source: Asian Development Bank

Figure 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 (International Monetary Fund, 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 percent include Thailand, Myanmar, Nepal, Mongolia and Sri Lanka. Relatively low ratios were found in Korea and Taiwan.

Figure 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.

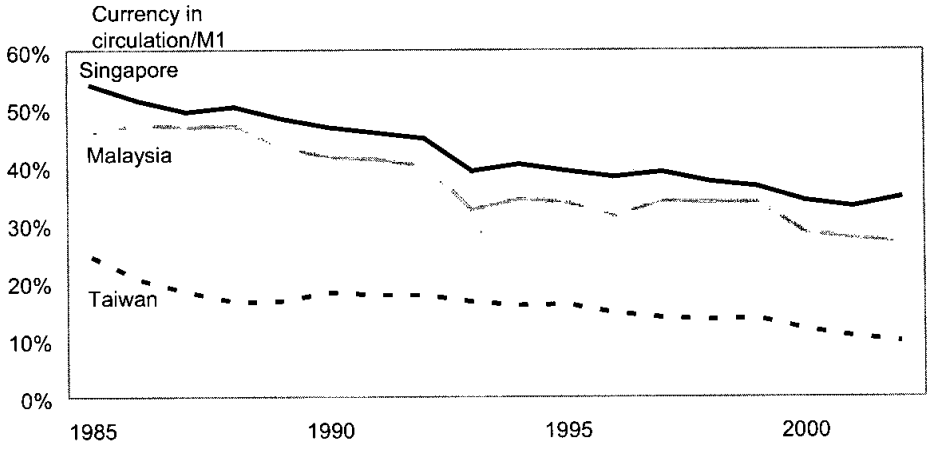
Figure 7. Currency in circulation to M1, in percent, 2002



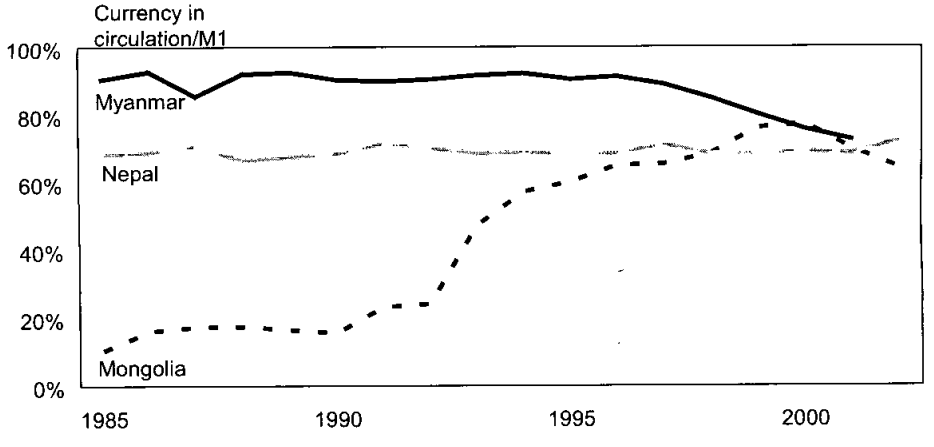
Source: Asian Development Bank
Notes: Figure for Myanmar is for 2001

Figure 8. Currency in circulation to M1, 1985-2002

(a) Malaysia, Singapore and Taiwan

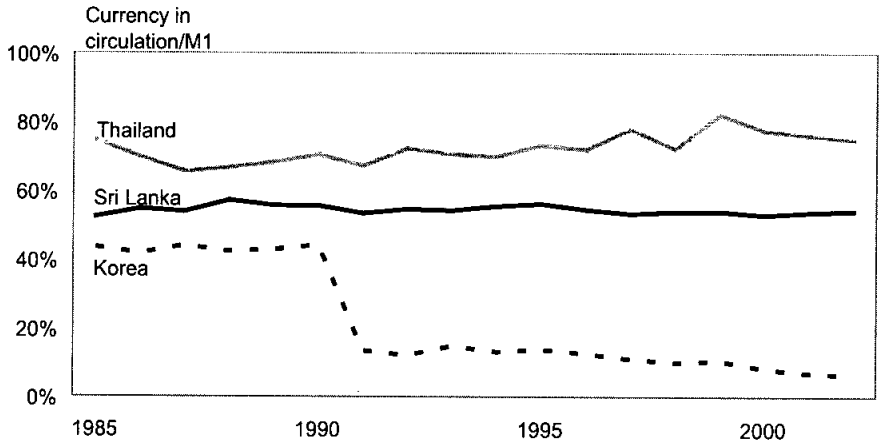


(b) Nepal, Mongolia and Myanmar

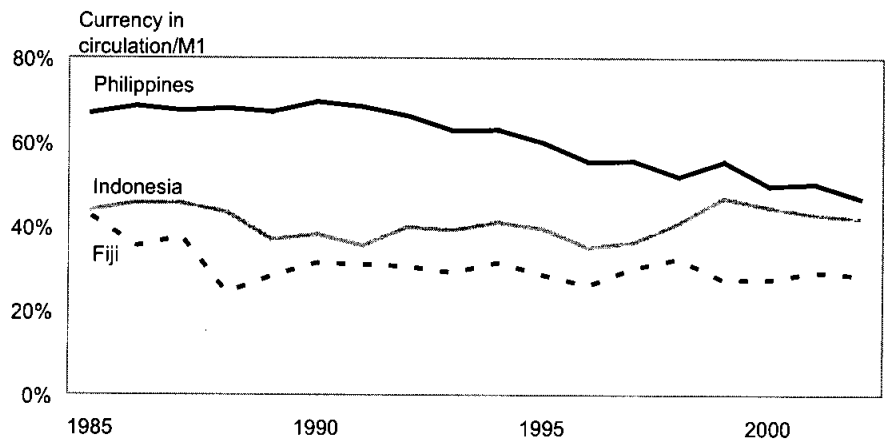


Source: Asian Development Bank
Notes: Figure for 2002 is not available for Myanmar.

(c) Korea, Sri Lanka, and Thailand



(d) Fiji, Indonesia, and Philippines

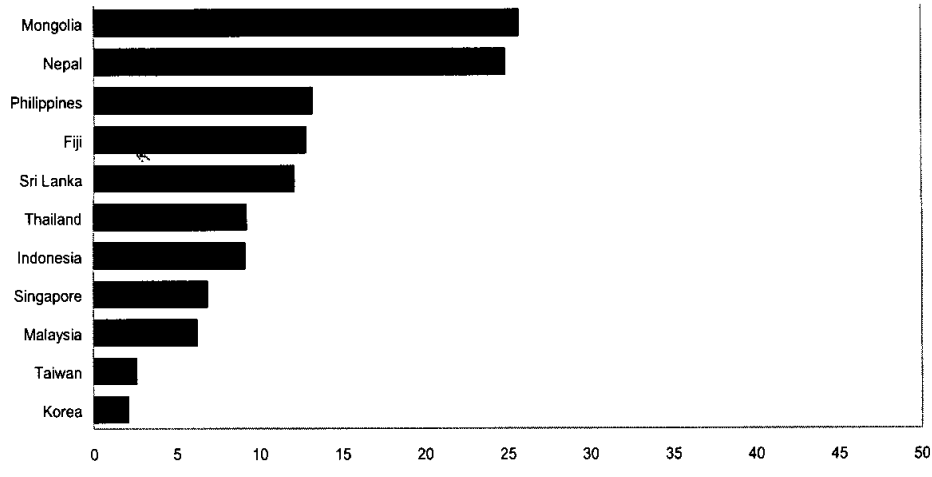


Source: Asian Development Bank

Figure 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 (International Monetary Fund, 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 percent include Myanmar, Mongolia and Nepal. Relatively low ratios were found in Korea, Taiwan, Malaysia and Singapore.

Figure 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.

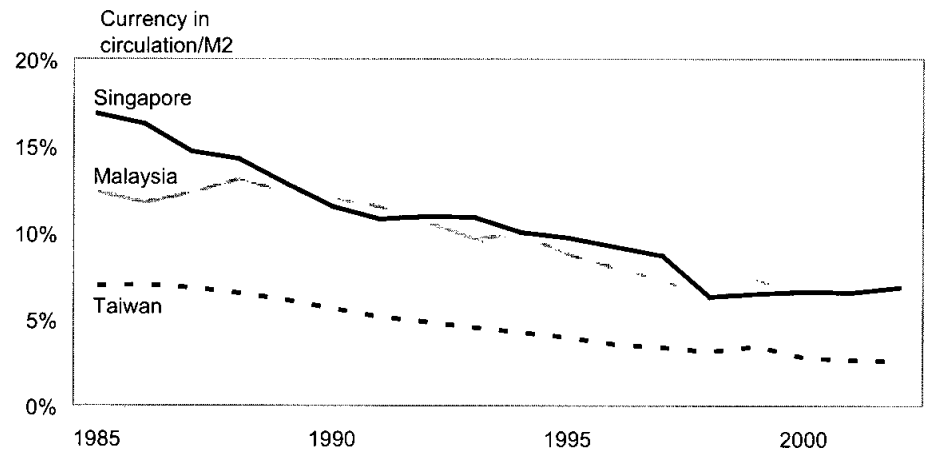
Figure 9. Currency in circulation to M2, in percent, 2002



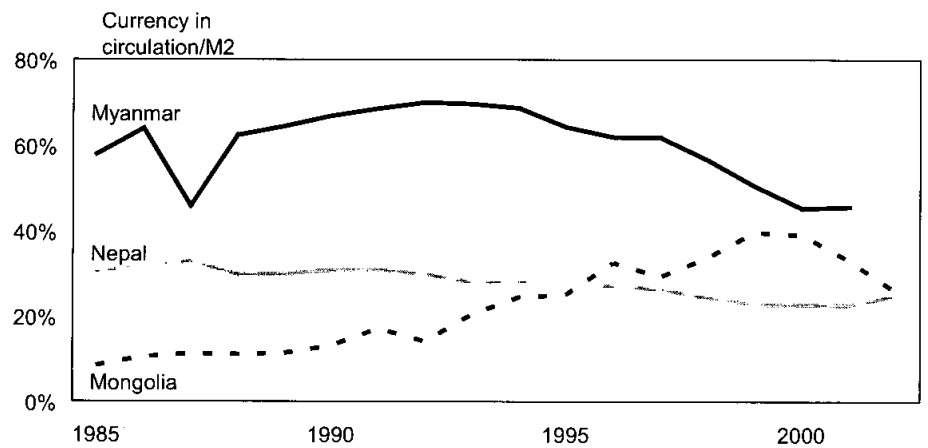
Source: Asian Development Bank
Notes: Figure for Myanmar is for 2001

Figure 10. Currency in circulation to M2, 1985-2002

(a) Malaysia, Singapore and Taiwan

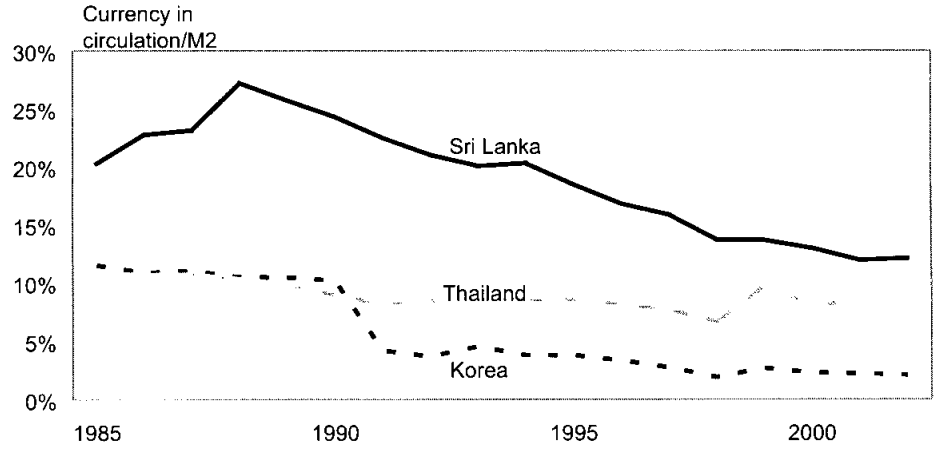


(b) Nepal, Mongolia and Myanmar

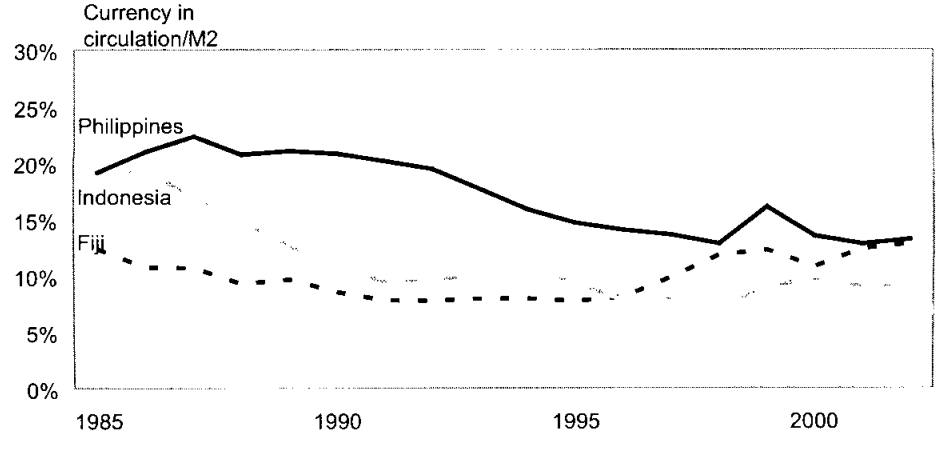


Source: Asian Development Bank
Notes: Figure for 2002 is not available for Myanmar.

(c) Korea, Sri Lanka, and Thailand



(d) Fiji, Indonesia, and Philippines



Source: Asian Development Bank

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 (the opportunity cost of holding idle cash balances (Humphrey et al., 1996, p. 916). The period preceding the century date change clearly further explains how cash continues to command confidence from consumers, as central banks in 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. Age of 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 automated teller machine (ATM) terminals tend 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, pp. 14-19). 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 that don't choose to subsidise or cross-subsidise cash services, after which price 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.

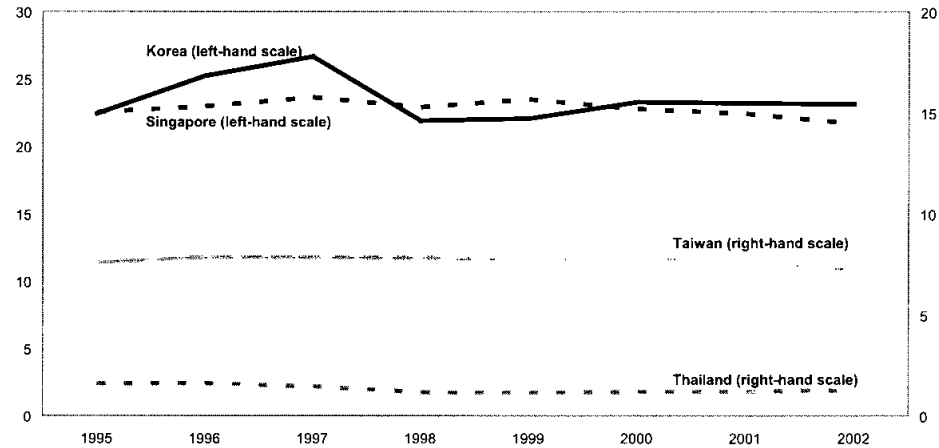
3.2 Cashless transactions

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

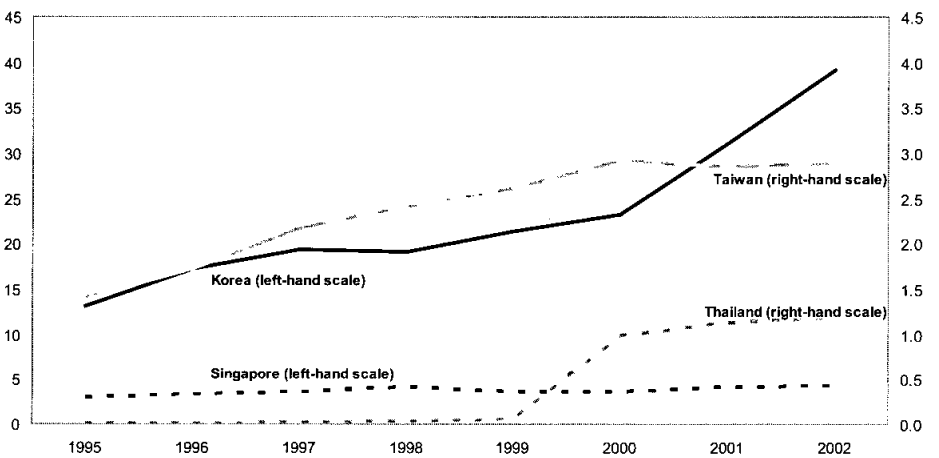
Figure 11 shows the number of cheque transactions per person per year for Korea and Singapore to be above 20, while Taiwan averaged 7 and Thailand 1 for the period 1995-2002. Figure 12 shows the number of paperless credit transfers per person per year with a relatively high number for Korea (39 in 2002), 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 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)

Figure 11. Number of cheque transactions per person, 1995-2002



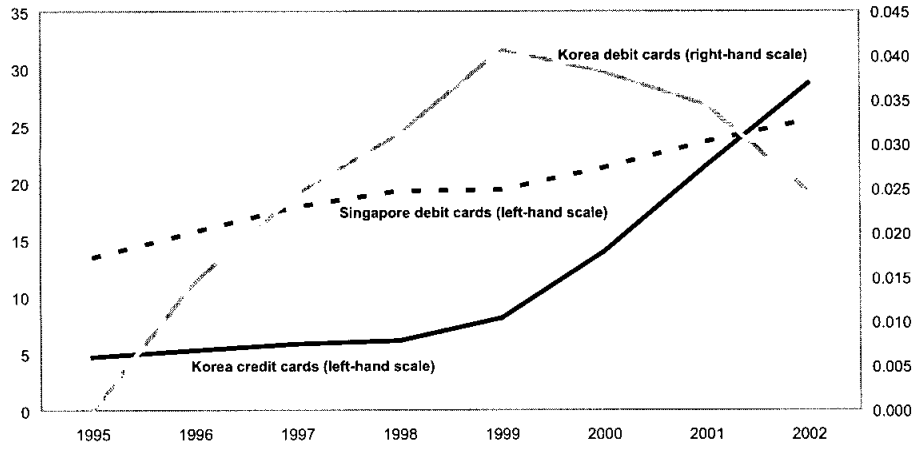
Source: EMEAP (2002), Torreja (2001) and central bank electronic sources

Figure 12. Number of credit transfer transactions per person, 1995-2002



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

Figure 13. Number of credit and debit card transactions per person, 1995-2002



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

3.3 A model of payment instrument use

We adopt a six-equation model developed by Humphrey et al. (1996, p. 927) with modifications to examine the factors that influence each payment instrument use both over time and across countries. This takes a log-linear form as follows:

$$(1) \quad \ln I_i = \alpha_i + \beta_1 \ln GDP_i + \beta_2 \ln ATM_i + \beta_3 \ln CASH_i + \beta_4 \ln CRIME_i + \beta_5 Y2K$$

where:

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.

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 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.

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 gross domestic product. Cash usage is positively correlated with the growth of automated teller machines and negatively correlated with the growth of point of sale terminals, crime rates, and a potential computer crisis (Y2K crisis). Table 2 summarises the regression results using pooled data. Appendices 3-4 present the data assumptions and notations, and estimation results, respectively.

Table 2. Regression results on use of payment instrument using pooled data

Explanatory variables	**Dependent variable: use of payment instrument**					
	(1) Cheque	**(2) ATM Card**	**(3) Credit Card**	**(4) Debit Card**	**(5) Credit Transfer**	**(6) Postal Money Order**
ln (GDP)	1.4733	-1.1064	0.4135	20.7260	-1.7301	-1.7047
	(7.5832) $^{+}$	(-5.5494) $^{+}$	(1.6959) ^{x}	(5.7250) $^{+}$	(-2.2497) *	(-1.7186) ^{x}
ln (ATM)	-0.6324	1.2682	-0.5316	-13.3242	4.4902	0.6119
	(-2.5621) $^{+}$	(5.0072) $^{+}$	(-1.7164) ^{x}	(-3.9362) $^{+}$	(4.5957) $^{+}$	(1.0758)
ln (CASH)	-1.8231	1.1237	-0.2239	-9.7855	3.6713	-0.4968
	(-4.9983)	(3.0023) $^{+}$	(-0.4892)	(-1.7981) ^{x}	(2.5427) $^{+}$	(-1.1368)
ln (CRIME)	0.3048	-0.1091	0.2910	-1.4410	0.8671	-0.0763
	(2.8853) $^{+}$	(-1.0069)	(2.1946)*	(-1.9022) ^{x}	(2.0733) *	(-0.3653)
Y2K	0.0459	-0.0485	0.1380	-0.2864	0.2615	0.2194
	(0.3394)	(-0.3489)	(0.8117)	(-0.2753)	(0.4877)	(1.8451) ^{x}
R^2-adjusted	0.9261	0.5382	0.1428	0.9717	0.7988	0.8291
N	32	32	32	16	32	16

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

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 (significant at 1%, 1% and 10%, respectively). 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 (significant at 1% and 10%, respectively). However, paperless credit transfers showed a negative relationship to an increase in per capita income (significant at 5%).

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 (significant at 1%, 10% and 1%, respectively). 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 (significant at 1% and 10%, respectively). 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 (significant at 1% and 5%, respectively). Not all crimes are monetary-related, however. A relatively strong relationship was also found for credit transfers (significant at 5%). 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.

3.4 Financial services infrastructure and x-efficiency

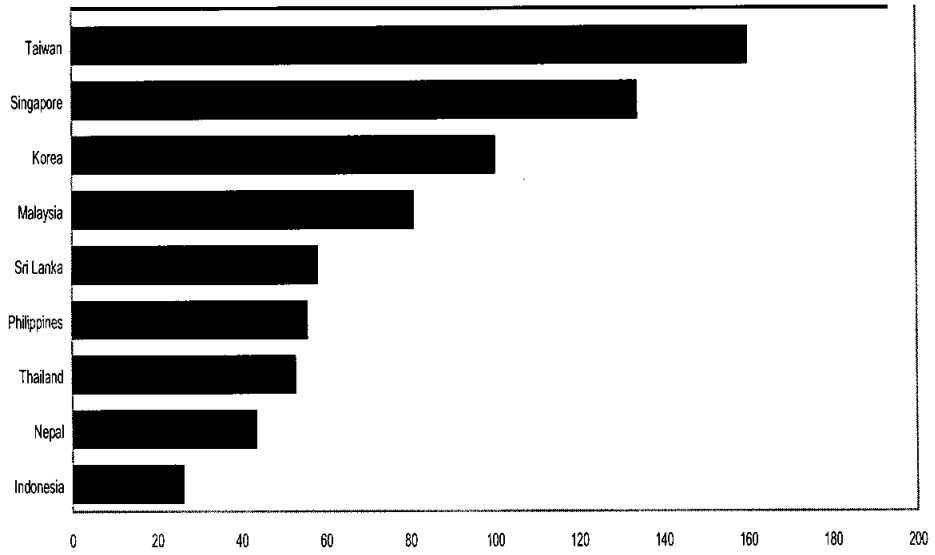
Payment systems are a key component of a country's financial infrastructure. Payment networks rely on financial institutions and non-financial institutions alike

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 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.

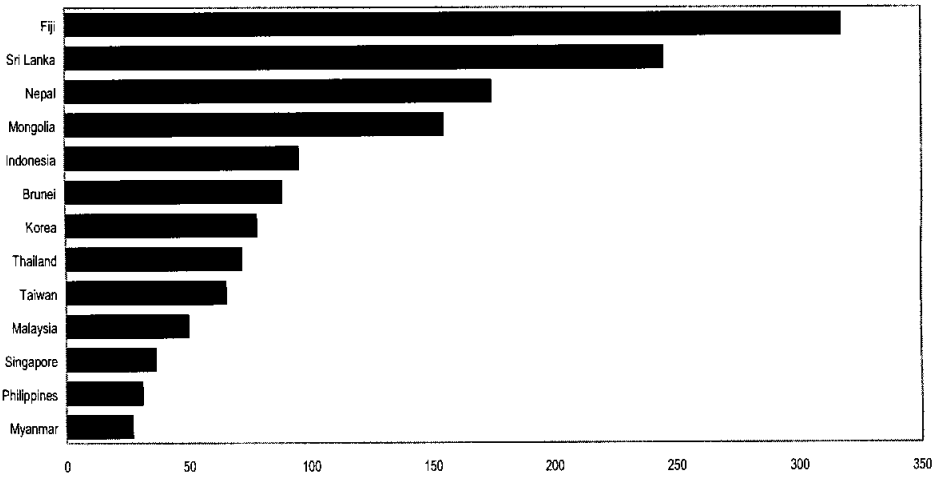
Figure 15 illustrates Fiji as the leading country in the number of post office branches per one million people, with 317 post offices serving a relatively small population below one million in 2001. Sri Lanka, Nepal and Mongolia were also leading countries with 245, 174, 154 post office branches per one million people, respectively. Myanmar, the Philippines and Singapore have 27, 31 and 36 post office branches per one million people, respectively. Customers may gain access to payment services, and possibly other financial services, through the post office. 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.

Figure 14. Commercial bank branches per 1 million people



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.

Figure 15. Post offices per 1 million people

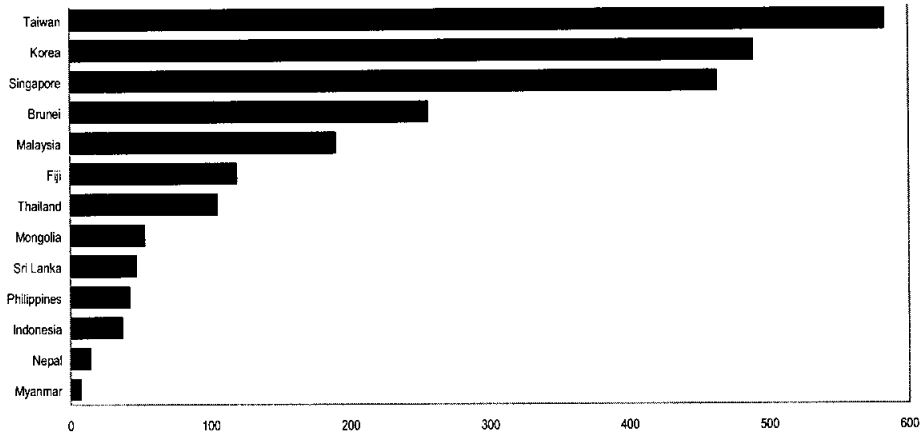


Source: Universal Postal Union, Statistics, www.upu.int; Torreja (2001b); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.
Notes: Figures are for 2002. Data for Fiji and Indonesia are 2001; Data for Nepal is 2000.

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 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 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 mainlines form the basis of many banking services such as telephone banking through call centers and Internet banking. This becomes particularly important with large countries where major financial cities are in distant geographical proximity. Figure 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 18 illustrates 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 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.

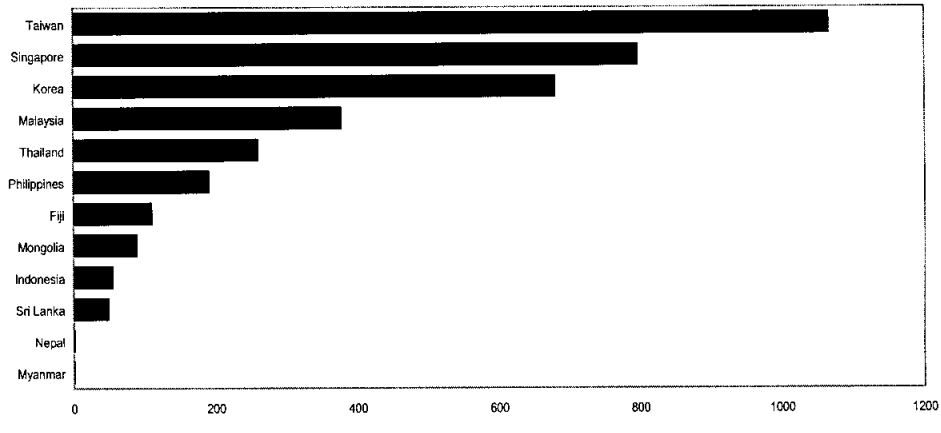
The figures above provide broad indicators. Although Internet users may be high or have high growth rates in some countries, this does not imply that there is a tendency to use Internet banking. Moreover, even if there are Internet banking users, it is important to examine if the accounts have been activated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

Figure 16. Telephone mainlines per 1,000 people



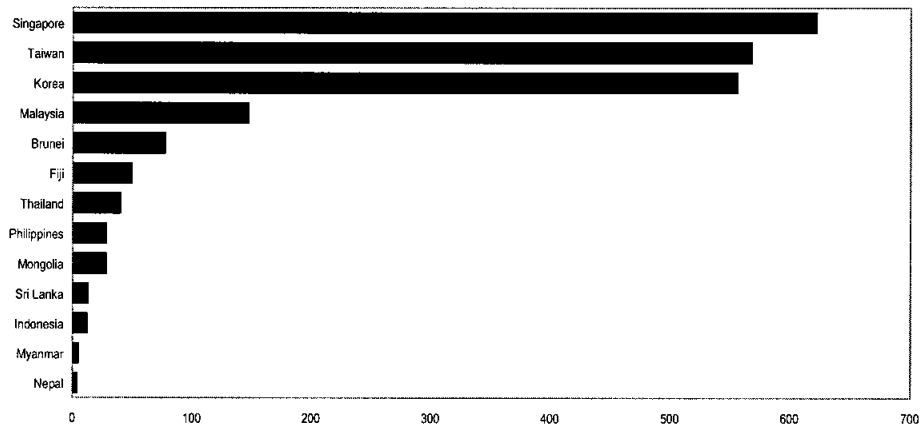
Source: International Telecommunication Union (2003); Directorate General of Budget Accounting and Statistics Executive Yuan,
Note: Figures are for 2002

Figure 17. Mobile phones per 1,000 people



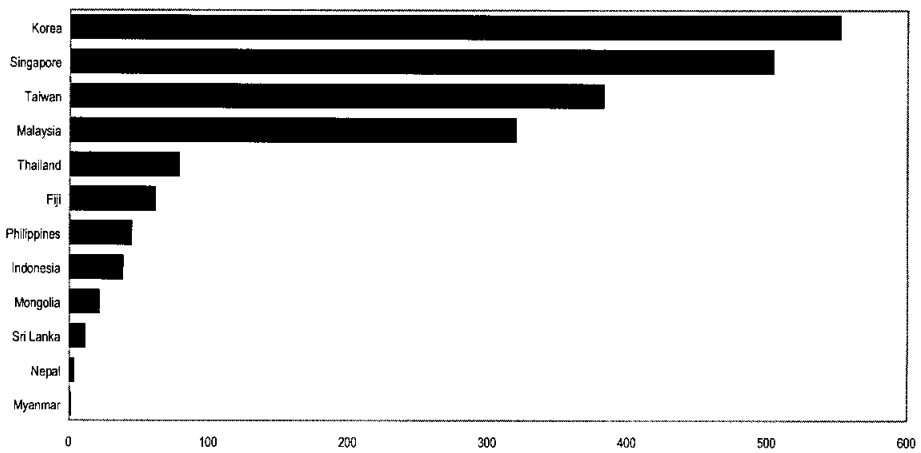
Source: International Telecommunication Union (2003); Directorate General of Budget Accounting and Statistics Executive Yuan, R.O.C.
Note: Figures are for 2002. Data is not available for Brunei.

Figure 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.

Figure 19. Internet users 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.

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 influence efficiency as it largely influences the pricing objective of a payment system. Basically, 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 subsidize 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 Canadian Payments Association (CPA), the Association for Payment Clearing Services (APACS), and the Australian Payments Clearing Association (APCA) 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. There is the lack of a specific time-frame for forecasting transaction volumes and costs.

3.5 Implications for payment systems efficiency

A country may save 1 percent of its gross domestic product 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, p. 159). 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 gross domestic product, 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 automated clearing houses. This helps promotes operational efficiency in operations 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.

And fourth, the shift to more efficient payment methods would largely depend on the x-efficiency factor. This covers organisational and managerial dimensions. The private sector, thru 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 Pricing of central bank payment services

4.1 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. Appendix 6 summarises the basic information for each payment system, including their year of implementation, ownership, message carrier, membership, volume of transactions, and value of transactions. Table 3 summarises the pricing method for selected payment systems. This

Table 3. Summary of pricing method

Payment System	Pricing Method: 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.

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 five 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. Appendix 6 provides a detailed description for each payment system. 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 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.

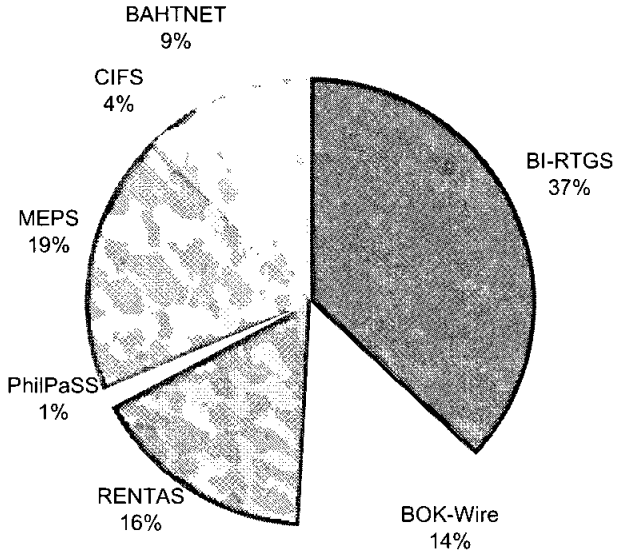
A total of 12 million payment instructions valued at USD 37 trillion were processed by SEACEN RTGS systems in 2003. Figure 20 presents the percentage share of transaction volumes in seven selected SEACEN RTGS systems to total transaction volume. BI-RTGS, where the growth of transaction volumes doubled for the period 2002-2003, has the highest percentage share of 37 percent, 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.

Figure 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 percent for the period 2002-2003.

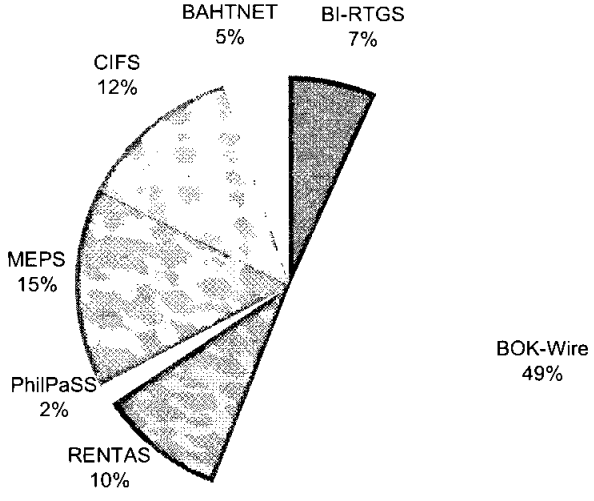
Figure 22 compares the number of RTGS payment instruction per one thousand persons in selected SEACEN RTGS systems. The highest ratio was for MEPS (462), followed by RENTAS (80), BOK-Wire (33), CIFS (20), BI-RTGS (18) and BAHTNET (15). RTGS systems in Sri Lanka and the Philippines were relatively low due to their recent introduction. Figure 23 compares the transaction value per payment instruction. The highest ratio was for BOK-Wire (USD 12 million) and CIFS (USD 10 million) with other RTGS systems ranging between USD 1-4 million.

Figure 20. Percentage share of RTGS transaction volumes, 2003



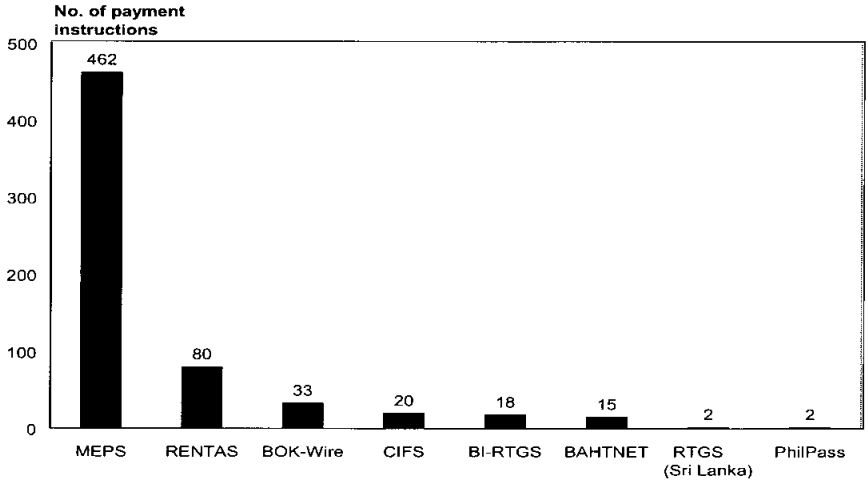
Source: Survey questionnaire

Figure 21. Percentage share of RTGS transaction values, 2003



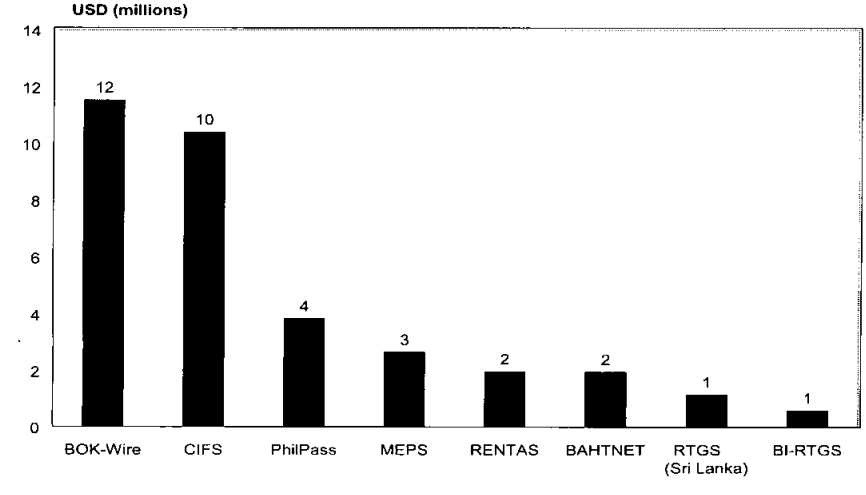
Source: Survey questionnaire

Figure 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.

Figure 23. RTGS transaction value per payment instruction, 2003



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

Table 4. Summary of payment system fees, in US dollars

Payment System	Type and Amount of Fee		
	Admission Fee	Membership Fee	Transaction Fee[1/]
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

Note: [1/] 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.

4.2 Fees and central bank services

Table 4 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 (See Appendix 7 for details on the pricing schedule for each payment system in local currency and Appendix 8 for USD exchange rates).

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 USD 0.12 (Korea) to USD 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 5 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 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 simply 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 5. Summary of fee structure and allocation

	Type of Fee Structure			Allocation
Payment System	**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

Table 6 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 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.

Table 6. Summary of central bank services and intraday credit facility charges

	Types of Services and Charges			
Payment System	**Settlement Account Charges**	**Interest on Settlement Balances**	**Form of ILF Facility**	**Interest Rate for ILF Facility**
Indonesia				
BI-RTGS	None	None	Collateralised ILF charged	Overnight rate[1/]
Korea				
BOK-Wire	None	None	Collateralised ILF free	Call rate[2/]
Malaysia				
RENTAS	None	None	Intraday credit free	
Philippines				
PhilPaSS	None	Yes	Intraday repos free	Weekly rate[3/]
Singapore				
MEPS	None	None	Intraday repos	
Sri Lanka				
RTGS System	None	None	Collateralised ILF free	
Taiwan				
CIFS	None	None	Collateralised ILF charged	CBC secured loan rate[4/]
Thailand				
BAHTNET	None	None	Collateralised ILF free	14-day repo rate[5/]

Source: Survey questionnaire

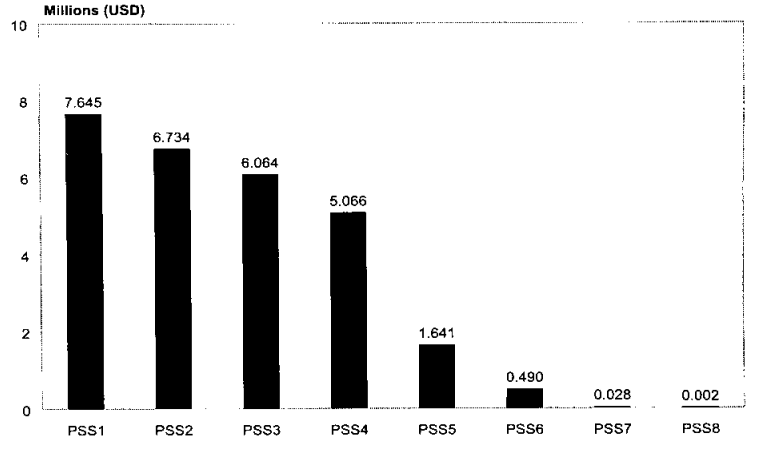
Notes: [1/] Weighted average overnight rate for overall money market (PUAB) at one day prior to the application of the intra-day liquidity facility (FLI). [2/] Unpaid intraday overdraft converted to a temporary loan carrying a penalty interest rate (average call transaction rate + 2%). [3/] Overnight 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. [4/] Interest charges are calculated by minute. [5/] Use of ILF overnight incurs interest charges equivalent to the 14-day repurchase rate plus the rate of 1.5%.

4.3 Costs and revenue

Figure 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 for the period 2000-2004 amounted to USD 28 million. Total investment cost for RTGS and retail payment systems amounted to USD 26 million and USD 2 million, respectively. The average investment cost for an RTGS system amounted to USD 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 center (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).

Figure 24. Investment costs in payment systems, 2000-2004



Source: Survey questionnaire

Table 7 summarises the types of costs included in the accounting process. This forms the basis of the pricing structure and schedule. A majority of countries

Table 7. Summary of costs included in the accounting process

	Costs Covered in the Accounting Process			
Payment System	**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 amortised 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 amortised at 10 years Peripherals and related installations amortised 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

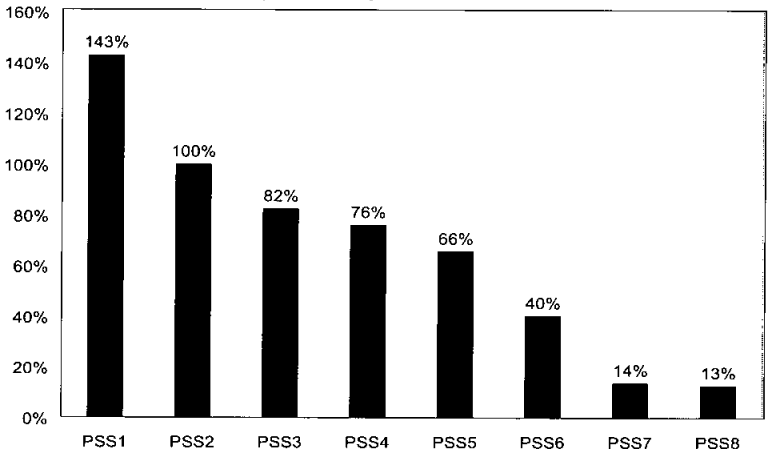
include operating, development and capital costs in determining fees. The investment horizon ranges from 5 to 10 years, largely depending on the pricing method. With subsidised methods, where operating costs are excluded in the accounting process, a longer period was used (e.g. BI-RTGS). Other factors 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.

Figure 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 percent. Figure 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 total cost recovery was found in a majority of payment systems. The average total cost recovery ratio was 52 percent for RTGS systems, with the highest at 100 percent and lowest at 13 percent. 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 percent, and the highest and lowest ratios at 97 percent and 8 percent, respectively.

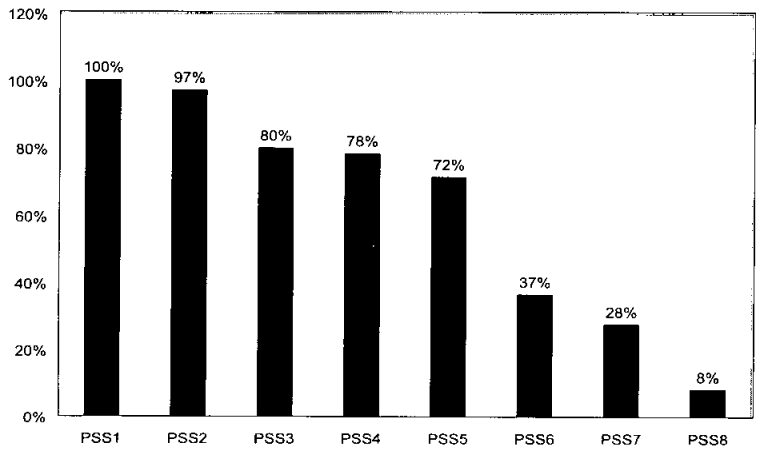
Subsidies were clearly evident in the cost recovery ratio results. Total subsidies for six payment systems amounted to USD 3.7 million. Total subsidy for RTGS systems alone amounted to USD 3.3 million. The highest and lowest subsidies amounted to USD 1.8 million and USD 0.2 million, respectively. The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

Figure 25. Total cost recovery ratio in selected SEACEN payment systems, 2003



Source: Survey questionnaire

Figure 26. Unit cost recovery ratio in selected SEACEN payment systems, 2003



Source: Survey questionnaire

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 behavior 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 Bank for International Settlements, the European Central Bank, 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.

4.4 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:

$$(2)\quad \ln UC_i = \alpha_{UC} + \beta_1 \ln VOL_i$$

The translog cost function takes the following quadratic form:

$$(3)\quad \ln TC_i = \alpha_{TC} + \beta_1 \ln VOL_i + \beta_2\ 1/2\ (\ln VOL_i)^2$$

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 2 is used to examine the effects of the number of payment instructions on unit cost. Equation 3, the translog cost function, is a more specific model developed for large-value payment systems and check clearing systems, examining the effects of output expansion on average unit cost (Humphrey, 1984, pp. 130-132). 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 8 summarises the regression results on estimating scale economies in selected large-value payment systems for each of the two equations (See Appendix 5 for detailed regression results). 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 5 payment systems from the SEACEN countries with 15 observations. A larger sample would have been preferred for the latter sample but this was constrained with 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.

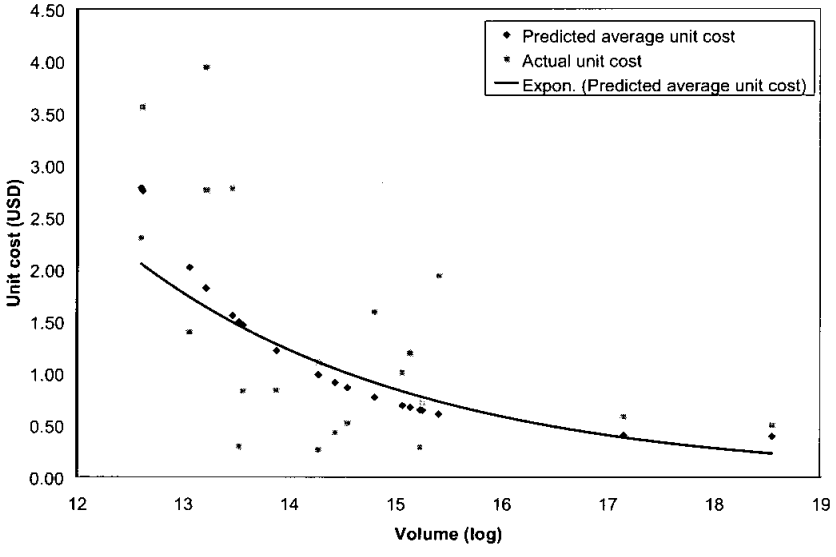
Table 8. Regression results on scale economies using pooled data

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}).

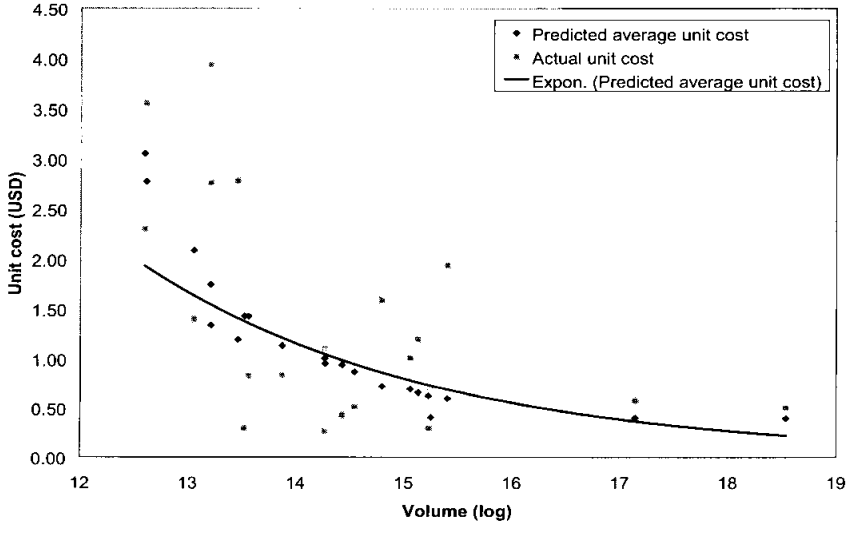
Figures 27-29 present a scatter diagram of the long-run average unit cost with cost-output point estimates for individual years for the period 2001-2003. Figure 30 provides a three-year average for the period 2001-2003. Average unit costs are reported in US dollars with transaction volumes converted to their logarithmic values. The scatter diagrams show a common pattern of an L-shaped curve. In theory, average unit cost firstly falls sharply, while leveling out and remaining flat when a certain level of output is achieved.

Figure 27. Average unit cost in large-value payment systems, 2001



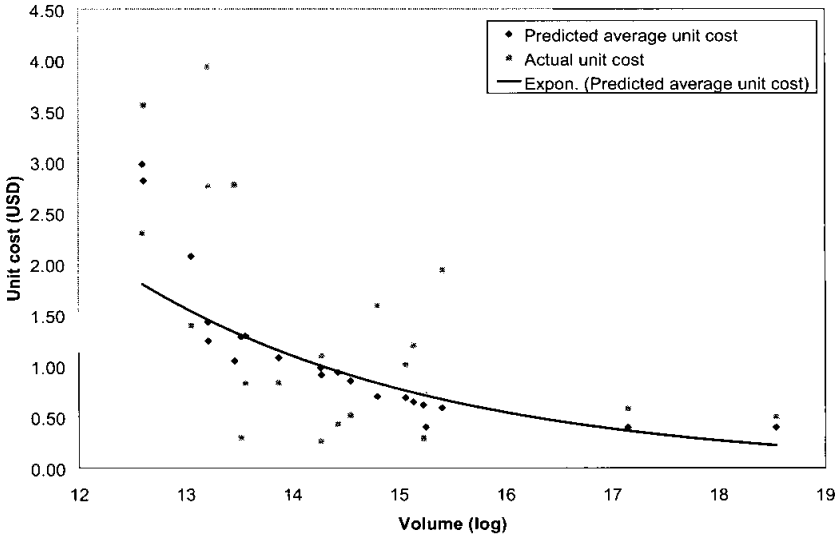
Source: Author's estimates

Figure 28. Average unit cost in large-value payment systems, 2002



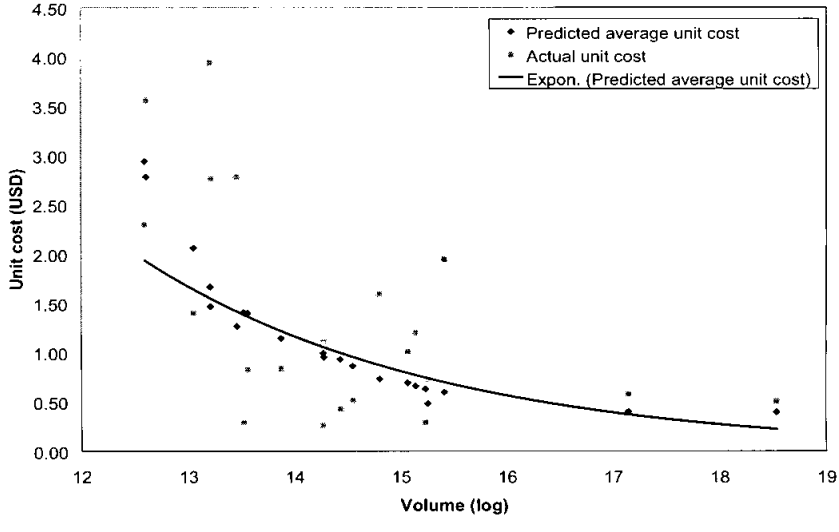
Source: Author's estimates

Figure 29. Average unit cost in large-value payment systems, 2003



Source: Author's estimates

Figure 30. Average unit cost in large-value payment systems, 2001-2003



Source: Author's estimates

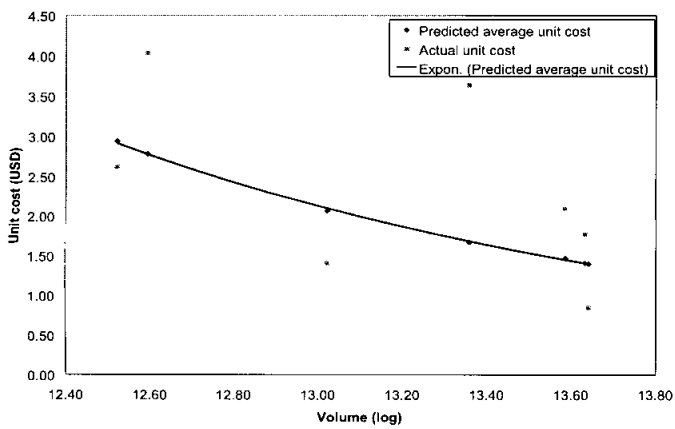
Table 9 groups the payment systems into three transaction classes based on their annual average transaction volumes handled for the period 2001-2003. The average annual transaction volume for this sample period is 96,490 items. A majority of payment systems are classified as medium-scale operations where the annual number of payment instructions processed ranged from one to 10 million items, accounting for 4 percent of average total transaction volume. Actual average unit 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 31 shows predicted average unit costs falling from USD 3 to USD 1.5. Figure 32 shows average unit costs decreasing to USD 1 on average in medium-scale operations. Figure 33 shows average unit cost dropping below USD 1 for large-scale operations where annual transaction volumes are above 10 million items.

Table 9. 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 (USD)	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

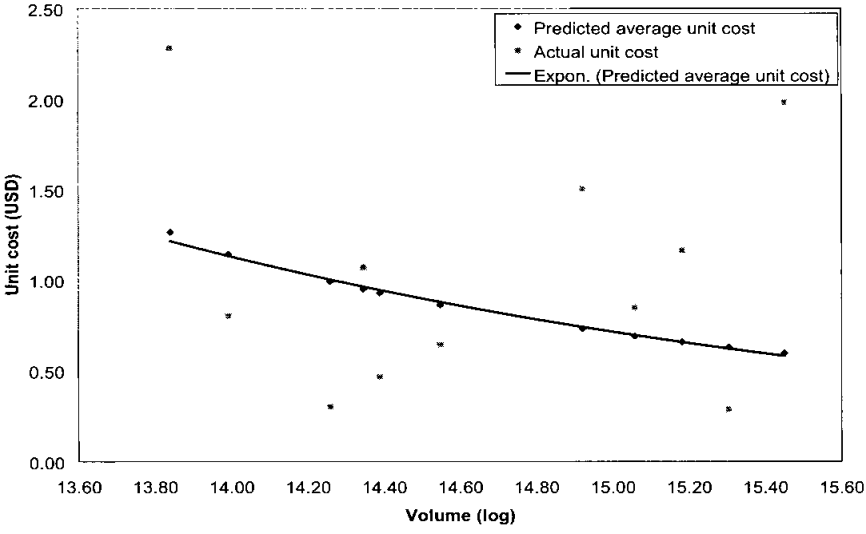
Source: Author's estimates

Figure 31. Average unit cost in small-scale operations, 2001-2003



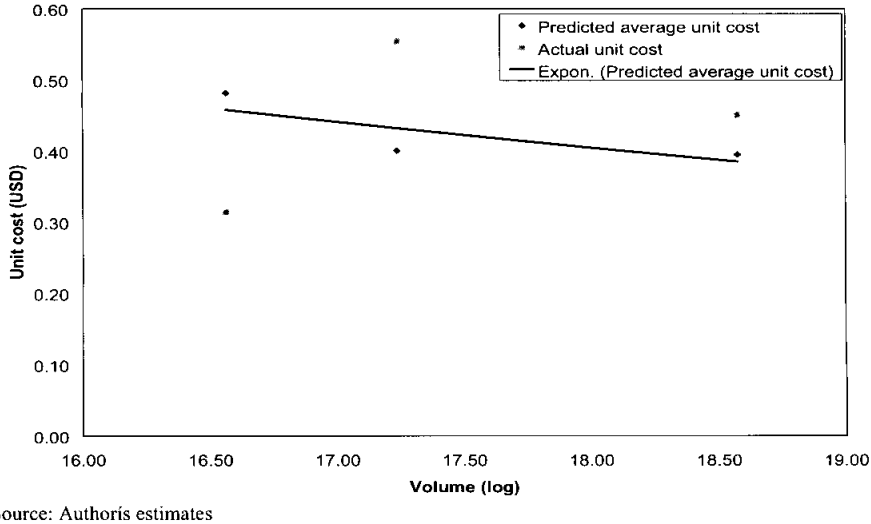
Source: Author's estimates

Figure 32. Average unit cost in medium-scale operations, 2001-2003



Source: Author's estimates

Figure 33. Average unit cost in large-scale operations, 2001-2003



Source: Authoris estimates

4.5 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 one to five 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 to 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.

4.6 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:

Recommendation 1: Collect cost and revenue data. The *accounting methodology* applied to cost data collection assist 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 down 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.

Recommendation 2: Forecast demand. A *forecasting model* of payment transaction volumes assists with capacity planning and the impact analysis on operating costs and revenues. For example, while real gross domestic product may be a significant determinant for the growth of cheque and automated clearing

house 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, 2004). As payment systems handle different types of transactions, it helps to develop a detailed forecasting model that captures the variables, other than gross domestic product, that influence their growth.

Recommendation 3: Formulate pricing strategy. 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 (For details, see Humphrey et., al, 1997; Humphrey, 1984, pp. 24-45). 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, p. 14). 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 ($V_{i,\ processed}$), the number of files submitted to be processed as batched payments ($V_{i,\ file}$), and the number of payment accounts serviced in real time ($V_{i,\ accounts}$). Fee setting for large-value and retail payment systems may take the following forms under two-part pricing:

For RTGS systems:

$$P_i = TVC_i/V_{i,\ processed} + TFC_i/V_{i,\ account}$$

For ACH and cheque clearing systems:

$$P_i = TVC_i/V_{i,\ processed} + TFC_i/V_{i,\ file}$$

The advantage of two-part fee structure are three-fold. 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.

Recommendation 4: Review price schedule. *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 five 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.

5 Conclusions

This study examined policy approaches to payment systems efficiency in the SEACEN countries. 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.

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 gross domestic product. 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.

Second, total investment cost in payment and settlement systems amounted to approximately USD 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 USD 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 USD 3 to USD 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 two-fold. 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 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.

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Appendix 2 Questionnaire on pricing policy for central bank payment services

SEACEN RESEARCH PROJECT ON POLICY APPROACHES TO PAYMENT SYSTEM EFFICIENCY

QUESTIONNAIRE ON PRICING POLICY FOR CENTRAL BANK PAYMENT SERVICES

Instructions:

1. Please answer for both large-value (real-time gross settlement systems) and retail (cheque clearing systems and automated clearing house systems) payment systems owned and operated by the central bank.
2. Use a separate answer sheet for each payment system under review.
3. Indicate 'non-applicable' for non-relevant questions.
4. Return the questionnaire response by **July 31, 2004**.

Notes:

For SEACEN member banks with membership in EMEAP, please be notified that the questionnaire was previously conducted for a workshop in March 18-19, 2004 where questions in Sections I-III are unchanged. Minor changes include the request for 2002 data in Section I and the request for cost and revenue data in Section IV.

Section I Basic information

This section provides basic information on the payment system under review.

1. What is the name of the payment system (e.g. In Thailand, BAHTNET is the RTGS system, ECS is the electronic cheque clearing system, and SMART is the automated clearing house system)?
2. When was the payment system implemented?
3. Ownership of the payment system
   - 3.1 Who is the owner of the payment system?
   - 3.2 Who operates the system? Please indicate any outsourcing agreement.
   - 3.3 Who is the message carrier (e.g. SWIFT)?
4. How many direct members does the payment system have (at year-end 2003)?

5. Transactions settled in the payment system
   5.1 What type of transactions does the payment system settle?
   5.2 What is the aggregate number of transactions in 2002 and 2003 (in thousands)? Please also indicate the likely trend in the medium term.
   5.3 What is the aggregate value of transactions in 2002 and 2003 (in domestic currency)? Please also indicate the likely trend in the medium term.
6. Are other payment systems a substitute for, or complementary to, the payment system under review here? Please describe the (competitive) environment briefly.

Section II Pricing methodology

The Core Principles discuss three methods for pricing payment transaction: cost recovery method, market-based pricing and subsidised pricing (*Core Principles for Systemically Important Payment Systems,* CPSS-BIS, Basel, January 2001, Box 17).

1. Pricing method
   1.1 Which of the three methods reflects the reality of the payment system the closest?
   1.2 Which types of costs are included in the accounting process (e.g. operating costs, development costs, capital costs)? How are these costs, particularly the capital costs, taken into consideration in practice?
   1.3 From an accounting point of view, what is the investment horizon over which assets (constituting the payment system infrastructure) are amortised? Is this the same investment horizon as is used for similar central bank assets? Are there any other ways in which the accounting treatment of the payment system differs from other central bank accounting treatment?

2. Does the chosen pricing method have a legal basis and/or documentation? Please describe briefly who is responsible for choosing and implementing the pricing method.

3. How often and by whom is the pricing method reviewed? If the system is privately owned, does it require the approval of the overseer?

Section III Payment system fees and central bank services

1. Admission fee
   - 1.1 Does an admission fee apply? If so, how large is it?
   - 1.2 Does the admission fee relate to the level of services provided? If so, how exactly? Is there any other factor that influences the fee (e.g. member size)?
   - 1.3 How often and by whom is the admission fee reviewed?
   - 1.4 Does the admission to the payment system imply specific investments for participants (e.g. software, hardware)? If so, to what extent?
2. Membership fee
   - 2.1 Does a membership fee apply? If so, how large is it? How often is it paid?
   - 2.2 Does the membership fee relate to the level of services provided? If so, how exactly? Is there any other factor that influences the fee (e.g. member size)?
   - 2.3 How often and by whom is the membership fee reviewed?
3. Payment transaction and communication fees
   - 3.1 What are the transaction fees applied in the payment system (e.g. flat fees, value and/or volume-based fees, time-based fees or any combination such as two-part pricing)? Please indicate whether there is a transaction fee that also applies to the receiver of the payment.
   - 3.2 Are information queries (e.g. queries on account balances) charged for? If so, how are they charged?
   - 3.3 Are there minimum daily charges for using the payment system? If so, what are they and how are they determined?
   - 3.4 What are the communication links with the payment system (e.g. SWIFT)? What are the corresponding fees?
4. Central bank services
   - 4.1 Where central bank money is used as a settlement asset, are settlement accounts offered free of charge? If not, are there account-based or transaction-based charges?
   - 4.2 Is there any interest paid on settlement balances? If so, how much?
   - 4.3 If an intraday credit facility is offered, which form (e.g. overdrafts with or without collateral, repos) does it take? What rate of interest is charged? Who bears any transaction costs (e.g., associated with repos or collaterals)?

Section IV Payment system cost and revenue

1. Cost data
   - 1.1 What is the investment cost since 2000 (in domestic currency)? What were they for (e.g., development of new system, enhancement of old system)?
     What was the source of funds (self-funded, World Bank, Asian Development Bank, etc.)?
   - 1.2 What types of costs are included in the investment cost?
   - 1.3 How much was the operational cost in 2002 and 2003? (in domestic currency for each payment system)
   - 1.4 What types of costs are included in the operational cost?
2. Revenue data
   - 2.1 How much was the operating revenue in 2002 and 2003 (in domestic currency for each payment system)?
   - 2.2 What is included in the operating revenue (e.g., transaction fees, etc.)?

THANK YOU VERY MUCH FOR YOUR ASSISTANCE

Appendix 3 Data assumptions and notations

Data assumptions: model of payment instrument use

Time series statistics on payment and settlement systems across the SEACEN countries are scarce, therefore making regression analysis difficult. Data from four countries – Korea, Singapore, Taiwan and Thailand – provide relatively adequate information to compare cash and cashless instrument use across time and countries. To develop a complete data set for the chosen time period, the following assumptions are made:

Debit card transactions
For Korea, the growth rate of debit card transactions for 1996-1997 was used to derive the number of transactions in 1995.

Value of transactions per credit card
Value of transactions per credit card is used as a proxy for the number of credit card transactions, which were not available for all the countries except for Korea. For Korea, figures cover cards issued by banks and non-banks and values are for lump sum and installment purchases, and cash advances (Source: Korea Non-Bank Financing Association). For Taiwan, figures for 2001-2002 are based on the annual growth rate of credit transaction values in the preceding year. Transaction values per card are translated into US dollars using the average exchange rate for 1995-2002 to reduce "noise".

Number of point of sale (POS) terminals
For Korea, the average growth rate of credit card and debit card transactions for 1996-1997 was used to derive the number of POS terminals in 1995. The number of POS terminals for 2000-2002 were also based on the growth rate of credit card and debit card transactions in the preceding years. For Taiwan, the number of ATM and POS terminals for 2001-2002 were based on the growth rate of the terminals in the preceding years, respectively.

Crime per 100,000 inhabitants
Crimes data from the United Nations Office on Drugs and Crime is available to 2000 only. Data for 2001-2002 will be covered under the Eight Survey, which is currently in progress at the time of writing. For Korea, Singapore and Thailand, the average growth rate of crime per 100,000 inhabitants for the two preceding years are used as estimates for the number of crime in 2001 and 2002. For Taiwan, crime data was obtained from the Ministry of Justice, Statistics of Justice

Crimes, which are recorded in criminal police statistics (including attempted crime) include the following: homicide, firearms, assaults, rapes, robberies, thefts, automobile thefts, fraud, embezzlements, and drug offences.

Y2K

A dummy variable is set for all countries to account for century date change preparations (Y2K crisis) in 1999 and 2000.

Data notations: model of payment instrument use

Variables	**Description**
Kor_atm	Number of ATM terminals per 1,000 person in Korea
Kor_atmcard	Annual ATM transactions per person in Korea
Kor_card	Transaction value per credit card in Korea
Kor_cash	Currency in circulation to gross domestic product in Korea
Kor_chq	Annual cheque transactions per person in Korea
Kor_cri	Number of crimes per 100,000 inhabitants in Korea
Kor_crt	Annual credit transfer transactions per person in Korea
Kor_dbc	Annual debit card transactions per person in Korea
Kor_gdp	Real per capita gross domestic product in Korea
Kor_pmo	Annual postal money order transactions per person in Korea
Kor_pos	Number of point of sale terminals per 1,000 person in Korea
Sin_atm	Number of ATM terminals per 1,000 person in Singapore
Sin_atmcard	Annual ATM transactions per person in Singapore
Sin_card	Transaction value per credit card in Singapore
Sin_cash	Currency in circulation to gross domestic product in Singapore
Sin_chq	Annual cheque transactions per person in Singapore
Sin_cri	Number of crimes per 100,000 inhabitants in Singapore
Sin_crt	Annual credit transfer transactions per person in Singapore
Sin_dbc	Annual debit card transactions per person in Singapore
Sin_gdp	Real per capita gross domestic product in Singapore
Sin_pos	Number of point of sale terminals per 1,000 person in Singapore
Tai_atm	Number of ATM terminals per 1,000 person in Taiwan
Tai_atmcard	Annual ATM transactions per person in Taiwan
Tai_card	Transaction value per credit card in Taiwan
Tai_cash	Currency in circulation to gross domestic product in Taiwan
Tai_chq	Annual cheque transactions per person in Taiwan
Tai_cri	Number of crimes per 100,000 inhabitants in Taiwan
Tai_crt	Annual credit transfer transactions per person in Taiwan
Tai_gdp	Real per capita gross domestic product in Taiwan
Tai_pos	Number of point of sale terminals per 1,000 person in Taiwan

Tha_atm	Number of ATM terminals per 1,000 person in Thailand
Tha_atmcard	Annual ATM transactions per person in Thailand
Tha_card	Transaction value per credit card in Thailand
Tha_cash	Currency in circulation to gross domestic product in Thailand
Tha_chq	Annual cheque transactions per person in Thailand
Tha_cri	Number of crimes per 100,000 inhabitants in Thailand
Tha_crt	Annual credit transfer transactions per person in Thailand
Tha_gdp	Real per capita gross domestic product in Thailand
Tha_pmo	Annual postal money order transactions per person in Thailand
Tha_pos	Number of point of sale terminals per 1,000 person in Thailand
Y2k	Dummy variable for century date change

Data assumptions: model of scale economies in large-value payment systems

Cost data from a previous study are used (Khiaonarong, 2003). 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. Assumptions are also made on no large-scale technological investments in payment systems during this period.

Data notations: model of scale economies in large-value payment systems

Variables	**Description**
Uc_01	Unit cost for 21 large-value payment systems in 2001
Uc_02	Unit cost for 21 large-value payment systems in 2002
Uc_03	Unit cost for 21 large-value payment systems in 2003
Uc_01seacen	Unit cost for 5 SEACEN large-value payment systems in 2001
Uc_02seacen	Unit cost for 5 SEACEN large-value payment systems in 2002
Uc_03seacen	Unit cost for 5 SEACEN large-value payment systems in 2003
Tc_01	Total cost for 21 large-value payment systems in 2001
Tc_02	Total cost for 21 large-value payment systems in 2002
Tc_03	Total cost for 21 large-value payment systems in 2003
Tc_01seacen	Total cost for 5 SEACEN large-value payment systems in 2001

Tc_02seacen	Total cost for 5 SEACEN large-value payment systems in 2002
Tc_03seacen	Total cost for 5 SEACEN large-value payment systems in 2003
Vol_01	Transaction volume for 21 large-value payment systems in 2001
Vol_02	Transaction volume for 21 large-value payment systems in 2002
Vol_03	Transaction volume for 21 large-value payment systems in 2003
Vol_01seacen	Transaction volume for 5 SEACEN large-value payment systems in 2001
Vol_02seacen	Transaction volume for 5 SEACEN large-value payment systems in 2002
Vol_03seacen	Transaction volume for 5 SEACEN large-value payment systems in 2003
Lnvolsq_01	Log square of transaction volume for 21 large-value payment systems in 2001
Lnvolsq_02	Log square of transaction volume for 21 large-value payment systems in 2002
Lnvolsq_03	Log square of transaction volume for 21 large-value payment systems in 2003
Lnvolsq_01seacen	Log square of transaction volume for 5 SEACEN large-value payment systems in 2001
Lnvolsq_02seacen	Log square of transaction volume for 5 SEACEN large-value payment systems in 2002
Lnvolsq_03seacen	Log square of transaction volume for 5 SEACEN large-value payment systems in 2003

Appendix 4 Estimation results of payment instrument use

(1) Cheque equation

Dependent Variable: LOG(?CHQ)
Method: Pooled Least Squares
Date: 07/27/04 Time: 13:25
Sample: 1995 2002
Included observations: 8
Number of cross-sections used: 4
Total panel (balanced) observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.23410	3.012420	-6.384934	0.0000
LOG(?GDP)	1.473313	0.194284	7.583289	0.0000
LOG(?ATM)	-0.632403	0.246825	-2.562155	0.0165
LOG(?CASH)	-1.823130	0.364744	-4.998378	0.0000
LOG(?CRI)	0.304874	0.105662	2.885373	0.0078
Y2K	0.045989	0.135482	0.339449	0.7370

R-squared	0.938052	Mean dependent var	2.149611
Adjusted R-squared	0.926139	S.D. dependent var	1.193193
S.E. of regression	0.324277	Sum squared resid	2.734053
Log likelihood	-6.046820	F-statistic	78.74200
Durbin-Watson stat	1.315953	Prob(F-statistic)	0.000000

(2) ATM card equation

Dependent Variable: LOG(?ATMCARD)
Method: Pooled Least Squares
Date: 07/27/04 Time: 13:25
Sample: 1995 2002
Included observations: 8
Number of cross-sections used: 4
Total panel (balanced) observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.92421	3.091323	5.474746	0.0000
LOG(?GDP)	-1.106407	0.199373	-5.549433	0.0000
LOG(?ATM)	1.268285	0.253290	5.007247	0.0000
LOG(?CASH)	1.123769	0.374298	3.002337	0.0059
LOG(?CRI)	-0.109185	0.108429	-1.006974	0.3232
Y2K	-0.048511	0.139030	-0.348925	0.7300

R-squared	0.612686	Mean dependent var	1.684131
Adjusted R-squared	0.538203	S.D. dependent var	0.489689
S.E. of regression	0.332771	Sum squared resid	2.879153
Log likelihood	-6.874199	F-statistic	8.225799
Durbin-Watson stat	0.618211	Prob(F-statistic)	0.000092

(3) Credit card equation

Dependent Variable: LOG(?CARD)
Method: Pooled Least Squares
Date: 07/27/04 Time: 13:26
Sample: 1995 2002
Included observations: 8
Number of cross-sections used: 4
Total panel (balanced) observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.671924	3.780596	0.177730	0.8603
LOG(?GDP)	0.413508	0.243827	1.695904	0.1018
LOG(?ATM)	-0.531696	0.309766	-1.716446	0.0980
LOG(?CASH)	-0.223967	0.457755	-0.489273	0.6288
LOG(?CRI)	0.291021	0.132606	2.194629	0.0373
Y2K	0.138026	0.170030	0.811773	0.4243

R-squared	0.281061	Mean dependent var	7.734347
Adjusted R-squared	0.142804	S.D. dependent var	0.439563
S.E. of regression	0.406969	Sum squared resid	4.306222
Log likelihood	-13.31523	F-statistic	2.032882
Durbin-Watson stat	0.462066	Prob(F-statistic)	0.107073

(4) Debit card equation

Dependent Variable: ?DBC
Method: Pooled Least Squares
Date: 07/27/04 Time: 13:26
Sample: 1995 2002
Included observations: 8
Number of cross-sections used: 2
Total panel (balanced) observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-212.2937	52.57661	-4.037798	0.0024
LOG(?GDP)	20.72601	3.620251	5.725021	0.0002
LOG(?ATM)	-13.32421	3.385041	-3.936202	0.0028
LOG(?CASH)	-9.785517	5.441915	-1.798175	0.1024
LOG(?CRI)	-1.441018	0.757547	-1.902215	0.0863
Y2K	-0.286430	1.040415	-0.275303	0.7887

R-squared	0.981165	Mean dependent var	9.746713
Adjusted R-squared	0.971747	S.D. dependent var	10.39536
S.E. of regression	1.747318	Sum squared resid	30.53119
Log likelihood	-27.87230	F-statistic	104.1834
Durbin-Watson stat	2.101707	Prob(F-statistic)	0.000000

(5) Credit transfer equation

Dependent Variable: LOG(?CRT)
Method: Pooled Least Squares
Date: 07/27/04 Time: 13:27
Sample: 1995 2002
Included observations: 8
Number of cross-sections used: 4
Total panel (balanced) observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.40697	11.92446	2.046799	0.0509
LOG(?GDP)	-1.730164	0.769061	-2.249710	0.0332
LOG(?ATM)	4.490271	0.977039	4.595795	0.0001
LOG(?CASH)	3.671300	1.443815	2.542777	0.0173
LOG(?CRI)	0.867178	0.418255	2.073326	0.0482
Y2K	0.261556	0.536295	0.487709	0.6298

R-squared	0.831290	Mean dependent var	0.478549
Adjusted R-squared	0.798846	S.D. dependent var	2.862041
S.E. of regression	1.283630	Sum squared resid	42.84036
Log likelihood	-50.07395	F-statistic	25.62220
Durbin-Watson stat	0.762001	Prob(F-statistic)	0.000000

(6) Postal money order equation

Dependent Variable: LOG(?PMO)
Method: Pooled Least Squares
Date: 07/27/04 Time: 13:28
Sample: 1995 2002
Included observations: 8
Number of cross-sections used: 2
Total panel (balanced) observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.48642	8.899695	1.403017	0.1909
LOG(?GDP)	-1.704762	0.991920	-1.718648	0.1164
LOG(?ATM)	0.611968	0.568807	1.075880	0.3073
LOG(?CASH)	-0.496869	0.437056	-1.136854	0.2821
LOG(?CRI)	-0.076357	0.208972	-0.365393	0.7224
Y2K	0.219421	0.118918	1.845152	0.0948

R-squared	0.886097	Mean dependent var	-1.636650
Adjusted R-squared	0.829146	S.D. dependent var	0.404746
S.E. of regression	0.167300	Sum squared resid	0.279892
Log likelihood	9.664493	F-statistic	15.55882
Durbin-Watson stat	1.450396	Prob(F-statistic)	0.000194

Appendix 5 Estimation results of scale economies

(a) Log-linear: international sample

Dependent Variable: LOG(UC?)
Method: Pooled Least Squares
Date: 08/11/04 Time: 11:05
Sample: 1 21
Included observations: 21
Number of cross-sections used: 3
Total panel (balanced) observations: 63

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.209075	0.875942	5.946826	0.0000
LOG(VOL?)	-0.358253	0.059802	-5.990660	0.0000

R-squared	0.370407	Mean dependent var	-0.011533
Adjusted R-squared	0.360086	S.D. dependent var	0.878310
S.E. of regression	0.702601	Sum squared resid	30.11253
Log likelihood	-66.14004	F-statistic	35.88800
Durbin-Watson stat	1.865494	Prob(F-statistic)	0.000000

(b) Translog: international sample

Dependent Variable: LOG(TC?)
Method: Pooled Least Squares
Date: 08/11/04 Time: 12:10
Sample: 1 21
Included observations: 21
Number of cross-sections used: 3
Total panel (balanced) observations: 63

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.04241	6.952089	3.026775	0.0036
LOG(VOL?)	-1.445878	0.911790	-1.585757	0.1181
LNVOLSQ?	0.135988	0.059288	2.293706	0.0253

R-squared	0.681088	Mean dependent var	14.56035
Adjusted R-squared	0.670458	S.D. dependent var	1.184002
S.E. of regression	0.679685	Sum squared resid	27.71833
Log likelihood	-63.53034	F-statistic	64.06992
Durbin-Watson stat	1.942836	Prob(F-statistic)	0.000000

(c) Log-linear: SEACEN sample

Dependent Variable: LOG(UC?)
Method: Pooled Least Squares
Date: 08/12/04 Time: 15:58
Sample(adjusted): 1 5
Included observations: 5 after adjusting endpoints
Number of cross-sections used: 3
Total panel (balanced) observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.907611	4.539208	1.742069	0.1051
LOG(VOL?)	-0.581922	0.324871	-1.791241	0.0966

R-squared	0.197954	Mean dependent var	-0.216584
Adjusted R-squared	0.136258	S.D. dependent var	0.763216
S.E. of regression	0.709315	Sum squared resid	6.540666
Log likelihood	-15.05899	F-statistic	3.208546
Durbin-Watson stat	2.163294	Prob(F-statistic)	0.096553

(d) Translog: SEACEN sample

Dependent Variable: LOG(TC?)
Method: Pooled Least Squares
Date: 08/11/04 Time: 11:32
Sample(adjusted): 1 5
Included observations: 5 after adjusting endpoints
Number of cross-sections used: 3
Total panel (balanced) observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.46908	167.3054	0.140277	0.8908
LOG(VOL?)	-1.843978	24.32674	-0.075800	0.9408
LNVOLSQ?	0.164114	1.765675	0.092947	0.9275

R-squared	0.113356	Mean dependent var	13.74504
Adjusted R-squared	-0.034418	S.D. dependent var	0.724596
S.E. of regression	0.736960	Sum squared resid	6.517315
Log likelihood	-15.03217	F-statistic	0.767091
Durbin-Watson stat	2.203032	Prob(F-statistic)	0.485843

Appendix 6 Basic information on payment systems

(a) Descriptive statistics

Payment system	Y[1]	O[2]	M[3]	P[4]	Number of transactions (thousands)		Value of transactions (USD billions)[5]	
					2003	2002	2003	2002
Indonesia [6]								
BI-RTGS	2000	CB	P,S	148	4,161	2,155	2,440	1,479
JECS	1998	CB	P	1,890	73,350	72,930	134	166
ACS Surabaya	1992	CB	P					
ACS Medan	1994	CB	P					
ACS Bandung	2002	CB	P					
SACS	1992	CB	P					
MCS	1982	CB	P					
Korea								
BOK-Wire	1994	CB	T	128	1,590	1,513	18,323	17,647
Malaysia								
RENTAS	1999	CB	T	53	1,845	1,683	3,624	3,233
SPICK	1997	CB	T	26	179,910	176,430	301	285
Philippines								
PhilPaSS	2002	CB	S	91	160	-	613	-
BSP RCO	1966	CB	P	90	28,498	-	29	-
Singapore								
MEPS	1998	CB	T	70	2,130	2,030	5,664	5,603
Sri Lanka								
RTGS System[7]	2003	CB	S	32	38	-	44	-
Taiwan								
CIFS	1995	CB	P	106	447	443	4,646	4,439
Thailand								
BAHTNET	1995	CB	P,S	63	964	803	1,884	1,562
ECS	1996	CB	P	37	62,020	58,139	480	395
SMART	1997	CB	P	28	9,453	7,369	9	6

Source: Survey questionnaire

Note: [1] Year of implementation; [2] Ownership: CB-Central Bank; [3] Message carrier: P=Proprietary, S=SWIFT, T=Third-party public or private network; [4] Number of participants at year-end 2003; [5] Transaction values are converted to US dollars using annual average exchange rates published in the International Financial Statistics (International Monetary Fund, 2004); [6] JECS-Jakarta Electronic Clearing System, ACS-Automated Clearing System, SACS-Semi-Automated Clearing System, MCS-Manual Clearing System, number of direct members and transaction volume and value figures are reported as a whole for the six clearing systems; [7] September 8 – end-December 2003.

(b) Types of transactions settled in the payment system

Payment System	Type of Transactions
Indonesia	
BI-RTGS	Inter-bank money market and customer transfers, DVP securities transfer, government transactions
Clearing	Inter-bank transaction; inter-bank customer transfers
Korea	
BOK-Wire	Transfer of domestic and foreign currencies (US dollar and Japanese yen).; settlement of net positions for 11 retail payments systems (cheques, bank giros, CD/ATM transactions, and electronic banking, etc); OTC bond transactions; gross to gross DVP basis; BOK's loans; disbursement and receipt of Treasury funds; issuance, transfer, repurchase, and redemption of government bonds and BOK Monetary Stabilization Bonds (MSBs); third-party funds transfer service for non-participants. Companies and individuals are able to transfer large-value funds (minimum 1 billion won per transaction, about USD 0.86 million) to their customers' accounts through BOK-Wire participants
Malaysia	
RENTAS	Inter-bank high value funds transfer, scripless securities
SPICK	Cheques, cashiers orders, demand drafts
Philippines	
PhilPaSS	Interbank call loans, peso leg of securities (purchase and sale as well as repos), peso leg of FX, high value customer payment instructions, PVP of USD/Peso FX, DVP of government securities traded in the secondary market, ATM network funds settlement
BSP RCO	Cheques and demand items drawn by regional and provincial branches of banks not covered by the PCHC clearing operations
Singapore	
MEPS	FX, money market, cash leg of SGS and SGD corporate bond, CLS, settlement of cheque/IBG transactions, 3rd party payments.
Sri Lanka	
RTGS System	Inter participant transactions; sales/purchases/repo/reverse repo transactions of government treasury bills and treasury bonds; primary auction and maturity/interest payments of government debt securities; interbank call money transactions; net clearing balances of retail payment systems; Rupee leg of foreign exchange transactions; and third party customer payments
Taiwan	
CIFS	Reserve requirement position adjustments; call loan market and short-term bills market transactions; government securities in primary and secondary markets; inter-bank transactions in foreign exchange markets
Thailand	
BAHTNET	Inter-bank funds transfers, third-party funds transfers, multilateral funds transfer, and securities transfers
ECS	All type of transaction can be settled except inter-bank funds transfers foreign exchange settlement, security settlement, and non-resident transaction which are settled via BAHTNET only.
SMART	Credit and debit transfers. Credit transfers only apply currently and include salary payment, dividend payment, tax refund payment, interest payment.

Source: Survey questionnaire

Appendix 7 Summary of fee schedules in selected payment systems

(1) Indonesia, as of July 2004, in local currency

Service	Variable fees (Price per item)		Fixed fees
	Origination	Receipt	
BI-RTGS			
Single credit (6.30-15.00)	7,000		
Single credit (15.00-18.00)	15,000		
Multiple credit (6.30-15.00)	35,000		
Multiple credit (15.00-18.00)	50,000		
Operating hour extension [1/]	5,000		
	10,000		
Administrative message	2,500		
BI-SSSS			
Intraday liquidity facility (normal time) [2/]	15,000	15,000	
Intraday liquidity facility (peak hour)	30,000	30,000	
Short term liquidity facility (normal time)	-	-	
Short term liquidity facility (peak hour)	30,000	30,000	
SBI repo (normal time)	-	-	
SBI repo (peak hour)	30,000	30,000	
Allotment (normal time)	15,000	15,000	
Allotment (peak hour)	15,000	15,000	
SST sale/buy (normal time)	15,000	15,000	
SST (peak hour)	30,000	30,000	
SSTS transfer (normal time)	15,000	15,000	
SSTS transfer (peak hour)	30,000	30,000	
SSTS repo/reverse repo (normal time)	15,000	15,000	
SSTS repo/reverse repo (peak hour)	30,000	30,000	
SSTS reverse repo (normal time)	15,000	15,000	
SSTS reverse repo (peak hour)	30,000	30,000	
SSTS pledge/unpledge (normal time)	15,000	15,000	
SSTS pledge/unpledge (peak hour)	30,000	30,000	
SSTS cancellation (normal time)	15,000	15,000	
SSTS cancellation (peak hour)	30,000	30,000	
Online retrieval (normal time)	15,000	15,000	
Online retrieval (peak hour)	30,000	30,000	
Enquiries (normal time)	15,000	15,000	
Enquiries (peak hour)	30,000	30,000	
Administration messages (normal time)	7,500	7,500	
Administration messages (peak hour)	15,000	15,000	
JECS/ACS			100,000/25,000[3/]
Per item	1,000		
Per returned item	10,000		
SACS			
Per item	500		
Per returned item	5,000		

Source: Survey questionnaire

Notes: [1/] Rates apply for the first 30 minutes and the second 30 minutes, respectively, with banks permitted to request a maximum of 1 hour extension per day; [2/] Normal time: 6.30-15.00; Peak hour: 15.00-18.00; JECS-Jakarta Electronic Clearing System, ACS-Automated Clearing System, SACS-Semi Automated Clearing System; [3/] Monthly membership fee.

(2) Korea, as of July 2004, in local currency

Service	Variable fees (Price per item)		Fixed fees
BOK-Wire	Origination	Receipt	
Funds transfers (9.30-16.00)	150		
Funds transfers (16.00-17.00)	300		
DVP transfers (9.30-16.00)	100		
DVP transfers (16.00-17.00)	150		
Cancellation	500		

Source: Survey questionnaire

(3) Malaysia, as of July 2004, in local currency

Service	Variable fees (Price per item)		Fixed fees
RENTAS	Origination	Receipt	5,000 (annual membership)
Funds transfers	2.50		
Balance query	2.00		
SPICK			
MICR processing	0.05		
Late delivery	0.02		

Source: Survey questionnaire

(4) Philippines, as of July 2004, in local currency*

A. Existing Fees	Fees	Description
Transaction fee - Debits	100.00	Debits refer to payments to settle transactions for interbank call loan, purchase and sale of government securities and high-value customer payments.
Transaction Inquiry	100.00	Transaction inquiries refer to request for details of debit or credit entries to the RTGS balance, unsettled payments, cancellation request, payment priority change, balances and account information.
Intra-day liquidity facility	1,000/ week of availment	Transfer of Intra-day liquidity facility refers to the transfer from a participant's own Regular DDA to its RTGS account during the day. Among the transaction types, this is priced the highest as a disincentive; a precaution to ensure that the Participant's RDDA is funded for its non-RTGS settlement.
Megalink transaction fees	100.00	Megalink transactions refer to electronic fund transfer instructions sent by each debited participant to *PhilPaSS* for the settlement of its credit card ATM transactions with other members of Megalink.
Philippine Depository & Trust Corp. (PDTC) (Payment vs Payment transactions)	100.00	PDTC Payment vs. Payment transactions refer to the peso leg of electronic settlement request to *PhilPaSS* by PDTC to finalise the settlement of FX transactions of commercial banks.
B. New Fees		
PCHC transactions	100.00	PCHC transactions refer to Electronic Check Clearing System/check clearing results and Electronic Peso Clearing and Settlement System results that are settled and posted to the RTGS account of the *PhilPaSS* participants.
Bureau of the Treasury (BTr) transactions	100.00	BTr transactions refer to government securities transactions of BTr (primary auction, secondary trades, redemption, interest repayments) with banks/financial institutions.

Electronic Fund Transfer System (EFTIS) transactions	100.00	EFTIS transactions refer to instructions initiated by the banks/financial institutions for their interbank transactions, transfer of funds within their deposit accounts with the BSP, remittance of tax collections or customs duties collections to the Bureau of the Treasury for the account of the Bureau of Internal Revenue and Bureau of Customs.
BSP Treasury Dept. (BSP-TD) payment Instructions	100.00	BSP's Treasury Department's debit transactions refer to debits to the Regular Demand Deposit of banks / financial institutions covering its RP/RRP repayments, Special Deposit Account and Outright Purchase/Sale of Securities.
Manual processing of interbank transactions	1,000.00	This refers to adjustment to be initiated by the BSP Payments Unit based on the request of the *PhilPaSS* participants on the erroneous payment instructions they have issued.
C. Access Fees		
Monthly Access /Connection Fees billed to third party service providers (e.g., Megalink, Bancnet, PCHC, PDTC, BTR)	30,000.00/mo, broken down into: 20,000-to connect to the primary site 10,000 – to connect to the back-up site	This refers to the direct access rights given by the BSP to external service providers of financial services (PCHC, Megalink, Bancnet, PDTC) for the electronic settlement of their transactions with *PhilPaSS.*
D. License Fee		
Annual license fee f or use of Electronic Fund Transfer Instruction System (EFTIS) Phil. Payments System - Front-End System	10,000/annum 20,000/annum	This refers to the fee related to BSP's in-house systems (EFTIS, PPS-FES) that were developed for the banks/financial institutions and non-SWIFT member banks. The fee shall cover system upgrades and maintenance/ operating costs of these two (2) in-house systems.
E. Administration Fees (EFTIS, PPS, SWIFT)		
Registration of new user profile - Registration/ Installation of new Workstations	2,000.00/user Up to two years 5,000.00/workstation	This refers to the cost of the registration of new/additional user profile of EFTIS, PPS-FES and SWIFT, and installation fees for new workstations for EFTIS and PPS-FES that will be charged to banks/financial institutions.

Source: Survey questionnaire

Note: * Current rates unless otherwise stated; No transaction fees are collected for BSP RCO. Penalty charges are imposed for clearing errors during the process as follows: corrupted data (1,000) and clearing errors such as misencoding and wrong date (100);

(5) Sri Lanka, as of July 2004, in local currency

Service	Variable fees (Price per item)		Fixed fees
RTGS System	Origination	Receipt	
Transaction fee	240		

Source: Survey questionnaire
Note: For securities-related payment transactions, the fee is charged from the participant who submits a Receive versus Payment instruction to LankaSecure. Participants have to bear the SWIFT message charges, which is approximately LKR 45 for the sender of payment (including reverse billing for confirmation messages viz. MT 012 and MT 019). In addition, a SWIFT charge of approximately LKR 15 has to be borne by the receiver of the payment in the case of securities transactions.

(6) Singapore, as of July 2004, in local currency

Service	Variable fees (Price per item)		Fixed fees
MEPS	Origination	Receipt	100 – 2,500 (monthly port charges)
Transaction fee	1.25		

Source: Survey questionnaire

(7) Taiwan, as of July 2004, in local currency

Service	Variable fees (Price per item)		Fixed fees
CIFS	Origination	Receipt	
Funds transfer	17.00	17.00	

Source: Survey questionnaire
Note: NT$34 funds transfer fee equally distributed between sender and beneficiary banks. Under throughput arrangements, participating banks are required by the CBC to complete their on-line payments at least 50% of total value of daily transaction before 14.30, and 80% before 16.30. To encourage banks to comply with this throughout schedule, the CBC offers a preferential price about 50% discount of the normal charges for those payments completed before 12.00.

(8) Thailand, as of July 2004, in local currency

(a) ECS and SMART

Service	Variable fees (Price per item)		Fixed fees
Cheque (ECS)	Collecting Bank	Paying Bank	1 million (joining fee per bank)
Capturing and prime sorting	0.20	0.40	
Sorting by branch and account number		0.60	
Sorting by amount		0.20	
Encoding errors	5.00		
Pre-encoding errors		5.00	
ACH (SMART)	Origination	Receipt	
6-7 days data delivery prior to effective date	0.40		
4-5 days data delivery prior to effective date	0.50		
1-3 days data delivery prior to effective date	0.60		

Source: Survey questionnaire

(b) BAHTNET – monthly and transaction fees

	Variable fees (price per item)			Fixed fees
	Zone 1 8.30-12.00	Zone 2 12.00-16.00	Zone 3 16.00-17.30	
BAHTNET				3,500/500
Inter-bank funds transfers (SWIFT)	5	10	200	
Inter-bank funds transfers (EFS)	8	16	200	
Third-party funds transfers (SWIFT)	5	10	200	
Third-party funds transfers (EFS)	8	16	200	
Securities transfers (deliver free) (SWIFT)	5	10	200	
Securities transfers (deliver free) (EFS)	8	13	200	
Securities transfers (receive free) (SWIFT)	5	10	200	
Securities transfers (receive free) (EFS)	8	13	200	
DVP transfers (deliver against payment) (SWIFT)	5	10	200	
DVP transfers (deliver against payment) (EFS)	8	13	200	
DVP transfers (receive against payment) (SWIFT)	5	10	200	
DVP transfers (receive against payment) EFS	8	13	200	
Debit confirmation (MT900) (SWIFT)	3	3	3	
Credit confirmation (MT910) (SWIFT)	3	3	3	
Statement message (SWIFT)	3	3	3	
General message (SWIFT/EFS)	6	6	6	
Message broadcast (EFS)	20	20	20	

Source: Survey questionnaire
Note: Monthly service charges apply to direct members (3,500) and associated members (500). EFS is an alternative web-based electronic connection channel for non-SWIFT members.

(c) BAHTNET – volume discounts

Category	Message Type	Number of transactions	Discount
Inter-bank funds transfers	202	200	20%
Third-party funds transfers	103	1,000	20%
Securities transfers (deliver free)	540	200	20%
Securities transfers (receive free)	541	200	20%
DVP transfers (deliver against payment)	542	200	20%
DVP transfers (receive against payment)	543	200	20%

Source: Survey questionnaire

Note: Monthly volume discounts apply to users sending payment instructions exceeding the number of transactions specified in time zone 2 (12.00-16.00), and the discounts apply to the exceeding transactions only, as indicated in the table.