



BANK OF FINLAND DISCUSSION PAPERS

1 • 2003

Tanai Khiaonarong
Research Department
15.1.2003

Payment systems efficiency,
policy approaches, and the
role of the central bank

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The views expressed are those of the author and do not necessarily reflect the views of the Bank of Finland or the Bank of Thailand.

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Payment systems efficiency, policy approaches, and the role of the central bank

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Research Department

Abstract

Central bank spending on the operation of inter-bank funds transfer systems may range from below one million to nearly a billion US dollars annually. This paper examines how such costs are incurred and recovered to pursue payment systems efficiency in different countries and under alternative policy approaches. The key findings are as follows. First, strong scale economy effects were found, with unit costs comparatively lower in retail than large-value payment services, while subsidisation was also evident in a survey of thirty-one payment systems. Second, the minimalist approach was more efficiency enhancing than the competitive and public service policy alternatives, due to higher cost-reducing effects, stronger private sector involvement, and the avoidance of the central bank's conflicting role as regulator and service provider in the payments system. And third, regulatory and financial innovations, in addition to technological means, are found to be equally important policy tools that the central bank may adopt to improve the technical and economic efficiency of payment systems.

Key words: payment systems, efficiency, cost, revenues, innovations

Maksujärjestelmien tehokkuus ja keskuspankin merkitys sen edistämisessä

Suomen Pankin keskustelualoitteita 1/2003

Tanai Khiaonarong
Tutkimusosasto

Tiivistelmä

Pankkienvälisten maksujärjestelmien toiminnasta aiheutuu eri maiden keskuspankeille vuosittain kustannuksia, jotka vaihtelevat alle miljoonasta lähes miljardiin dollariin. Tutkimuksessa selvitetään, miten nämä kustannukset rakentuvat, miten niitä katetaan maksujärjestelmistä saatavin tuloin ja millaisten linjausten pohjalta eri maiden keskuspankit pyrkivät edistämään maksujärjestelmien tehokkuutta. Yhteensä 31 maksujärjestelmää kattaneen kyselytutkimuksen perusteella saatiin ensinnäkin tulokseksi, että maksujärjestelmissä saavutetaan huomattavia suurtuotannon etuja ja että yksikkökustannukset ovat suhteellisesti alhaisemmat pieniä kuin suuria maksuja välittävissä järjestelmissä. Kävi myös ilmi, että monet keskuspankit tukevat maksujärjestelmiä jonkin verran. Toinen tärkeä tutkimustulos oli, että keskuspankki pystyi edistämään maksujärjestelmän tehokkuutta paremmin noudattamalla ns. minimalistista kuin kilpailua tai julkisten palvelujen merkitystä korostavaa linjausta. Tämä johtui siitä, että minimalistisen linjauksen ansiosta kustannuksia onnistuttiin vähentämään enemmän ja yksityinen sektori osallistui aktiivisemmin kuin muiden linjausten pohjalta, ja lisäksi keskuspankki välttyi maksujärjestelmän sääntelijän ja palveluntuottajan tehtävien väliseltä ristiriidalta. Kolmantena keskeisenä tuloksena oli, että keskuspankki voi edistää maksujärjestelmien teknistä ja taloudellista tehokkuutta paitsi teknisten parannusten avulla myös uudistamalla sääntelyä ja maksujärjestelmiin liittyviä rahoitusjärjestelyitä.

Avainsanat: maksujärjestelmät, tehokkuus, kustannukset, tulot, innovaatiot

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1 Introduction

Payment systems efficiency is a common objective shared by many central banks but has also remained a topic where understanding has been marginal. Efficiency is among one of the ten core principles for systemically important payment systems, which gives importance to practicality and economic efficiency.¹ The means in achieving efficiency has often been through technological investments. Technological efficiency, however, does not always result in economic efficiency, and it is the latter perspective, where research has been relatively limited due to the scarcity and confidentiality of cost data.

This paper aims to contribute towards a better understanding of payment systems efficiency by focusing on three major themes. The first theme compares the alternative policy approaches found in central banks with respect to promoting and pursuing payment systems efficiency. These are categorised as the minimalist, competitive, and public service approaches, where the key differences lie in the roles played by the public and private sectors in the payments system. An econometric analysis of unit costs and a review of country cases are used to illustrate the three approaches. Key lessons are drawn on their effects on payment systems efficiency.

The second theme examines payment systems efficiency in international practice and focuses on three regions: Europe, East Asia-Pacific, and North America. The analysis is largely based on a survey of cost and revenues of inter-bank funds transfer systems sent to 26 central banks and monetary authorities in Europe and East Asia-Pacific. This is supplemented with data from Canada and the United States. The survey results provide estimates on the cost, revenues, cost recovery, unit costs, service subsidisation, and an analysis of their implications on improving payment systems efficiency.

The third theme focuses on the role of central banks in improving payment systems efficiency. Three major policy innovation tools are available to the central bank: technological, regulatory, and financial innovations. Innovations do not solely focus on promoting the most advanced computer and communications technologies. Equally important are regulatory innovations, which may involve transparent pricing regulations and organisational innovations where the central bank plays a constructive role in the establishment of, and participation in, payment associations. Such innovation policies have the potential to shift the position of payment systems along the efficiency frontier. Key lessons are drawn from the survey results and country cases.

¹ See Bank for International Settlements (2001, 44–50).

The objectives of the study are twofold: to examine the cost and revenues of selected inter-bank funds transfer systems and to compare alternative policy approaches in promoting payment systems efficiency.

The remaining sections of the paper are organised as follows. Section 2 provides an overview of payment systems efficiency. Section 3 examines payments cost and revenues in international perspective. Section 4 compares the alternative policy approaches through country cases with respect to promoting payment systems efficiency. Section 5 discusses the role of the central bank in improving efficiency through three major types of innovations, and raises some of the key policy issues. Section 6 concludes the paper.

2 Overview of payment systems efficiency

This section provides an overview of payment systems efficiency. First, the types of costs that are involved in the whole payment and settlement process are presented. Second, the contrast is made between promoting payment systems efficiency through technological and economic efficiency. Third, the central bank's conflicting role as regulator and service provider, and their implications to payment systems efficiency, is discussed. And fourth, an analytical approach is presented to examine payment systems efficiency.

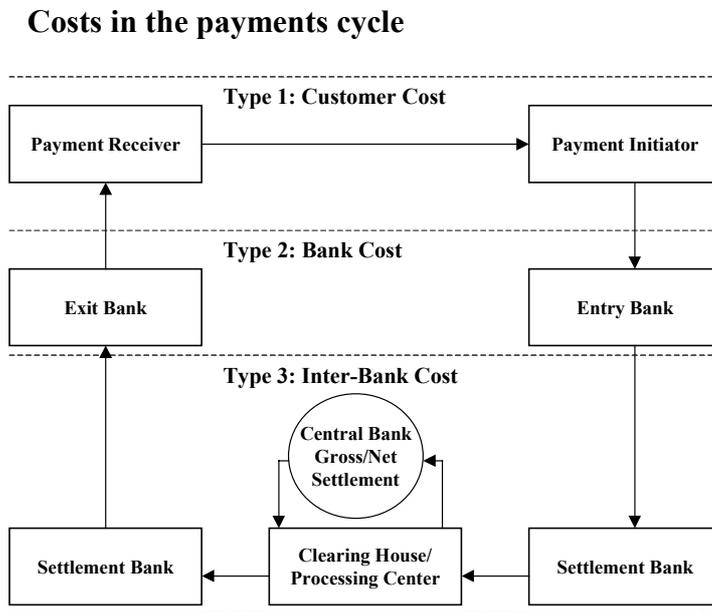
2.1 Costs in the payments cycle

Payment systems support the discharge of financial obligations between two or more parties and facilitate the flow of funds in the sale of goods and services. Figure 1 illustrates the process involved in initiating and receiving a payments transfer and the three major types of costs involved: customer cost, bank cost and inter-bank cost.

The payments cycle generally involves a transaction initiated and received between two or more payment parties. They may originate from the household sector, the business sector, government agencies or financial institutions. A payment instruction goes through inbound processing at an entry bank (paying/receiving bank or branch), is transferred to a settlement bank (bank head office or correspondent bank), and proceeds to in-bound clearing at a clearing house or processing center. Settlement generally takes place at the central bank where the accounts of settlement banks are maintained. In some cases this function may be performed by a private entity. Similarly, the out-bound process involves a settlement bank (bank head office or correspondent bank) and exit bank

(paying/receiving bank or branch), while payment distribution to a payment receiver completes the process.

Figure 1.



The common payment environments between the payment initiator and receiver include the following examples: bill payments, purchases, expenses, dividends, salaries, taxes, license fees, interest, insurance claims, securities transfers, and vendor payments. Common payment methods include examples as follows: cash, cheques, direct debits, direct credit, credit transfers, credit/debit cards, store-valued cards, and postal money orders.

Costs in the payments cycle may be broadly categorised as real resource cost and financial cost. Real resource costs involve development, production and processing. Development costs relate to the initial investments in the payments system, and may also involve their subsequent enhancements. Production costs are the resources required producing a payment instrument before its use. For example, this includes the cost for producing currency (notes and coins), cheques, cards (cash cards, credit cards, debit cards, store-valued cards), and forms. Processing costs cover expenses related to labor, accounting, mailing, and transportation among others. Financial costs include costs related to float, opportunity costs for holding idle funds, and liquidity costs that may be required with the posting of collateral to reduce risks in the settlement system.

Figure 1 further categorises costs in the payments cycle into three types where both real resource and financial costs are present. Customer costs are perhaps the most visible of the three. This may include the cost for writing cheques (or giros), mailing, stationary (forms, slips), printing, computer hardware, computer software, connection charges, and bank statement inquiries.

Bank cost mainly involves costs at the bank and intra-bank levels covering a bank's head office and branches. Banks generally develop, produce and process payment instruments and services. Some choose to outsource them to reduce costs. Countries that have studied bank-level cost include Norway, for example (Lindquist, 2002; Flatraaker and Robinson, 1995; Robinson and Flatraaker, 1995). Other studies have included the analysis of payment industry costs (Jitsuchon and Khiaonarong, 2000; Association for Payment Clearing Services, 1996).

Inter-bank cost focuses on payment clearing and settlement costs. Clearing houses may be owned and operated by either a public or private entity. Settlement is generally carried out under accounts maintained with the central bank. This may be on a gross or net settlement basis, where the choice of settlement would influence the financial cost. Alternatively, there may be no centralised clearing house as payment participants send bilateral payment instructions to each other, while settlement is made directly at the central bank. Such a network-based system helps reduce centralised operating costs.

This study focuses on inter-bank cost that mainly arises from inter-bank funds transfer systems. This includes the real resource costs in their operation. Costs that are incurred at the inter-bank level play a key role in the whole payments cycle as they involve significant real resource and financial costs and may, or may not, be fully passed on to the bank and customer levels. The pricing policies of central banks and similar service providers determine the management and allocation of such resources. They may partially subsidise services for social welfare or fully recover costs with a 'cost push' strategy to industry. Both policies influence bank cost, customer cost, and payment systems efficiency.

2.2 Perspectives on efficiency

Payment systems efficiency may be viewed from two broad perspectives: technological and economic efficiency. Technological efficiency basically focuses on the adoption of advanced computer and communication technologies to improve the operational performance in payments processing and settlement. Economic efficiency mainly focuses on the management and allocation of resources in the operation itself to produce optimal prices in providing payment and settlement services. Technological efficiency is a means to achieve economic efficiency, while other influences may include competition and governance. Overall payment efficiencies are achieved with improvements in both technological and economic efficiencies, as a technologically efficient payments system does not necessarily reflect an economically efficient one.

Technological efficiency may be best illustrated with the move from deferred net settlement (DNS) to real-time gross settlement (RTGS) in a majority of inter-

bank funds transfer systems world wide (European Central Bank, 2002, 25–26; Executives’ Meeting of East Asia-Pacific Central Banks and Monetary Authorities, 2002, 473). In these systems, payments processing and settlement are carried out in real-time. Technological efficiency may be further illustrated with the adoption of cheque imaging technology and multiple settlement cycles in retail payment and settlement services. Cheque imaging technology captures electronically the payment information in a cheque and transmits them for further processing and settlement, improving the turnover time in processing and cashing a cheque. Multiple settlement cycles have also reduced the settlement time of small-value transactions handled by automated clearing houses (ACH), instead of end-of-day or later settlement. Improving technological efficiency, however, may come with high expenses such as investment costs, operating costs and liquidity cost, among others. With these cost considerations, recent developments have included hybrid systems, which provide liquidity-saving features in large-value inter-bank funds transfer systems (McAndrews and Trundle, 2001), while network-based payment infrastructures have also been proposed as an alternative approach in developing integrated, efficient and decentralised payment systems (Leinonen, Lumiala, and Sarlin, 2002; Leinonen, 2000).

Economic efficiency, as contrasted to technological efficiency, focuses on the cost recovery and pricing of payment services (Humphrey, Keppler, and Montes-Negret, 1997). Achieving economic efficiency is partly based on understanding the scale economies or scale diseconomies of payment operations. Other factors include x-efficiencies, such as in good or bad management. Scale economies occur when unit or average cost reductions is realised with increases in transaction volumes. Scale diseconomies exist when volume increases also result in an increase in cost. In addition, economies of scope may exist when a payments system handles more than one type of transaction, allowing fixed costs to be spread out over a wider range of output. The understanding of overall scale economies is particularly important for payment service providers as it helps them allocate resources and formulate pricing policies to best achieve the optimal outcome. Such an understanding is best illustrated with studies on the efficiency of payment services provided by the US Federal Reserve. Such studies have covered the analysis of scale economies, scale diseconomies, cost efficiencies, competition, and technological change in multiple payments processing sites over time (Gilbert, 1999; 1998; Bauer and Ferrier, 1996; Bauer and Hancock, 1995; Bauer and Hancock, 1993; Humphrey, 1984). Knowledge on international policies and practices in promoting payment systems efficiency is comparatively limited.

2.3 Conflicts of interest

The central bank may face conflicts of interest in pursuing payment systems efficiency. This stems from two inter-related factors: competition and subsidisation. Competition issues are raised when there is a potential conflict of interest stemming from the central bank being both a regulator and service provider. This dual role is sometimes viewed by private operators as an unfair practice in the competitive market for payment services. Subsidisation issues arise when the central bank absorbs some or all of the payment costs on welfare grounds to encourage the use of efficient payment means. Subsidised price structures are generally introduced during the initial implementation period of a payment system, and its reduction may be reduced over time to avoid the concept being institutionalised (Humphrey, Keppler, and Montes-Negret, 1997, 18). In effect, subsidised price structures for public goods does not reflect its actual resource cost and may cause a distortion in the market prices for related services provided by private operators. The recovery of fixed costs is also an issue, as it has been argued that only marginal (variable) costs should be priced to induce the efficient use of existing capacity.

The experience of the US Federal Reserve provides some illustration. White (1983) argues that there is a conflicting role of being both a regulator and competitor by the US Federal Reserve, and suggests its withdrawal as service provider, while seeking market-based alternatives. For example, the subsidisation of cheque collection services through prices and free funds availability had not help promote the use of efficient electronic payment alternatives by banks, businesses and individuals. He finally argues that payment operations should be moved under congressional mandate, through a government unit such as the Treasury, while the US Federal Reserve can focus on its primary function of conducting monetary policy. Tucker (1990) further raises the issue of whether the central bank should intervene in the market for payment services or promote private competition.

Baxter (1983, 571) supports the view that the subsidy extended by the US Federal Reserve in the form of par clearance in cheque collection has led to much controversy in the banking industry. Stevens (1998) also argues that universal par cheque collection was achieved not through competition, but through US Federal Reserve intervention, and suggests that the US Federal Reserve should withdraw from services that it is not competitive, unless subsidies are justified. Lacker, Walker and Weinberg (1999) note that US Federal Reserve par presentment rights served as a barrier to competition as it allowed Reserve Banks to provide lower cost cheque collection services than its competitors. This exists in the form of a 'six-hour monopoly' where the Reserve Banks have a longer time advantage over commercial banks in cheque presentment time to obtain same-day funds.

US Federal Reserve-operated ACH and currency services provide further illustration. Stone and White (1986) argue that ACH volume growth will remain slow and most non-cash payments will still be cheque-based, unless there are changes to the current organisational infrastructure. In other words, the US Federal Reserve should explore alternative scenarios for operating its ACH services, including the restructuring of local payment associations to play a more active role in product development and the operation of processing systems, and allowing more competition from private sector ACH systems. Lacker (1993) further raises the issue on currency use subsidisation, including unrecovered costs, and suggests a currency deposit fee for converting currency into reserve balances. Such measures would support the public policy goal of payments system efficiency.

As policy considerations, Weinberg (1994) introduces the concept of sustainable pricing, noting that the US Federal Reserve should guide the market towards efficiency if it seeks to provide payment services that are in the public's interest. In such a case, private operators with lower costs should be accommodated, while US Federal Reserve pricing should only acknowledge efficiency-enhancing losses. Through sustainable pricing, prices are set to sustain an efficient allocation of production. Green and Todd (2001) propose that the US Federal Reserve should specialise in payment services where it has comparative advantage, particularly in providing interbank settlement services that offer economies of scope, while also considering withdrawing from giving direct service provisions if markets for payment services evolve. The issue of subsidising payment services is not uncommon for central banks in other countries. This is discussed in sections 3 and 4.

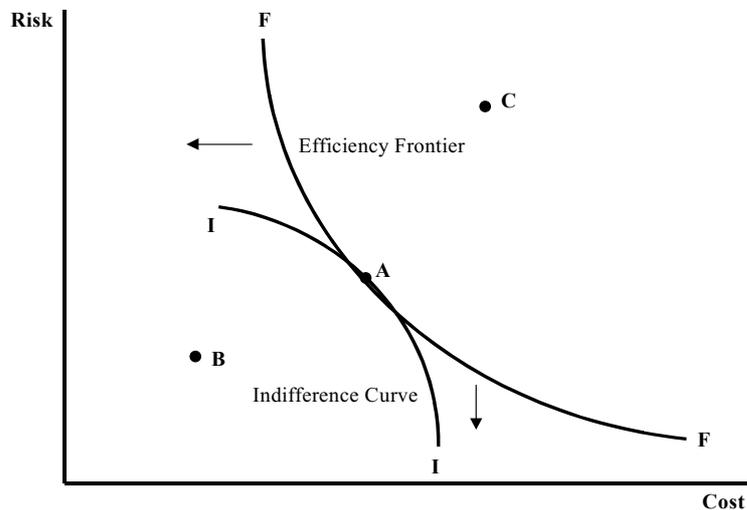
2.4 An analytical framework

The economic analysis of payment systems efficiency has been limited due to two factors. The first factor is the lack of detailed cost data. Total production costs (fixed and variable cost components) and transaction volumes are required for estimating scale economies under the translog cost function model, for example (Humphrey, 1984, 130). In addition, common costing methodologies are needed to make comparisons across different payment services or multiple payment processing sites over time. The second factor is that cost data is generally confidential and not publicly available.

Frankel and Marquardt (1983) discuss alternative theories and models for studying payment systems. Figure 2 illustrates the risk-cost frontier framework, an approach that examines efficiency, risks, costs and innovations in the payments system (Berger, Hancock, and Marquardt, 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.

Figure 2. **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 DNS versus RTGS in large-value transfer systems in both developed and developing countries (Fry *et al* 1999, 44–59). Gilbert (1998, 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. In other words, achieving lower risks in the payments system comes at a higher cost, while achieving lower costs comes with higher risks. One illustration would be the introduction of RTGS systems to reduce potential systemic risks in the payments system, which involve considerable real resource and financial costs to operate. Alternatively, in a DNS system, settlement may take place towards the end of the day, while settlement failures by one participant may also be resolved through the unwinding and the re-settlement of payment positions of other participants. With no need for instantaneous payment and settlements, and intraday liquidity, the overall costs are lower to operate, but this is achieved only with higher risks than RTGS systems.

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

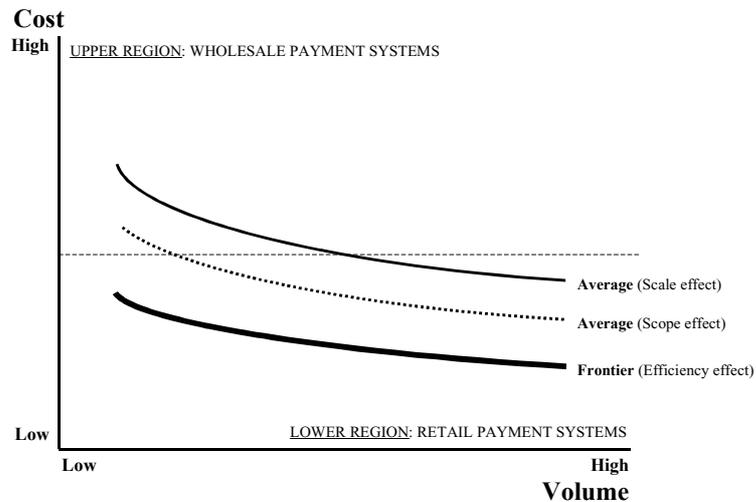
and higher costs along the efficiency frontier. In other words, society is willing to incur a high cost for high-risk payments and vice versa. This can be illustrated with the transfer of large sums of money through electronic means rather than the withdrawal and carrying of cash. Social welfare is maximised 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.

Figure 3 adapts the risk-cost frontier framework to explain the relationship between cost and volumes along the efficiency frontier. Costs are substituted for risk on the vertical axis, and volumes are substituted for cost on the horizontal axis. As noted by Fry et al, (1999, 14), “Comparing volumes is useful in that transactions costs are virtually unrelated to the value of any particular transaction, ie, they are fixed costs. So the relative volumes of each payment instrument may relate to the overall efficiency of a country’s payment system. Value comparisons, in contrast, are particularly relevant for risk analysis because, *ceteris paribus*, larger values increase risk exposure.”

Figure 3.

Scale-scope effects on the efficiency frontier



Payment systems operate in two regions. In the upper region, wholesale payment systems handle high-value but low-volume transactions, and can be illustrated by interbank funds transfer and settlement services. In the lower region, retail payment systems handle high-volume but low-value transactions, and can be illustrated by clearing houses that process cheques and automated direct and credit transfer instructions. The distinction between wholesale and retail payment systems is not always clear-cut, as some wholesale systems do not set minimum transaction values and may handle small-value transactions. The efficiency in producing payment services varies in the two regions. The cost for producing wholesale payment services is comparatively higher than retail services, due to the higher real resource cost involved in investment and operations, combined with higher financial cost in terms of liquidity cost, and this translates into higher overall unit cost.

Figure 3 compares three levels of cost-volume combinations.² Scale effects (thin line) occur with initial scale economies and declining average cost, but average cost flattens out and becomes constant when there is a moderate increase in volume. Scope effects (dotted line) occur with the average cost of a particular payment instrument being further reduced with the processing of a second payment instrument at the same facility. Efficiency effects (thick line) occur in payment systems that have the lowest average cost. This is also known as the “frontier” of best practice payment systems. Figures 2 and 3 are used as the basic framework to examine the efficiency of producing and operating payment services

² See Humphrey, Keppler, and Montes-Negret (1997, 40–41) for an analysis of scale, scope and efficiency effects on the average cheque processing cost at 47 offices of US Federal Reserve between 1983–1990.

in sections 3 and 4. In this regard, we focus on the real resource cost, particularly the annual operating expenses, which are incurred by different payment systems, and further estimate their cost recovery and unit costs.

3 Payment costs and pricing

This section presents the results of a survey on central bank payment costs and revenues. First, the research data and methodology are described. Second, an overview of the different types of payment systems ownership is presented. Third, the cost recovery and pricing policies of payment operations is compared at the regional, country and system levels. And fourth, unit cost and transaction volumes are analysed to compare the efficiency in producing and operating selected large-value and retail payment systems.

3.1 Data and methodology

Data on payment cost and revenues are relatively difficult to obtain in the public domain. Many public and private service providers generally treat such data as confidential or restricted for internal use. Secondary data sources that were available and used in the study include the following:

- pricing policies of specific payment systems published in country chapters and comparative statistical tables compiled by the European Central Bank (2002, 2001) and the Executives' Meeting of East Asia-Pacific Central Banks and Monetary Authorities (2002);
- annual reports of central banks (Bank of England, Reserve Bank of Australia, Board of Governors of the Federal Reserve System);
- annual reports of payment associations; and
- cost, revenue and pricing reports obtained with permission from payment associations and international financial institutions.

Primary data sources were obtained through survey questionnaires. The objective was to obtain data on the operating costs and revenues for providing payment and settlement services owned and operated by central banks. The survey covered both large-value and retail payment services and included three questions as follows: the annual amount and sources of revenues; the annual amount of operating expenses; and an open-ended question on the future of ownership, operations and outsourcing.

The sample included 26 central banks from Europe and East Asia-Pacific. This includes 15 central banks from the European Union and 11 member countries of the Executives Meeting of East Asia-Pacific Central Banks and Monetary Authorities (EMEAP). Mid-level to senior-ranking central bank officials involved in inter-bank funds transfer systems were contacted. Table 1 shows the list of central banks and monetary authorities. As mentioned, both regional groups have compiled and published country reports and comparative statistics on payment systems. This provided useful background information on the types of ownership and pricing policies in 72 payment systems. The total number of payment systems, however, is subject to on-going changes, namely the consolidation of payments processing sites and the development of new systems.

Table 1. **List of EU and EMEAP central banks**

European Union	Executives' Meeting of East Asia-Pacific Central Banks and Monetary Authorities
Banque Nationale de Belgique S.A.	Reserve Bank of Australia
Danmarks Nationalbank	People's Bank of China
Deutsche Bundesbank	Hong Kong Monetary Authority
Bank of Greece	Bank Indonesia
Banco de España	Bank of Japan
Banque de France	Bank of Korea
Central Bank of Ireland	Bank Negara Malaysia
Banca d'Italia	Reserve Bank of New Zealand
Banque centrale du Luxembourg	Bangko Sentral ng Pilipinas
De Nederlandsche N.V.	Monetary Authority of Singapore
Banco de Portugal	Bank of Thailand
Suomen Pankki	
Sveriges Riksbank	
Bank of England	
Oesterreichische Nationalbank	

The response rate was approximately 70 percent. Respondents included 18 of 26 central banks (10 from EU and 8 from EMEAP), giving a relatively fair representation of both regions. The remaining eight central banks were unable to disclose cost and revenue figures due to confidentiality, the non-application of cost accounting to payment systems, and the on-going changes taking place in some countries. Cost and revenue figures were obtained from 26 payment systems, including 19 large-value and 7 retail payment services. The total number of observations is 31 (21 large-value and 10 retail payment services) with the inclusion of available data from Canada and the United States.

Methodological differences exist in pricing policies and costing methods. There is no uniform approach to cost recovery strategies and accounting policies that are applied across the countries surveyed. Most countries have an explicit

policy on the full cost or variable cost recovery for specific systems. Few countries, however, have a transparent pricing policy with a clear breakdown of revenues and operating costs. Costing methodologies also differ. Basically, this should account for labor, materials, communications and building cost. In practice, the inclusion and calculation of each cost variable would largely depend on the internal accounting rules of each central bank. Therefore, differences may occur in the calculation of depreciation, capital costs, overheads, and internal services.

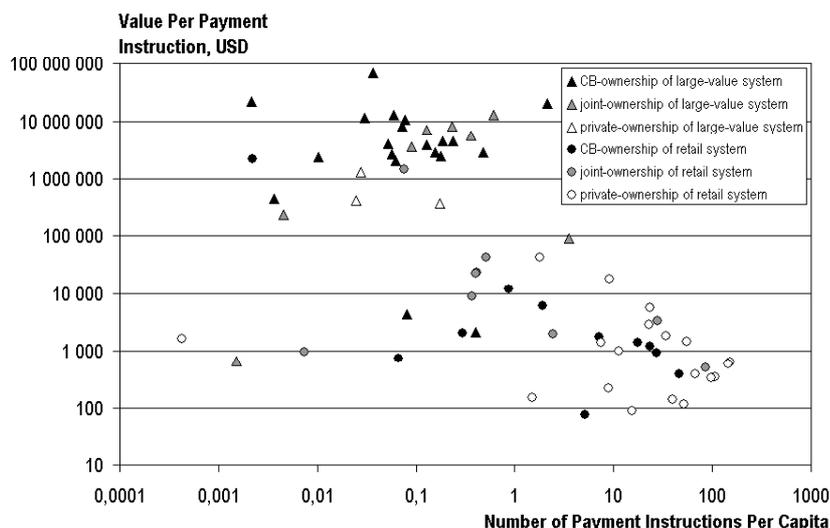
The analysis of data has three main objectives as follows: to provide comparative estimates on the cost recovery and efficiency of different payment systems, to identify the frontier of best practice payments systems, and to identify innovations that may improve efficiency. Data analysis accounts for the methodological differences and the confidentiality of the cost and revenue figures and is not attributed to specific central banks. Survey results are reported as aggregates and estimates at the regional, country, system, and unit cost levels. Regression analysis is made to examine the effects of volume, labor cost, the average size of payments, and policy approaches on unit cost. Local currencies are converted into USD (see Appendix 1 for exchange rates). The analysis does not make direct cross-country comparisons. It is not aimed at price setting. A more rigorous and uniform approach in calculating fixed and variable costs would be more appropriate.

3.2 Ownership of payment systems

Ownership of payment systems may be grouped into three main categories: sole-ownership by the central bank (CB-ownership); joint-ownership between the central bank and commercial bank, or a joint-investment/operation arrangement; and private-ownership by a group of commercial banks where payment operations may be managed under a banking association, a payments association, or the central bank. Ownership depends on many factors, such as a country's institutional structure, banking structure, or the level of economic development (Fry *et al*, 1999, 76–79). Figure 4 illustrates the ownership of selected payment systems in the European Union and EMEAP based on the number of payment instructions per capita and USD values to volume handled during 2000.

Figure 4.

Ownership of payment systems



Sources: European Central Bank (2001, 2002), EMEAP (2002), and International Monetary Fund (2002).

Notes: Figures are reported on a logarithmic scale.

A majority of 72 payment systems in both regions is under CB-ownership (44%) followed by private-ownership (32%) and joint-ownership (24%). CB-ownership (64%) dominates in 33 large-value systems, with minor shares for joint-ownership (24%), and private-ownership (12%). Private-ownership was found in a majority of 39 retail payment services (49%) as compared with CB-ownership (28%) and joint-ownership (23%). This includes ACH and cheque clearing and processing systems. Figure 4 shows the clustering of large-value payment systems in the upper region of the scattergram. The lower region shows the concentration of privately-owned retail payment services. Type of ownership is distinguished by color as follows: CB-ownership (black), joint-ownership (gray), and private-ownership (white).

CB-ownership in a majority of large-value payment systems mainly stems from risk-related reasons. Most central banks share a common concern over the reduction and control of risks in systemically important payment systems. A payment system is of systemic importance if it handles large aggregate or individual value of transactions, and is used in the settlement of financial market transactions or for the settlement of other payment systems (Bank for International Settlements, 2001, 15). They also have the ability to transmit financial shocks to both domestic and international payment systems. For this reason, many central banks own and operate core RTGS systems, which are linked to the accounts that commercial banks maintain with them for settlement purposes.

Private-ownership in a majority of retail payment services mainly stems from efficiency-related reasons. Retail payment systems have scale and scope effects in terms of the higher volume of transactions handled than large-value systems. Scale effects occur with the reduction of unit cost as output expands. Scope effects occur when unit cost reduction result from output increases with the processing of an additional type of payment instrument at the same facility. This spreads out the fixed cost of the facility to a wider range of payment instruments. In ACH operations, this may include direct debit, direct credit, and card-based transactions. In cheque clearing and processing operations, the types of paper-based payments are diverse and may include the following: promissory notes, bills of exchange, postal money orders, dividend receipts, bankers' acceptances, cashier's orders, demand drafts, interest warrants, pensions warrants, and drawing vouchers.

Although a majority of central banks own and operate large-value systems at comparatively low volumes per capita than similar arrangements for retail systems, this is considered by many to be justified from a risk-cost tradeoff standpoint. As mentioned, the central bank is particularly concerned with systemically important payment systems. Managing such risk is thus viewed as contributing towards greater social welfare. The same concept, however, may need to be assessed in the context of retail payment systems.

3.3 Cost, revenues, and pricing policies

Payment costs can be substantial, accounting for about 3 percent of gross domestic product (Humphrey, Keppler and Montes-Negret, 1997, 33). As mentioned in section 2, payment cost in the survey focused on the annual operating expenses incurred in selected inter-bank funds transfer systems. This is the real resource cost as compared to financial cost, which considers the cost of collateral and liquidity. The survey also considers the annual amount and sources of revenue generated for each payment system. Both annual revenue and operating expenses help provide an overview of the cost recovery ratios and evaluate the explicit and actual pricing policies practiced in individual countries. All figures are estimates, due to differences in costing methodologies and accounting rules.

Table 2 illustrates the estimated cost and revenues from operating inter-bank funds transfer systems in three regions. The total annual revenue generated by 31 payment systems in 20 countries was approximately USD 1 billion, as compared to the total annual operating expenses of USD 975 million. North America makes up the largest share of total revenues (89%) and operating expenses (91%). This is

followed by the Europe Union (7% of total revenues and 6% of total operating expenses) and EMEAP (4% of total revenues and 3% of total operating expenses).

Table 2. **Cost and revenue estimates of 31 payment systems by region in 2001 (USD millions, except as noted)**

Grouping	No. of Countries	No. of Systems	Revenues (Ranges)	Operating Expenses (Ranges)	Total Revenues	Total Operating Expenses
European Union	10	12	0.5–42	0.7–24	72	57
EMEAP	8	14	0.02–15	0.04–13	39	31
North America	2	5	7.8–936	7.9–879	944	887
Total	20	31	0.02–936	0.04–879	1,055	975

Source: Survey questionnaire

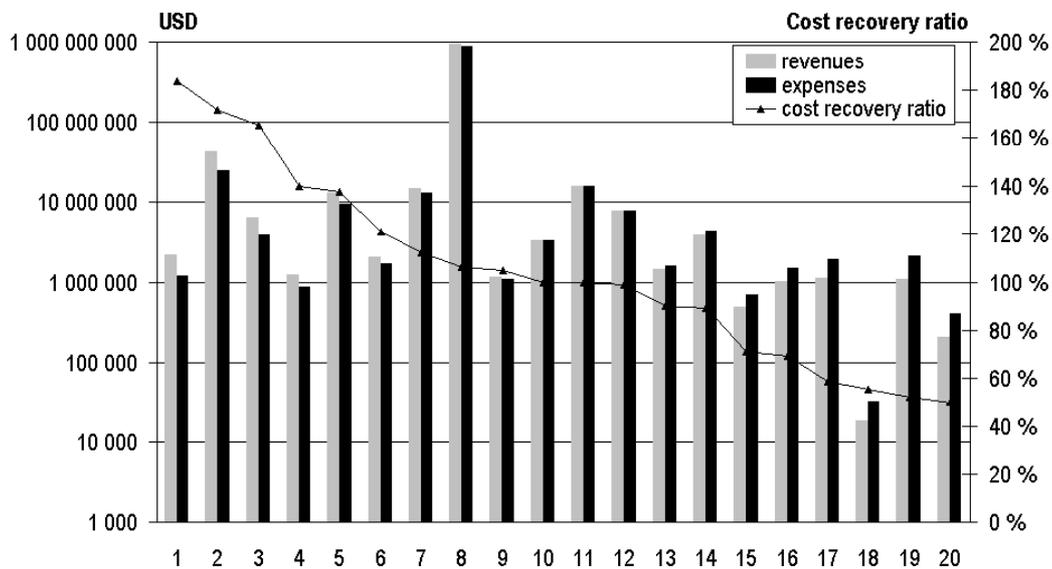
Notes: Figures are for 2000 in three countries and forecast for 2002 in two countries.

Wide differences exist in the ranges for revenues and operating expenses in each region. This may be explained by three factors: size of economy, scope of services, and costing methodology. The *economic size* of a country plays an important part as payment and settlement services support the large payment flows that are generated through economic and financial activities. The *scope of services* also varies across countries depending on the role of that the central bank takes in payment operations as compared to private operators. For central banks, such services may include: monetary policy related payments; cash distribution related payments; interbank settlements; interbank payments; payments generated by central or local governments; correspondent banking services; payment services to companies and private customers; ACH services; cheque clearing, collection and processing services; and securities transfer and settlement services. The *costing methodology*, as mentioned, varies with the internal accounting rules. Differences may lie in defining the sources of revenue, the total cost components, the breakdown of fixed and variable costs and the accounting methodology used in calculating costs figures.

Figure 5 provides a breakdown of cost and revenue estimates in 20 countries. If the countries with the highest (country 8) and lowest (country 18) annual revenues and expenses are excluded, the average figures are USD 6.6 million and USD 5.3 million, respectively, for each of the remaining 18 countries. Figure 5 also shows five countries that operate near full cost recovery, while eight countries indicate partially recovered cost. The cost recovery ratios of the remaining seven countries were comparatively high, suggesting pricing policies are growth-oriented or profit-oriented to recover total cost, to provide funds for

future enhancements, or to obtain a rate of return. Alternatively, cost and revenue components and calculations may have been different across the countries.

Figure 5. **Cost and revenue estimates of 31 payment systems by country in 2001**



Source: Survey questionnaire

Notes: Figures are for 2000 in three countries and forecast for 2002 in two countries. USD amounts are reported on a logarithmic scale.

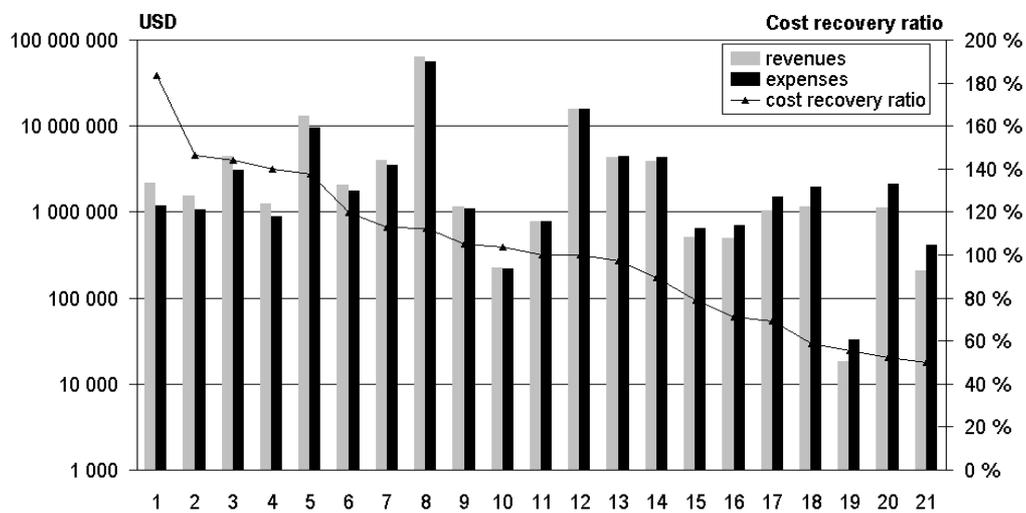
Figure 6 illustrates the cost and revenue estimates of 21 large-value payment systems in Europe (10 systems), East Asia-Pacific (9 systems), and North America (2 systems). Table 3 further summarises their pricing policies, sources of revenue and cost recovery ratios. Annual revenues ranged from USD 18 thousand to USD 63 million. Annual operating expenses varied from USD 33 thousand to USD 56 million. If systems with the highest and lowest annual revenues and expenses (payment systems 8 and 19 respectively) were excluded, the average figures are USD 3 million and USD 2.9 million, respectively, for each of the remaining 19 large-value payment systems. The *major pricing policy* adopted in the selected large-value payment systems was full cost recovery. Costs were fully recovered in a majority of the systems, while nearly half indicated partial cost recovery. The *major source of revenue* was from per item charges (20 systems). Other sources included annual charges (9 systems), monthly charges (4 systems), other charges relating to depository fees, network and software charges and others (4 systems), and lastly, joining fees (2 systems). Per item charges, or transaction fees, varied with use of flat fees, volume-based fees (fee reductions for larger volumes), and variable-based fees (fee reductions for faster settlement times).

Annual charges mainly consist of membership fees. This also includes member contributions towards annual operating expenses calculated based on the proportion of payment instructions they handle, and have a non-profit aim to fully recover costs. Also, annual account management charges, with reduced rates for subsequent accounts, are also applied to participants in some systems.

Figure 7 illustrates the estimated cost and revenues of 10 retail payment systems in Europe (2 systems), East Asia-Pacific (5 systems), and North America (3 systems). Table 4 further summarises their pricing policies, sources of revenue, and cost recovery ratios. The retail payment systems include six ACH systems and four cheque-based operations. Annual revenues ranged from USD 78 thousand to USD 793 million. Annual operating expenses varied from USD 101 thousand to USD 754 million. The *major pricing policy* in the selected retail payment systems was full cost recovery. Costs were fully recovered in a majority of the systems, while two systems indicated partial cost recovery. The *major source of revenue* was from per item charges (8 systems). Other sources included annual charges (1 system), quarterly charges (1), monthly charges (1 system), and other (1 system).

The role of the central bank in owning and operating retail payment services is comparatively minimal than that taken in large-value payment systems, hence, the lower number of responses. In some countries, a banking or payments association either operated them. In others, the central bank plays a coordinating role between participants and provides the daily settlement of the net position of each participant against the others. An ACH system may be divided into sub-systems that clears and settles specific types of payment instruments such as credit transfers, cheques, direct debits, bills of exchange, and other operations. The exchange of information and payments clearing is carried out on a bilateral basis among members, for example through private telecommunication links. An external company develops the supporting software, while development costs are shared among participants, and as a result, operational expenses arising on the part of the central bank is relatively minimal. A majority of the central banks surveyed indicated their continuing role in owning and operating systemically important inter-bank funds transfer systems. This is mainly to maintain financial stability. Comparatively, some have undergone, or have regular, policy reviews to phase out non-core areas such as in securities settlement or retail payment services, with conditions that the alternative operator is suitable and could provide similar services more efficiently.

Figure 6. **Cost and revenue estimates of 21 large-value payment systems in 2001**



Source: Survey questionnaire

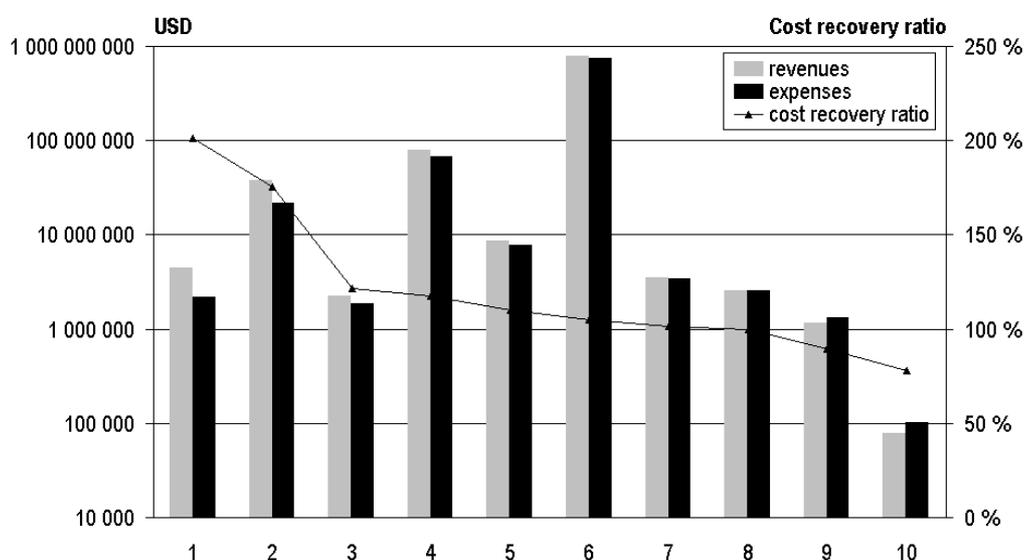
Notes: Figures are for 2000 in three systems and forecast for 2002 in two systems. USD amounts are reported on a logarithmic scale.

Table 3. **Pricing policy, revenue sources and cost recovery estimates of 21 large-value payment systems in 2001**

Payment System	Pricing Policy	Revenue Sources	Cost Recovery Ratio
1	F	A M P	183.7 %
2	F	J A P O	146.3 %
3	F	P	144.1 %
4	F	J A P	139.7 %
5	F	P	137.5 %
6	F	A P O	119.7 %
7	F	P	112.8 %
8	F	P	112.6 %
9	V	P	105.3 %
10	V	M P	103.6 %
11	F	A P	100.0 %
12	F	A P O	100.0 %
13	F	A	97.4 %
14	F	M P	89.3 %
15	F	P	79.0 %
16	F	M P	71.1 %
17	F	P	69.1 %
18	F	A P O	58.8 %
19	V	P	55.5 %
20	F	A P	52.1 %
21	F	P	50.0 %

Source: Survey questionnaire. Notes: Figures are for 2000 in three systems and forecast for 2002 in two systems. Pricing policy: F = full cost, V = variable cost; Revenue sources: J = joining fees, A = annual fees, M = monthly fees, P = per item fees, O = others

Figure 7. **Cost and revenue estimates of 10 retail payment systems in 2001**



Source: Survey questionnaire

Notes: Figures are forecast for 2002 in one system. USD amounts are reported on a logarithmic scale.

Table 4. **Pricing policy, revenue sources and cost recovery estimates of 10 retail payment systems in 2001**

Payment System	Pricing Policy	Revenue Sources	Cost Recovery Ratio
1	F	P O	201.2 %
2	F	P	175.4 %
3	F	P	121.8 %
4	F	M P	117.3 %
5	F	P	110.1 %
6	F	P	105.1 %
7	F	A	101.7 %
8	F	Q	100.0 %
9	V	P	89.2 %
10	V	P	77.8 %

Source: Survey questionnaire

Notes: Figures are forecast for 2002 in one system. Pricing policy: F = full cost, V = variable cost; Revenue sources: A = annual fees, Q = quarterly charges, M = monthly fees, P = per item fees, O = others

Partial subsidisation was also found in 11 of 31 payment systems surveyed. This was evident in all of the three regions and even in payment systems that adopted a full cost recovery pricing policy. Table 5 illustrates the estimated subsidies per payment system and per transaction. In some countries, payment services are provided as a public service. Therefore, subsidisation is an explicit policy and is

reflected in variable cost recovery strategies. For example, subsidised prices may exclude costs related to overhead (labor, building amortisation, and electricity), the internal rate of return, and the present value of investments. Relatively long payback periods are also used in calculating the break-even point. Costs that are included relate to the computer hardware, application software, security software, telecommunications, and system maintenance. In other countries that do not adopt this policy, subsidisation may be partly explained by the positive externality effects that it contributes to reducing risk in the payments system.

Table 5. **Subsidy estimates of 11 payment systems in 2001**

Payment System	Type	Pricing Policy	Amount of Subsidy (USD thousands)	Subsidy per Transaction (USD)
1	L	F	116	0.0309
2	L	F	1,020	1.8752
3	L	F	801	1.2237
4	L	F	467	0.8554
5	L	F	203	0.5067
6	L	F	134	0.1874
7	L	F	467	0.1748
8	L	F	206	0.1312
9	R	V	142	0.0026
10	R	V	22	0.0039
11	L	V	15	0.3139

Source: Survey questionnaire

Notes: Figures are for 2000 in 2 systems; L = large-value payment systems, R= retail payment systems; F = full cost, V = variable cost.

Full cost recovery may be influenced by factors such as the number of participants, the volume of payment flows and the competitive environment in each country. But two increasingly important elements are the choice of the cost recovery framework and the pricing structure that fully accounts for both fixed and variable costs. The *cost recovery framework* may be adjusted accordingly to different phases during the system development life-cycle. This may start with partial cost recovery (recover a portion of development and operational cost), and proceed with full cost recovery (recover full development and operating costs), planned growth cost recovery (recover full costs and provide funds for future capital equipment purchases), and finally profit-generating (recover full costs and provide funds for future enhancement and returns). Moreover, cost recovery strategies take into account volume forecast and their effects on future costs and revenues, as illustrated in two of the countries surveyed that have adopted full cost recovery as a pricing policy.

The *pricing structure* is equally important. This may take the form of combining annual, monthly, per item and other charges to achieve the expected outcome. Others may include annual membership contributions towards operating

expenses that are proportionally allocated. *Two-part pricing* has been commonly accepted as one of the best pricing methods as the pricing structure serves two purposes (Humphrey, Keppler and Montes-Negret, 1997, 14). It reflects the potential economies of scale in payments processing, and passes the benefits of high volume operations to high volume users. Two-part pricing forms the basis for many central bank payment and settlement services, particularly the US Federal Reserve. Three major price components are included: *per item charges* is applied for cheque, ACH and funds transfer services to reflect average variable costs; *per batch charges* are applied for cheque and ACH services to reflect average fixed costs; and *monthly account servicing charges* are used for ACH services to reflect average fixed costs. Other relevant charges include electronic connection fees that vary between telephone dial up, dedicated leased line and encryption certification – all reflecting average fixed costs. In the countries surveyed, two-part pricing was practiced in payment systems using volume-based fees, where price reductions were applied to larger volumes or batches of payments, which encourages economies of scale in the payments processing system.

3.4 Unit cost

Unit cost estimates were calculated for the selected 31 payment systems. Table 6 summarises the results of the actual average unit cost for large-value, ACH and cheque-related payment systems in Europe, East Asia-Pacific, and North America. Unit cost for large-value payment systems were comparatively lower in North America than in Europe and East Asia-Pacific. Unit cost for ACH systems were comparatively lower in Europe than the two other regions. Unit cost for large-value payment systems were highest and for ACH lowest when total average unit costs for the three types of payment systems are compared. Such comparisons should take into account the different sample and standard deviations.

Table 6. **Average unit cost estimates of 31 payment systems by region in 2001 (USD, except as noted)**

Region/System	No. of Systems	Average Unit Cost	Standard Deviation
European Union			
Large-value systems	10	1.5364	1.3285
ACH systems	2	0.0061	0.0047
Cheque systems	–	–	–
EMEAP			
Large-value systems	9	1.1479	1.0346
ACH systems	2	0.0246	0.0100
Cheque systems	3	0.0317	0.0234
North America			
Large-value systems	2	0.8436	0.4980
ACH systems	2	0.0080	0.0102
Cheque systems	1	0.0446	-
Total			
Large-value systems	21	1.3039	1.1375
ACH systems	6	0.0129	0.0113
Cheque systems	4	0.0349	0.0201

Source: Survey questionnaire

Notes: Figures are for 2000 in 3 countries and forecast for 2002 in 2 countries.

A log-linear cost function model is used to further estimate unit cost when other variables are considered and can be expressed as:

$$\ln UC_i = \alpha_i + \beta_1 \ln VOL_i + \beta_2 \ln GDPC_i + \beta_3 \ln SIZ_i + \beta_4 MIN_i + \beta_5 PUB_i$$

where:

UC = unit cost for inter-bank payments instruction (cheque, ACH or funds transfer and settlement activity);

VOL = total number of payment instructions (cheque, ACH or funds transfer and settlement);

GDPC = gross domestic product per capita;

SIZ = size of transaction value to number of payment instructions;

MIN = 1 if minimalist approach
= 0 otherwise; and

PUB = 1 if public service approach
= 0 otherwise.

The model is used to examine the effects of the number of payment instructions, the cost of labor, the size of transaction values, and policy approaches on the unit cost of payment systems across different countries. Two binary variables are introduced to represent three types of policy approaches – minimalist, public

service, and competitive – the latter being the benchmark category. Regressions are based on the ordinary least squares method and are used to estimate the parameters using cross-sectional data of 31 unit cost observations. Table 7 presents the regression results. The role of the central bank versus the private sector varies under the alternative approaches, while the categorisation of payment systems considers the common features as follows.³

The minimalist approach:

- Central bank owns and operates only core inter-bank funds transfer systems
- Private sector owns and operates a majority of inter-bank funds transfer systems
- Central bank does not compete with the private sector
- Central bank pricing policy is based on full cost recovery

The competitive approach:

- Central bank owns and operates major inter-bank funds transfer systems
- Private sector owns and operates competing inter-bank funds transfer systems
- Central bank competes directly with the private sector under the level playing field principle
- Central bank pricing policy is based on full cost recovery, including imputed costs

The public service approach:

- Central bank owns and operates a majority of inter-bank funds transfer systems
- Private sector does not compete with the central bank
- Central bank pricing policy is based on variable cost recovery, including subsidisation of at least the fixed cost

³ Further illustrations are discussed in section 4. The number of each payment systems under each category is as follows: minimalist (22), competitive (3), and public services (5).

Table 7.

Regression results of log-linear cost function

Explanatory Variables	Dependent Variable: Unit Cost			
	Model 1 Parameter Estimates	Model 2 Parameter Estimates	Model 3 Parameter Estimates	Model 4 Parameter Estimates
Intercept	3.8307 (5.2032)**	-3.5922 (-1.9324)	-3.9959 (-2.3426)*	-0.6692 (-0.2777)
LnVOL	-0.5753 (-7.7389)**	-0.6787 (-10.5868)**	-0.4903 (-5.1732)**	-0.6075 (-6.8339)**
LnGDPC		0.8835 (4.2081)**	0.5143 (2.0601)*	0.4776 (1.5672)
LnSIZ			0.1784 (2.3927)*	0.1698 (2.6792)*
MIN				-1.9421 (-3.6358)**
PUB				-1.0482 (-1.5660)
R ² -adjusted	0.6625	0.7858	0.8179	0.8675
F-statistics	59.89	56.05	44.43	38.98
N	31	31	30	30

Notes: T-statistics are reported in parenthesis. Significant at 1% (**) and 5% (*) level.

The regression results suggest the following. First, economies of scale effects are relatively strong. Model 1 relates the volume of payment instructions to the unit cost. In this linear regression, increases in the number of payment instructions are associated with lower unit cost. The regression explains that if payment instructions increased by one percent on the average, unit cost reduces by 0.57 percent. This negative relation is still maintained when the variables of gross domestic product per capita, the size of payments, and the type of policy approach are added into Models 2–4, respectively. According to Model 3, both gross domestic product per capita and the average size of payments have a significant positive relationship to the unit cost. In other words, an increase in the general cost level in the country and/or the need to limit risks causes an increase in the unit cost.

Second, cost-reducing effects were comparatively stronger under the minimalist approach. Model 4 considers the type of policy approach and their effects on unit cost. Unit cost reductions were greater under the minimalist as compared to the competitive and public service approaches. Under Model 4, cost adjustments were made to three of the five payment systems in the public service category to account for fixed costs that were not reported in the survey response. The share of fixed cost accounted for approximately 50 to 80 percent of the total cost in the retail and large-value payment systems, respectively. The two remaining payment systems under this category reported fixed costs. This improves the comparative analysis with a majority of payment systems under the

minimalist and competitive approaches that included fixed costs. Appendix 2 reports the regression results comparing the actual and forecasted unit costs under each of the four models. Figures 8–10 plots the unit costs in a scattergram for each of the models to locate each of the payment systems on the efficiency frontier when the observations are examined as a group, and as large-value and retail payment systems, respectively. The actual number of payment instructions is reported as logarithmic values so that payment systems are unattributed, but in principle, they represent the expansion of output.

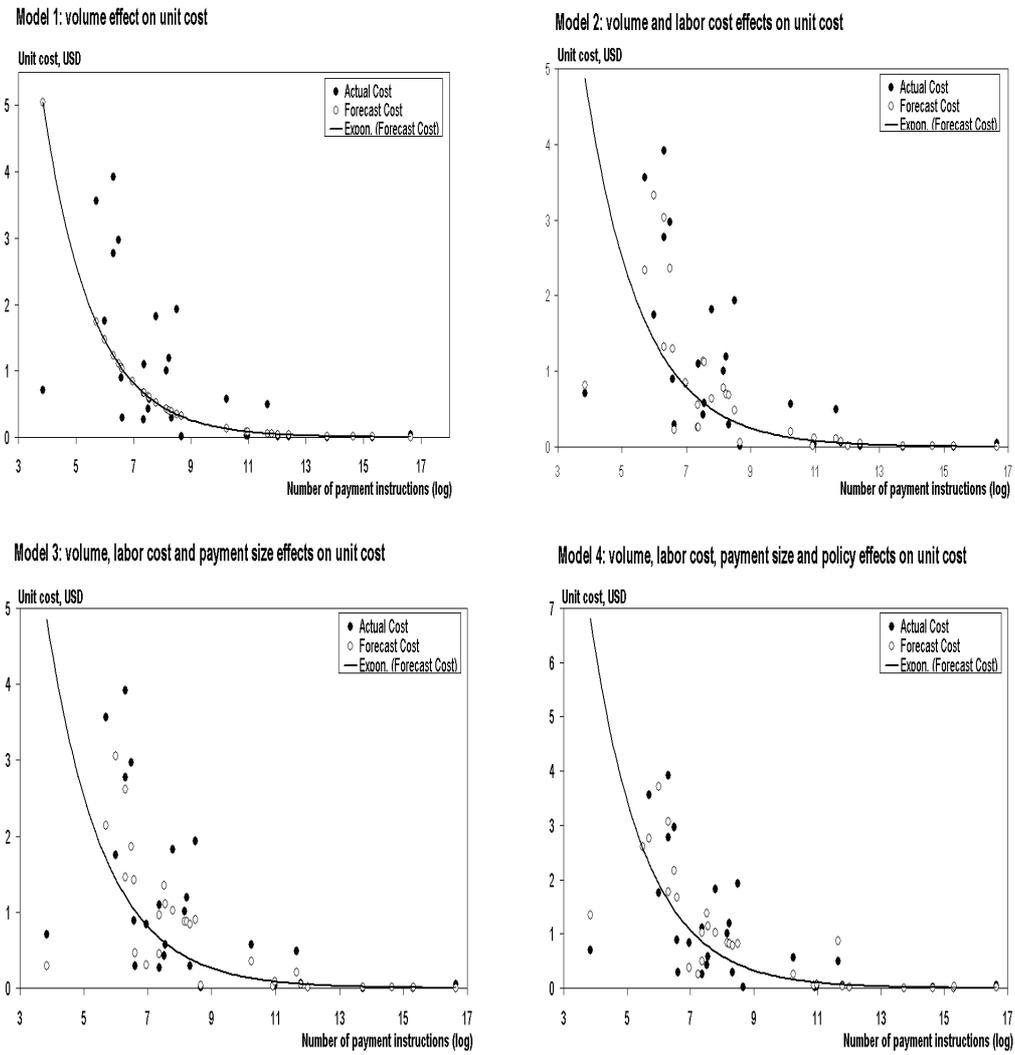
Figure 8 compares the unit cost estimates of 31 payment systems along the efficiency frontier. Retail payment systems operate between the level of zero to one USD, while a majority of large-value payment systems operate above one USD. The curve also explains the strong scale economies as the number of payment instructions move from large-value to retail payment systems with unit cost reductions.

Figure 9 compares the unit cost estimates of 21 large-value payment systems along the efficiency frontier. Under Model 3, 11 payment systems operated below the forecast unit cost of one USD per payment instruction, while nine payment systems operated above that level. Six payment systems operate close to the efficiency frontier where economies of scale set in with larger volumes and lower unit cost. Model 4 identifies four large-value payment systems, under the minimalist approach, operating with comparatively large volumes and lower forecast unit cost than their competitive and public service counterparts.

Figure 10 compares the unit cost estimates of 10 retail payment systems along the efficiency frontier. This includes six ACH and four cheque systems. Under Model 3, four ACH systems operated below the forecast unit cost of two US cents per payment instruction, as compared to two others systems, which were between four to nine US cents. Model 4 identifies three ACH systems, under the minimalist approach, operating with comparatively large volumes and lower forecast unit cost than both of their counterparts.

Figure 8.

Unit cost estimates of all 31 payment systems along the efficiency frontier

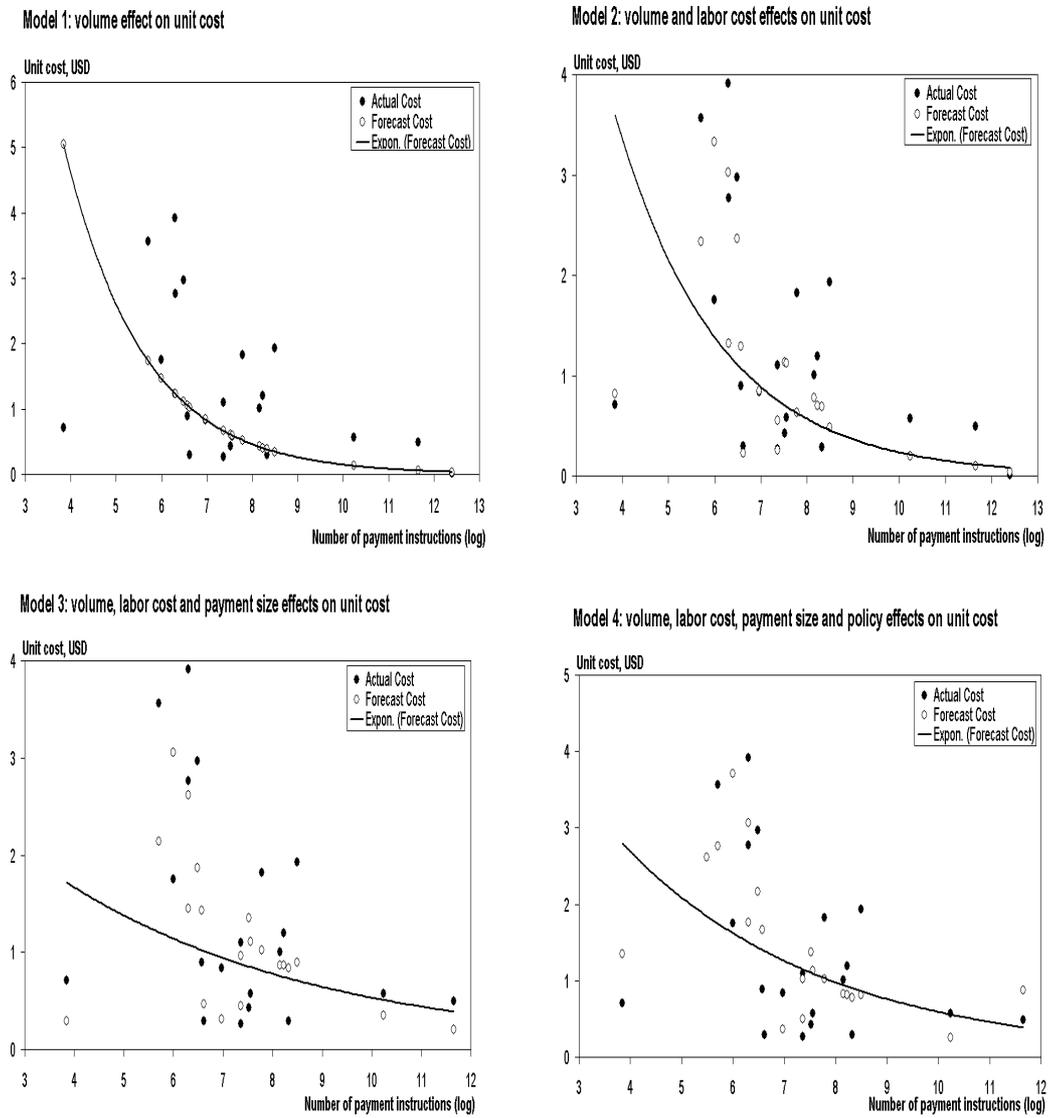


Source: Author's calculations

Notes: Models 3-4 are based on 30 observations. Number of payment instructions is reported as logarithmic values.

Figure 9.

Unit cost estimates of 21 large-value payment systems along the efficiency frontier

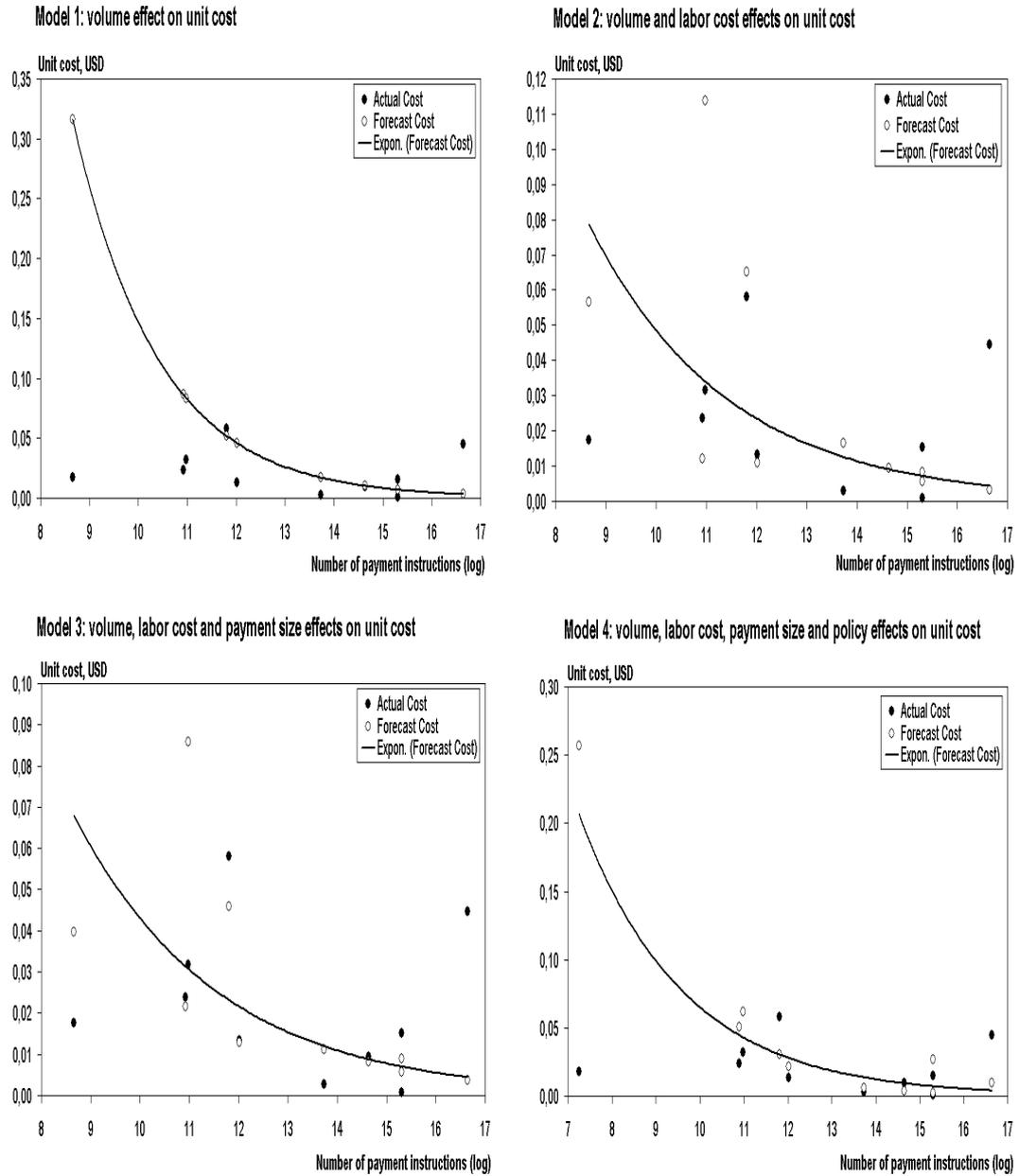


Source: Author's calculations

Notes: Models 3-4 are based on 20 observations. Number of payment instructions is reported as logarithmic values.

Figure 10.

Unit cost estimates of 10 retail payment systems along the efficiency frontier



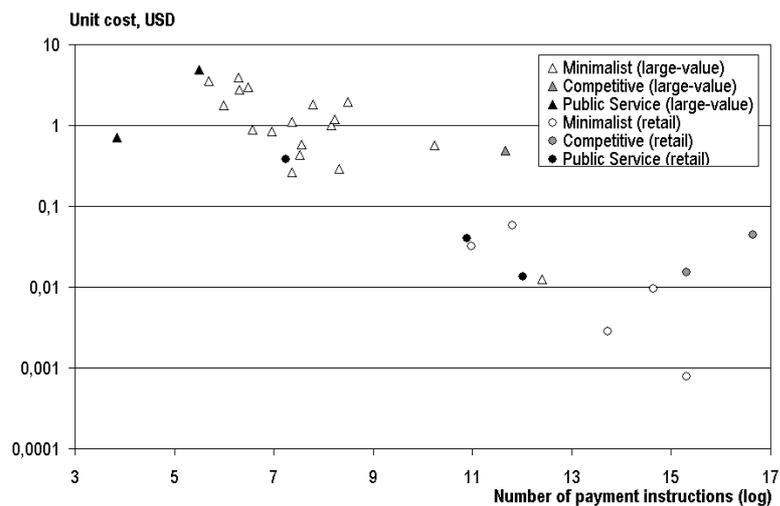
Source: Author's calculations

Notes: Number of payment instructions is reported as logarithmic values.

Figure 11 compares actual unit cost estimates by policy approach. Scale economies can be found for large-value and retail payment systems under the minimalist approach, starting from approximately one USD and falling below one US cent as volumes increase, respectively. Payment systems under the public service approach operated at comparatively lower volumes and higher unit costs to both their counterparts. Alternatively, payment systems under the competitive approach operated at comparatively higher volumes than most of their counterparts, but unit cost were higher. This may be explained by the following factors. First, unit costs also accounted for imputed costs. This may range from nine to 14 percent of total costs (operating expenses plus imputed costs). And second, scope economies were comparatively stronger under the minimalist approach where a single payment facility handled more than one payment instrument.

Figure 11.

Comparison of unit cost estimates under alternative policy approaches



Source: Author's calculations.

Notes: USD amounts are reported on a logarithmic scale.

Number of payment instructions is reported as logarithmic values.

Scale economies are comparatively stronger in retail than large-value payment systems due to the larger number and lower values of payment instructions. This is explained by the risk-cost trade-off framework, which shows that low-risk payments come at a higher cost. Another important factor is scope economies, particularly in ACH systems. This includes the processing of multiple types of payment instruments, possibly organised as sub-systems, under the same facility and may include: cheques, truncated cheques, paper remittances, electronic data interchange, magnetic tape credits, magnetic tape debits, credit transfers, debit

transfers, point-of-sale transactions, card-based transactions, etc. This helps distribute fixed costs at a common facility over a larger number of items.

In sum, scale and scope effects were found in the large-value and retail payment systems surveyed. Lower unit cost was attributed to increases in the number of payment instructions handled and the relative value per payment instruction. Moreover, payment systems that operated under a minimalist approach demonstrated comparatively stronger cost-reducing effects than their competitive and public service counterparts. Differences among alternative policy approaches are further examined in the following section.

4 Policy approaches

This section examines three major policy approaches towards promoting and pursuing payment systems efficiency. The approaches are categorised into three groups: the minimalist, competitive, and public service approaches. The analysis compares the involvement of the central bank and the private sector in payment operations by illustrating how ownership, pricing policies, and cost recovery may vary, and how such factors may influence payment systems efficiency across selected countries.

4.1 The minimalist approach: Australia, Canada, Finland, United Kingdom

The private sector takes precedence in promoting payment systems efficiency under the minimalist approach. The central bank plays a minor role in payment operations, which may be limited to providing settlement account services, collateral services and liquidity facilities. Others may own and operate the core large-value inter-bank funds transfer system. The private sector plays a larger role in payment clearing and settlement. This may take the form of joint-ownership and operations of a centralised or decentralised payments system, which may be self-managed by banks or administered by an association. The central bank is involved in such associations as a board member, shareholder, or participant. It may also take part in their establishment. Such practices may be illustrated with the approach adopted in Australia, Canada, Finland and the United Kingdom.⁴

⁴ See Berg (1999) for a discussion of the minimalist approach in Nordic countries. For full details of country cases, see Executives' Meeting of East Asia-Pacific Central Banks and Monetary Authorities (2002) for Australia; Goodlet (2001) and Anvari (1990) for Canada; and European Central Bank (2001) for Finland and the United Kingdom.

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

The annual settlement costs associated with operating RITS is approximately 15 percent of the central bank's underlying operating cost (Reserve Bank of Australia, 2002, 56–57). The share of settlement cost gradually increased from 6 percent to 15 percent between 1997–1999, reflecting the high development costs incurred before and during the introduction of the system in mid-1998, while leveling off during 1999–2002. Other underlying operating costs includes functions relating to monetary policy, financial system surveillance, note distribution, and banking and registry. This excludes notes printing.

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

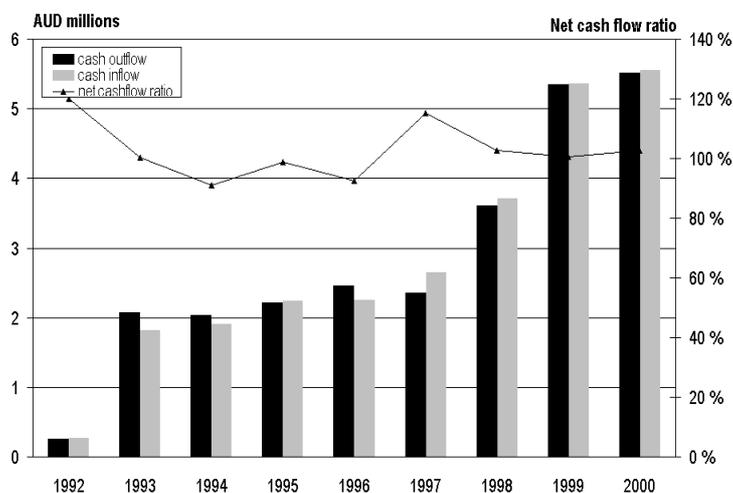
The Australian Payments Clearing Association Limited (APCA) plays a major role in managing, developing and operating payment systems in Australia. APCA was first conceived by the Australian Bankers' Association in 1988, while the reform process was later guided by a central bank representative in an industry-wide Reform of the Clearing System Steering Committee, which eventually led to the establishment of APCA in 1992. APCA shareholders include the RBA, commercial banks and the building society and credit union industry bodies. It operates five clearing systems as follows: the Australian Paper Clearing System (APCS); the Bulk Electronic Clearing System (BECS); the Consumer Electronic Clearing System (CECS); the High-Value Clearing System (HVCS); and the Australian Cash Distribution and Exchange System (ACDES).

APCA costs are associated with its general administration and the development and operation of its five clearing streams. Figure 12 illustrates the cash flows generated from APCA operating activities between 1992–2000. In 2000, the total costs to the payments industry was over AUD 5 million, according

to cash outflows from operating activities. Members share these costs in proportion to their importance in the payments system, and their category of membership would also determine the extent to which types of fees are paid. Such fees may include entrance fees, operational change fees, operating fees, and annual membership fees.⁵ The pricing policies for the four clearing systems are not based on transaction fees, but are determined independently by individual financial institutions. For ACDES, members share operational costs based on their share of national activity.

Figure 12.

Cost recovery of payment systems in Australia, 1992–2000



Source: Australian Payments Clearing Association, Annual Report, various issues.

Operational costs and revenue figures for each of the five clearing streams are not available. Thus, it may help to analyse APCA financial performance through the use of cash flow statements reported between 1992–2000. In particular, we focus on operating activities, which reflect cash inflows and cash outflows directly related to developing and operating the clearing systems. Cash flows from investing and financing activities are excluded, as they relate to proceeds from the issue of shares and the payment for the redemption of shares, and payment for office equipment.

Cash inflows are used to represent revenues, and are based on the contributions towards expenses by members, other operating income, proceeds from the sale of inventories, income tax refunds, interest received, and proceeds from the sale of property, plant and equipment. Cash outflows are used to

⁵ See Regulations for Australian Paper Clearing System (APCA, 1993), Regulations for Bulk Electronic Clearing System (APCA, 1994), Regulations for Consumer Electronic Clearing Stream (APCA, 2000), and Regulations for High-Value Clearing System (APCA, 1997).

represent costs, and are based on payments to suppliers and employees, interest and other costs of finance paid, income tax payments, and depreciation. The largest source of cash inflows from operating activities comes from the annual contributions towards expenses by members, while the major cash outflows originate from payments to suppliers and employees. Between 1992–2000, member contributions and suppliers and employees payments were 91 percent and 95 percent of total cash inflows and total cash outflows, respectively.

Figure 12 also shows how the increase in costs from operating activities, resulting from the development of new clearing systems, are absorbed by APCA members. The first sharp increase was in 1993 with the establishment of APCS. The second significant increase was experienced between 1997–1999 with the introduction of HVCS in 1997, while net cash flows leveled off in 2000. Moreover, although net cash flows indicated that cost were not being fully recovered in the early-1990s, this also leveled off by 2000.

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

The CPA is a “not-for-profit” organisation established in 1980 based on amendments to the *Bank Act* of 1980. Members are from deposit-taking institutions. The Canadian Payments Act came into effect in the fall of 2001, replacing the former Canadian Payments Association Act. This expanded the types of organizations that are eligible for membership beyond deposit-taking institutions to include three new groups: life insurance companies, securities dealers and money market mutual funds. Although these groups are now eligible to become CPA members, none have applied as of 2002. Its mandates are threefold: “to establish and operate national systems for the clearing and settlement of payments and other arrangements for the making or exchange of payments; to facilitate the interaction of its clearing and settlement systems and related arrangements with other systems or arrangements involved in the exchange, clearing or settlement of payments; and to facilitate the development of new payment methods and technologies.” It operates two major national clearing and settlement systems: Automated Clearing Settlement System (ACSS) and Large-Value Transfer System (LVTS). In 2001, ACSS handled over 99 percent of the total number of payment instructions and 15 percent of total transaction values in Canada. Comparatively, LVTS handled less than one percent of the total number of payment instructions but 85 percent of total transaction values.

Payment values handled by LVTS is expected to rise due to the planned introduction of a CAD 25 million ceiling in early-2003 for paper-based transactions such as cheques and bank drafts that are currently cleared by ACSS. This migration of value would seek to reduce the potential systemic risks in ACSS.

The CPA recovers operating costs through its membership fee structure. According to the *Canadian Payments Act* the CPA Board is required to prepare an operating and capital budget for each fiscal year and to seek approval from members. If a budget surplus exists in a given year, it is applied to re-duce membership dues in the following year. Members are required by the association's by-laws to pay dues, which take two forms: individual member general dues and LVTS dues.⁶

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

Gradual unit cost reductions were achieved for the ACSS over the 1990–2001 period with volume increases. These operating costs focus on the centralised cost shared by members but do not account for other costs that would have been incurred by individual institutions. Unit cost reductions largely stem from the large number of payment instructions and the economies of scope of the system. The ACSS handles a wide range of paper-based and electronic transactions. This includes, large- and small-value paper items, paper bill payment remittances, automated funds transfer (AFT) debits and credits, shared cash dispensing via ABM networks, point-of-sale transactions, EDI transactions, and electronic bill payment remittances. With strong scale and scope economies, relatively low unit costs, and a concentrated banking structure, the Canadian payment system, particularly ACSS, has been regarded as one of the most efficient in the world (Anvari, 1990, 93).

In Finland, the central bank owns and operates a core inter-bank RTGS system (BoF-RTGS). The central bank maintains accounts for settling financial obligations between participants in the financial market. BoF-RTGS operates on a full cost recovery principle and cost is recovered through the following fees:

⁶ See Department of Finance, By-law No. 2 Respecting Finance. Changes to the Financial By-law, and the structure of dues, would take effect on January 1, 2003. See www.cdnpay.ca for the *Canadian Payments Act* (revised 2001) and the new By-law.

joining fees (to open an account), monthly fees (account maintenance) and per item fees. Other fees include charges for applications and their monthly maintenance fees, which is required by account holders to establish and secure connection to the central system.

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

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

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

PMJ and POPS costs and revenues figures are not available. As the systems are decentralised and network-based, there are no administrative or central operating costs that are charged to members by the FBA. New participants, however, are charged an entry fee to help cover initial investment costs relating to systems design and implementation, along with costs for making subsequent changes. The unit cost incurred by participants is estimated to be relatively minimal and relate to their investment and the costs for operating data processing centers. This mainly arises from the sending of bilateral payment information, where financial obligations are later settled across accounts at the central bank.

In the United Kingdom, the central bank does not own the core inter-bank RTGS system – the Clearing House Automated Payment System (CHAPS). It partly operates the CHAPS processor, maintains settlement accounts, and processes multilateral settlement across them. Annual budgeted settlement costs is 7 percent of all other major central bank functions, which include monetary policy, note issue, banking, financial stability, and services for the government (Bank of England, 2002, 38). CHAPS operates on a full cost recovery principle and include the following fees: annual fee (account maintenance), annual fee (terminal connection to the Enquiry Link function), and per-item tariff (sterling transfers).

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

CHAPS ownership belongs to banks, while it is operated under a company structure and managed by APACS. APACS manages two other major retail payment systems that also operate under a company structure: the Bankers' Automated Clearing Services (BACS) and Cheque and Credit Clearing. In 2000, CHAPS Sterling handled less than one percent of the total number of payment instructions, but 93 percent of total transaction values. Comparatively, BACS and Cheque and Credit Clearing handled 61 and 38 percent of the total number of payment instructions, and four and three percent of total transaction values, respectively.

A study into the costs of money transmission of the payments industry, which includes commercial banks and building societies, suggests that total costs declined between 1991 and 1994 (Association for Payment Clearing Services, 1996). This provides the most recent and available industry payment cost data to date in the United Kingdom. Cash comprised the largest proportion of all costs. This covers cash receipts, and cash withdrawals at branches, automated teller machines and in bulk. Cheques experienced the largest cost reductions during the three-year period.

APACS members share the costs of major payment clearing operations (Association for Payment Clearing Services, 2002, 21). This source of funding serves the purpose of recovering costs. Its interest groups and clearing companies formulate their own budget, while costs are allocated among members based on a formula. This is based on the level of activity a member is involved with or their

share of the total number of transactions handled in a given clearing system. Thus, members with a higher share of transaction volumes are required to pay a larger share for the cost of clearing operations, and vice versa.

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

4.2 The competitive approach: United States

The public and private sectors take competing roles in promoting payment systems efficiency under the competitive approach. The central bank plays a major role in owning and operating inter-bank funds transfer systems and competes directly with commercial banks. In doing so, its pricing policy is formulated to fully recover all real resource costs, but more importantly, the imputed costs, which account for the costs that would have been incurred by a private firm providing similar services. This practice can be best illustrated with the case of the United States.⁷

The US Federal Reserve has been actively involved in providing payments processing services since its establishment in 1913, including the operation of cheque processing, the automated clearinghouse, and a large-dollar wire transfer system. These roles have been reviewed in light of the *Depository Institutions Deregulation and Monetary Control Act* of 1980, which gave it a mandate to recover all direct and indirect costs in providing priced services (Humphrey, 1984, 1–2). By the late-1990s, a comprehensive study on its role in the payments mechanism concluded that it should remain a provider of payment services and play a more active role in collaborating with both service providers and users (Federal Reserve System, 1998, 3).

The US Federal Reserve's pricing policy is guided by the *Monetary Control Act*. The law "requires the Federal System to establish fees that, over the long run, recover all direct and indirect costs of providing services to depository institutions, as well as imputed costs, such as income taxes that would have been paid and the pretax return on equity that would have been earned had the services

⁷ See Humphrey (1984) on the costs, pricing, competition and risk in the U.S. payments system.

been provided by a private firm.” (Board of Governors of the Federal Reserve System, 1995, 260). This is the basis for pursuing full cost recovery where an *annual pricing process* projects volumes, revenues, expenses, the private sector adjustment factor (PSAF), and net income in major service areas. Fee schedules undergo an approval process by product directors, the Financial Services Policy Committee, and finally, by the Board of Governors.

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

Fee-based revenues originate from the following sources.⁸ Commercial cheque collection fees vary across the different districts where Federal Reserve offices operate. Generally, per item fees are applied to cheque forward collection, cheque return item, and electronic cheques. Fees for electronic cheques are comparatively lower than cheque forward collection, while higher fees are charged for returned items.

Funds transfer and settlement fees originate from the following. For funds transfer, fees are largely based on volume-based pricing for origination and receipt services. Fees per transfer are set at three-levels, with fee reductions applied when volumes reach a predetermined level of volume per month. Other charges include comparatively higher fees for off-line transfers (origination and receipt) and additional fees for the delivery of reports. For settlement, basic fees include per entry and settlement file charges. In addition, there is a minimum monthly fee. Other charges include comparatively higher off-line origination fees per file in exceptional cases.

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

Non fee-based revenue originates from the net income on clearing balances. The investment income on clearing balances is equal to the average coupon-equivalent yield on three-month Treasury bills applied to the total clearing balance maintained net of earnings credits, and adjusted for the effect of reserve

⁸ See www.frbervices.org for a complete schedule of fees.

requirements on clearing balances (Board of Governors of the Federal Reserve System, 1995, 274).

Figure 13 illustrates the cost recovery ratios and unit costs for the following priced services: cheque collection services, funds transfer and net settlement, and commercial ACH. The figures help illustrate how the above pricing structure was instrumental in achieving full cost recovery, including the real resource and imputed costs, in the selected priced services between 1995–2001.⁹

The total cost for priced services takes into account both resource and imputed costs. Resource costs relate to operating expenses. This includes direct, indirect, and other general administrative expenses of the Reserve Banks for priced services plus the expenses for staff members of the Board of Governors working directly on the development of priced services (Board of Governors of the Federal Reserve System, 1995, 274). Such resource costs are also called total activity costs and are comprised of fixed and variable expenses as follows: personnel, equipment, shipping, travel, communications, and detailed support costs (computer operations, data systems support, motor vehicles, building operations, house-keeping, stock of supplies, printing and duplicating, graphics, and planning). Costs stemming from district projects, which are defined as ‘planned efforts at the District level that focus on broad areas with specific, generally long-range objectives or anticipated end results’, are also included in the calculation of service costs.¹⁰

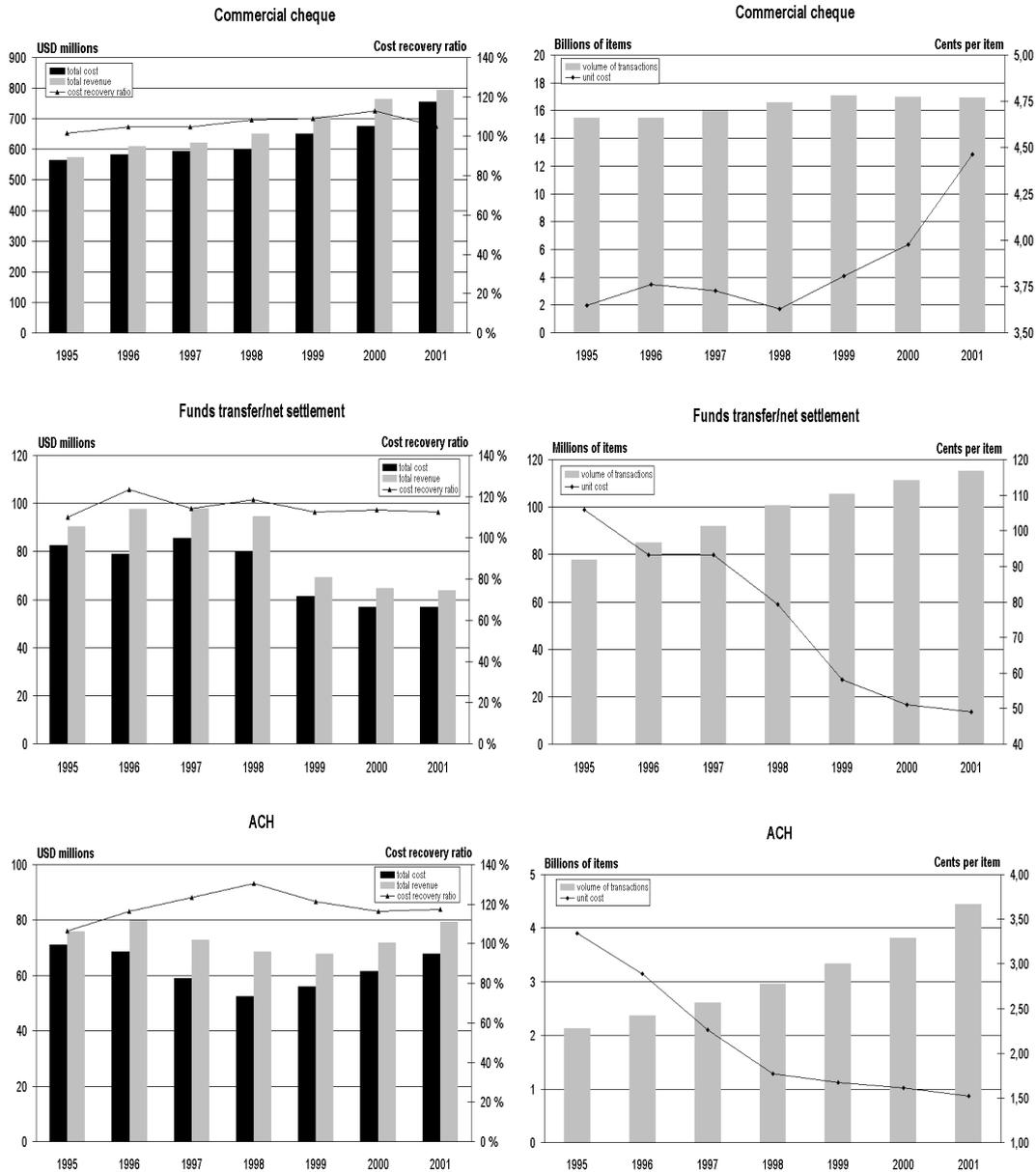
Imputed costs, also known as the PSAF, serves as a ‘profit’ element in direct competition with correspondent banks. The PSAF is added to the real resource costs required for producing payment services, and includes three major components as follows: tax rates, capital structure (debt-equity ratio) and return on capital (the weighted average of debt costs and return on equity). To arrive at the PSAF, a set of commercial banks is used for comparative basis, while adjustments are made prior to calculating the final PSAF. Figure 13 shows full cost recovery in each of the three services and unit cost increases for cheque collection services, as compared with corresponding unit cost reductions for funds transfer and net settlement, and commercial ACH services between 1995–2001.

⁹ Cost components and allocation among Federal Reserve offices are reported in the Planning and Control System (PACS) of the Board of Governors of the Federal Reserve System.

¹⁰ See Planning and Control Systems report.

Figure 13.

Cost recovery and unit costs of selected US Federal Reserve priced services, 1995–2001



Source: Board of Governors of the Federal Reserve System, Annual Reports. Author's calculations.

Note: Transaction volumes include the following: commercial cheques (total number of commercial cheques collected, including both processed and fine-sort items); funds transfer and net settlement (number of transactions originated on line and off line); and ACH (total number of commercial items processed).

Efficiency improvements in the US payments system have been largely attributed to the role of the US Federal Reserve. Although past studies found scale diseconomies in US Federal Reserve cheque processing services, this was attributed to the lack of competition, only to be improved with the introduction of the *Monetary Control Act* (Humphrey, 1984). Further efficiency improvements were reported in empirical studies of specific services. Bauer and Hancock (1993) examined the efficiency and productivity of 47 cheque processing offices of the Federal Reserve System over the period 1979–1990 and found that no offices were operating with scale diseconomies. This confirmed scale efficiency improvements after a new pricing policy was introduced in the early 1980s. Bauer and Hancock (1995) further examined and found scale economies in 38 ACH payment processing sites over the period 1979–1994, while noting that further cost savings may be achieved through the consolidation of processing sites.

Bauer and Ferrier (1996) carried out a comprehensive cost function study on cheque processing, ACH and Fedwire funds transfer over the period 1990–1994 to estimate their marginal costs, scale economies, cost efficiency, and technological change. The study found scale economies for all but the twelve smallest cheque processing sites, suggesting the possibility to further reduce costs through consolidation. ACH and Fedwire services also experienced scale economies. Using a more general and analytical approach, Gilbert (1999; 1998) applies the risk-cost frontier framework and notes that the US Federal Reserve's founding did improve the efficiency of the payment system, where lower ratios of cash to total assets were experienced.

4.3 The public service approach: Thailand

The public sector plays a major role in promoting payment systems efficiency under the public service approach. This is characterised by the major role that central banks play in payment operations. The central bank owns and operates a majority, if not all, inter-bank funds transfer systems. This includes large-value funds transfers and settlement, cheque clearing and ACH clearing. The monopoly of payment networks, and their pricing method, is aimed to encourage economies of scale. A 'non-profit' and subsidised pricing policy is adopted to promote payment systems efficiency, and has a strong influence on the setting of fees that commercial banks charge their customers. This practice can be illustrated with the case of Thailand.¹¹

¹¹ See Johnson (1998, 131–140) for a description of the Thai payments system and Jitsuchon and Khiaonarong (2000) for an analysis of their cost, pricing and income.

The central bank owns and operates three major payment systems: the RTGS-based Bank of Thailand Automated High-Value Transfer Network (BAHTNET), the Electronic Cheque Clearing System (ECS), and Media Clearing. It also partly owns the Provincial Cheque Clearing system with commercial banks. Payment and settlement services are provided on a non-profit principle to promote the use of electronic payments, and the general pricing policy has been variable cost recovery. Costs are recovered through the following fees for each system. BAHTNET: monthly fee (terminal connection) and per-item fees; ECS: per-item fees; and Media Clearing: per-item fees.

Table 8 illustrates the cost and revenue estimates in providing the major inter-bank settlement services. These services were introduced in the mid-1990s in a wide-ranging program to modernise the country's payments system to support financial sector and economic development (Watanagase, 1994). The lack of readiness on the part of commercial banks was also a key rationale that prompted the direct involvement from the central bank. As a result, it absorbed the underlying investment costs, and solely owns and operates each of the system. This gives the central bank substantial monopoly power on the pricing policy of services provided to commercial banks, and to a larger extent, the related payment service that latter provides to their customers.

Table 8. **Cost and revenue estimates of payment services provided by the Bank of Thailand, 1998 (THB million, except as noted)**

Payment Service	Total Transaction Volumes	Total Revenues (TR)	Total Costs (TC)	Variable Costs (VC)	Full Cost Recovery (TR-TC)	Variable Cost Recovery (TR-VC)
BAHTNET	243,127	6.3	48.5	8.9	-42.2	-2.6
ECS	53,773,018	62.2	88.1	37.9	-25.9	24.2
Media Clearing	1,397,379	0.8	22.2	10.1	-21.4	-9.3
Total	55,413,524	69.3	158.8	56.9	-89.5	12.3

Source: Adapted from Jitsuchon and Khiaonarong (2000, p. 15).

Notes: BAHTNET and Media Clearing cost figures are based on 1997. ECS cost figures are based on 1996. Low increases in input prices before 1998 are assumed.

In 1998, the total cost for providing the three inter-bank funds transfer systems was estimated at approximately THB 159 million (USD 3.8 million), while total revenues were THB 69 million (USD 1.7 million). The total amount of subsidisation amounted to THB 90 million (USD 2.2 million), while the figure declines to THB 12 million (USD 0.3 million) if the pricing policy is based on the recovery of variable costs.

Major subsidised services were Media Clearing and BAHTNET, where full cost recovery ratios were 3.6 percent and 13 percent, respectively. The low ratios

are largely due to relatively large fixed cost components. Also, the volume of electronic payment transactions was comparatively lower than cheques, which accounted for 97 percent of the total volume of transactions in 1998. As a result, there were lower levels of ECS subsidisation, where the full cost recovery ratio was 71 percent. This was largely recovered through per item charges, where revenues made up 90 percent of total revenues.

Although BAHTNET was introduced in 1995, and Media Clearing later in 1997, the total volume of electronic payments remained comparatively lower than cheques (Table 8). Moreover, Media Clearing was under-utilised, handling only direct credit transactions, as commercial banks were unprepared to process direct debit instructions. Thus, Jitsuchon and Khiaonarong (2000) argue that although Thai payment systems have undergone progressive technological developments, they have remained highly paper-based and subsidised. There was a lack of payment systems efficiency, a lack of appropriate resource allocation and price transparency, and cost-savings methods of payments were not being promoted.

The public service approach to promote the use of electronic payments raises three important policy issues. The *first policy issue* concerns whether or not the subsidisation of payment services has improved overall efficiency. In practice, this is reflected in the move towards cost-savings means of payments, particularly through increases in the volume of electronic payment transactions, where scale economies and unit cost reductions may be achieved. These conditions were absent with high levels of subsidisation, the continued dominance of cheques, and low increases in electronic payments.

The *second policy issue* concerns the review of the overall pricing policy. The choice of a subsidisation policy translates into partial cost recovery in practice, where costs are mainly recovered through per-item charges and where a majority of the fixed costs are absorbed by the central bank. In partial cost recovery, there is also the choice between de facto or selective subsidisation of services. While a de facto approach seeks to cover all payment services, selective subsidisation would target areas where there is a need to promote payment systems efficiency, while reducing the level of subsidisation supported by the central bank. This is particularly important when considering future investment costs for enhancing or developing the payment systems, in addition to the on-going operating costs, that are incurred by the central bank.

The *third policy issue* concerns the effect of the central bank's pricing policy on other payment participants, particularly commercial banks. As mentioned, the central bank, being owner and operator of the payments system, can have a strong influence on how commercial banks determine fees for their customers. This leads to its conflicting role as regulator and service provider. Price ceilings, for example, are set for BAHTNET and Media Clearing. In practice, most commercial banks would charge up to such a ceiling under a general agreement that is organised by the local banking association. While the central bank views

capped prices as a means to promote low-cost electronic payments, the private sector shares a contrary view that it is a form of price fixing, which does not enhance efficiency in the payments system.

4.4 Comparison of approaches

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

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

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

Under the public service approach, ownership and operations of major inter-bank funds transfer systems are solely by the central bank. Cost recovery is based on subsidisation, where a large share of fixed costs is absorbed by the central

bank. Pricing structures and fees are determined based on the non-profit principle, and are targeted at per item charges to recover variable cost from financial institutions. In addition, the central bank sets price ceilings for fees that the private sector charges its customers. This latter point also raises the issue of conflicts of interest between the central bank and the private sector.

Table 9 illustrates changes in domestic payment market shares for the selected country cases. This compares the percentage changes in the volumes and values of payment instructions handled in selected inter-bank funds transfer systems to total market shares in each country in 1996 and 2000.

Table 9. **Changes in payment market share in Canada, Finland, Thailand, United Kingdom, and United States, 1996 and 2000**

Country	Percentage Share of Volume		Percentage Share of Value	
	1996	2000	1996	2000
Canada				
ACSS	99.90	99.92	38.14	17.03
LVTS	0.10 ^{1/}	0.08	61.86	82.97
Finland				
BOF-RTGS	0.04	0.12	73.55	90.11
PMJ	99.88	99.62	21.08	2.78
POPS	0.08	0.26	5.38	7.11
Thailand				
Cheque Clearing ^{2/}	99.60	93.79	93.77	30.29
BAHTNET	0.11	0.84	6.22	69.57
Media Clearing	0.29 ^{3/}	5.37	0.01	0.13
United Kingdom				
CHAPS	0.30	0.47	91.58	95.66
BACS	51.24	61.71	3.96	2.47
Cheque and Credit Clearing	48.46	37.82	4.46	1.87
United States ^{4/}				
CHIPS	0.27	0.26	54.92	41.59
Fedwire	0.42	0.47	41.27	54.06
Fed Cheque Clearing	82.37	76.29	2.00	2.02
Private ACH	1.63	2.68	0.23	0.34
Fed ACH	15.31	20.29	1.58	2.00

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

Notes: 1/ 1999 figures. 2/ ECS and provincial cheques. 3/ 1997 figures. 4/ 1996 figures are unavailable for private cheque clearing houses and direct exchanges. Annual figures are unavailable for Australia.

Table 9 shows cheque volume reductions in each country as follows: United Kingdom (48% to 38%), United States (82% to 76%), and Thailand (99% to 94%). Largest market share reductions for cheques were in the United Kingdom. The share of cheque operation cost to total operating cost was comparatively

highest as compared to the selected major inter-bank funds transfer systems, and is as follows: United States (86%), United Kingdom (71%), and Thailand (55%).¹²

Migration of volumes to ACHs were also evident as follows: United Kingdom (51% to 62%), United States (15% to 20% for Fed ACH; 2% to 3% for private ACH), and to a lesser extent Thailand (0.29% to 5%). The United Kingdom, once again, experienced the largest market share increases in ACH volumes. Comparatively higher market shares of over 90 percent were evident in both Canada and Finland, where payment systems operate with scope economies – processing more than one type of payment instrument. The share of ACH operation cost to total operating cost is comparatively lower than cheques and is as follows: United Kingdom (23%), Thailand (14%), and United States (7%).

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

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

Secondly, value migration to RTGS systems reduces risks in the payments system, although volume increases may not appear to be significant. This comes at a higher cost. Unit cost were found to be higher in large-value than retail payment systems, due to the lower number of payment transactions handled. Unit cost may also increase if opportunity cost are added when system participants are faced with costly intraday credit in maintaining liquidity or in the posting of

¹² Total operating costs are based on cheque, ACH and funds transfer and settlement systems in each country. U.S. figures are based on the total cost for Federal Reserve check collection, funds transfer and settlement, and commercial ACH services in 2001. Thailand figures are based on Bank of Thailand operating costs for cheque and electronic payment services (Jitsuchon and Khiaonrong, 2000). U.K. figures are based on payment industry cost for cheques and automated payments in 1994 (APACS, 1996).

collateral as a prudential requirement by the central bank. Many of the countries reviewed were relatively successful in migrating values to RTGS systems.

Finally, and perhaps most importantly, payment market failures existed in countries where there was a divergence between private cost and social cost. In other words, the price paid for versus the costs consumed to produce a payment service is distorted. A divergence remains even if low unit cost were achieved in an efficient payment service. Humphrey and Berger (1990, 45–46) argue that this divergence stems from two sources – subsidies and taxes – which ‘distort incentives and misallocate resources, so that from a social viewpoint some payment instruments are underused and others are overused.’ Payment market failures can be found in cheque and large-value payment transfers. Cheque subsidies may be in the form of par clearance in cheque collection. Large-value payment transfers use quantity constraints rather than explicit pricing to reduce risk (Faulhaber, Phillips and Santomero, 1990, 200). Cheque operations with a high share of volumes were found in Thailand (Cheque Clearing, 94% in 2000) and the United States (Fed Cheque Clearing, 76% in 2000). These countries are under the public service and competitive approaches, respectively.

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

5 The role of the central bank

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

5.1 Technological innovations

Technological innovations are perhaps the most direct means in improving payment systems efficiency and include the following: consolidation of payment

processing facilities, hybrid systems, outsourcing of operations, cheque modernisation, multiple net settlement, and decentralised payment systems.

Consolidation of payment processing sites reduces the number of facilities to achieve economies of scale and cost reductions. This applies equally to ACH, cheque and funds transfer operations. In the United States, the central bank consolidated many of its payments processing facilities provided by district office and branches nationwide in direct competition with private operators. In Italy, the central bank replaced the Ingrosso and Electronic Memoranda retail payment systems with BI-REL as from 1998 (European Central Bank, 2001, 531). In Spain, the National Electronic Clearing System, owned by the central bank, gradually replaced all traditional provincial clearinghouses by 1996 (European Central Bank, 2001, 202). The European Central Bank has also prepared evolutionary plans for TARGET based on the voluntary use of central banks of a shared platform with the objective of guaranteeing cost efficiency.¹³

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

Outsourcing of operations or facilities management by an external entity, have also been reviewed by some central banks. The objectives of outsourcing may be to reduce cost, to gain outside expertise, or to phase out selected non-core functions of the central bank. Policy reviews initiated by some central banks to outsource large-value and retail payment operations are cases in point, although there may be no immediate plans.¹⁴ Comparatively, a large number of central banks see their continuing role in operating core inter-bank RTGS systems to ensure financial stability and market confidence. Others have considered long-

¹³ See European Central Bank, ‘The long-term evolution of TARGET’, Press Release, 24 October, 2002.

¹⁴ See Sveriges Riksbank (2002). Policy reviews of current central bank retail payment operations were also reported in the survey.

term outsourcing options, such as in the movement of inter-bank settlement system hardware to an overseas site, as in New Zealand.¹⁵

Cheque modernisation has been introduced in many countries to increase the operating efficiency of cheque processing. In principle, cheque information is captured electronically at processing sites, and sent for further clearing and settlement. In the United States, a five-year cheque modernisation program, costing USD 250 million, was initiated to develop common standards, cheque imaging, and an Internet-based delivery channel for cheques (Board of Governors of the Federal Reserve System, 2000, 143–145). Cheque information, in electronic form, may be processed at a common ACH facility that also handles other types of payment instruments. This provides economies of scope and lower unit cost with output expansion, as illustrated by the ACH operations that operated close to the efficiency frontier in the survey.

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

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

5.2 Regulatory innovations

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

Legislation can empower the central bank to pursue payment systems efficiency. This may be either explicit or implicit. Explicit legislation clearly defines the role of the central bank in the payments system, and this may broadly cover the objectives of promoting efficiency, reducing risk, and protecting

¹⁵ See Reserve Bank of New Zealand, 'New Zealand's inter-bank settlement system to remain in New Zealand for the time being' News Releases, 18 April 2001.

consumers.¹⁶ Implicit legislation may be found in the main central bank act or related laws. In promoting efficiency, legislation may address competitive issues such as the fair access and pricing of payment systems. The central bank may have powers to designate a payment system as systemically important, and therefore, putting it under strict oversight. In addition, it may also have data collection powers such as in the case of gathering cost data.

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

Cost accounting applications to payment services contribute to improved resource allocation and management. A transparent pricing policy is supported by a good cost accounting system. This applies to all types of central bank priced services, including payment and settlement services. Costing practices vary across central banks, where this may be on a systematic or an ad hoc basis. A systematic approach is the US Federal Reserve System's Planning and Control System (PACS) developed since the mid-1970s. PACS serves three major purposes: to identify the full cost of output services on a uniform basis for all Reserve Banks; to integrate expense accounting and budgeting; and to provide a consistent basis for measuring Reserve Bank performance. A conceptual framework is further used to create credible cost accounting information with the underlying principles of accountability, integrity, decision-making, and efficiency. In practice, expenses are reported by activity with cost breakdowns by office and district.

¹⁶ Australia, Canada, Norway, and the United States have explicit legislation on payment systems.

Payment associations help in cost sharing by industry and promote private sector led initiatives to improve efficiency. A payment association is generally set-up with a not-for-profit objective where full cost recovery is met through annual membership dues or contributions that are in proportion with their level of activity. Members determine customer charges independently. The central bank's role may vary from being a non-member, founder, shareholder, system participant, or even chairperson or board member in the associations. In some countries, such as the United Kingdom, the central bank has played a constructive role in the establishment of the association. The benefits of the association is not solely on the cost sharing of payment clearing operations, but is also a channel for industry co-operation on matters of common interest. Payment associations exist in Australia, Canada, and the United Kingdom. Similar industry arrangements have also been adopted in Korea (Korea Financial Telecommunications and Clearings Institute), and more recently, in Ireland (Irish Payment Services Organisation), where four autonomous companies operate under the umbrella of IPSO (European Central Bank, 2001, 269).

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

5.3 Financial innovations

Financial innovations focus on liquidity-saving features in large-value payment and settlement systems. They may also include the potential use of private substitutes for central bank money for the settlement of transactions (Lahdenperä, 2001). Liquidity management systems provide an illustration. In Canada, a *collateral valuation and tracking system* was developed by the central bank to efficiently and accurately monitor the value for the different types of assets used as collateral security by participants in the LVTS. In addition, interest-bearing *special deposit accounts* are provided for LVTS participants by the central bank, which can be used as a form of collateral and reduce the overall collateral cost of participants (Goodlet, 1997, 63). In Malaysia, a *real-time surveillance system* has been introduced by the central bank to monitor liquidity in the large-value inter-bank funds transfer system RENTAS (Bank Negara Malaysia, 2001, 177). Hybrid systems, as mentioned, may also be viewed as a financial innovation.

5.4 Key policy issues

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

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

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

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

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

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

6 Conclusions

This paper has examined the relationship between payment systems efficiency, policy approaches, and the role of the central bank. Key findings fall into three major areas. The first area concerns payment systems efficiency. A majority of central banks owned and operated large-value payment systems, while the private sector largely played similar roles in retail payment operations. Central bank spending on the operation of inter-bank funds transfer systems varied from below one million to nearly a billion US dollars annually, while a large portion of costs stems from cheque operations. Pricing policies were largely based on full cost recovery, and sources of revenue were mainly derived from per item charges. Partial subsidisation was found in nearly half of the payment systems surveyed, particularly in large-value systems and in systems with full cost recovery policies. Scale economies were found in the payment systems surveyed, particularly for retail payment operations, resulting in unit cost reductions with increases in the number of payment instructions processed. Unit cost were comparatively higher in large-value than retail payment systems, confirming that lower-risk payments are only achieved at a higher cost, as explained by the risk-cost tradeoff frontier framework.

The second area concerns policy approaches. The minimalist approach was found to be efficiency enhancing and have cost-reducing effects. This is partly due to private sector involvement in cost sharing and operating payment systems with relatively strong scale and scope economies. Moreover, the central bank's conflicting role as regulator and service provider is avoided, where subsidisation issues may arise. This has a direct influence on promoting payment systems efficiency. Under the competitive and public service approaches, this has resulted in a payment market failure, where cost-savings payment means were not being used, even if there was payment systems efficiency.

The third area concerns the role of the central bank. A mix of technological, regulatory and financial innovations were found as the underlying characteristics of payment systems that operated close to the efficiency frontier. The central bank also faces four key policy issues in improving payment systems efficiency, namely choice of policy approach, service subsidisation, service specialisation, and the balancing of oversight and operational functions.

Further research areas include the improved analysis of payment cost and revenues through uniform costing methods. Although internal accounting rules may vary across central banks, a harmonised system would provide a framework for defining the key cost components and their calculation methods. This serves as an important basis in improving direct cross-country comparisons and the analysis of economies of scale across different payment systems. The efficiency of public versus private operators is another interesting research area. Direct comparisons

between services provided by the central bank and the private sector would need to consider the similar types of costs that are incurred, whether this may be solely centralised operating cost or also costs at the bank branch levels. This study mainly contributed towards an improved understanding on the operating costs of inter-bank funds transfer systems, and their relation to payment systems efficiency. Lastly, an efficiency index, based on a pre-determined set of variables, may be developed as a measurement tool to compare efficiencies across different payment systems.

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Appendix 1

Foreign exchange rates to USD

Country	1998	1999	2000	2001
Australia**	0.63	0.65	0.58	0.52
Austria*	12.38	0.94	1.09	1.12
Belgium*	36.30	0.94	1.09	1.12
Canada	1.48	1.49	1.49	1.55
China	8.28	8.28	8.28	8.28
Denmark	6.70	6.98	8.08	8.32
Finland*	5.34	0.94	1.09	1.12
France*	5.90	0.94	1.09	1.12
Germany*	1.76	0.94	1.09	1.12
Greece*	295.53	0.94	1.09	1.12
Hong Kong	7.75	7.76	7.79	7.80
Indonesia	10013.60	7855.15	8421.77	10260.80
Ireland*	1.43	0.94	1.09	1.12
Italy*	1736.21	0.94	1.09	1.12
Japan	130.91	113.91	107.77	121.53
Korea	1401.44	1188.82	1130.96	1290.99
Luxembourg*	36.30	0.94	1.09	1.12
Malaysia	3.92	3.80	3.80	3.80
Netherlands*	1.98	0.94	1.09	1.12
New Zealand**	0.54	0.53	0.46	0.42
Philippines	40.89	39.09	44.19	50.99
Portugal*	180.10	0.94	1.09	1.12
Singapore	1.67	1.69	1.72	1.79
Spain*	149.40	0.94	1.09	1.12
Sweden	7.95	8.26	9.16	10.33
Thailand	41.36	37.81	40.11	44.43
United Kingdom**	1.66	1.62	1.52	1.44

Source: International Monetary Fund, various issues

Notes: Official rates based on period average (local currency per USD). * Figures are reported as EUR per USD between 1999–2001. ** Figures are reported as USD per local currency.

Appendix 2

Cross-sectional regression results of unit cost

Payment System	Unit Cost (Actual)	Unit Cost (Model 1)	Unit Cost (Model 2)	Unit Cost (Model 3)	Unit Cost (Model 4)
1	0.7061	5.0461	0.8149	0.2887	1.3517
2	3.5621	1.7371	2.3389	2.1372	2.7659
3	1.7505	1.4695	3.3294	3.0573	3.7085
4	3.9150	1.2313	3.0279	2.6161	3.0602
5	2.7679	1.2288	1.3225	1.4544	1.7637
6	2.9709	1.1066	2.3612	1.8649	2.1656
7	0.8940	1.0514	1.2916	1.4266	1.6639
8	0.2930	1.0276	0.2278	0.4646	2.6104
9	0.8389	0.8395	0.8493	0.3082	0.3706
10	0.2625	0.6694	0.5510	0.9618	1.0248
11	1.1000	0.6672	0.2547	0.4494	0.5011
12	0.4267	0.6107	1.1361	1.3513	1.3754
13	0.5770	0.5981	1.1207	1.1063	1.1329
14	1.8210	0.5243	0.6351	1.0225	1.0190
15	1.0064	0.4243	0.7781	0.8708	0.8287
16	1.1957	0.4063	0.6999	0.8708	0.8198
17	0.2904	0.3853	0.6883	0.8390	0.7808
18	1.9300	0.3478	0.4849	0.8986	0.8125
19	0.5701	0.1278	0.1978	0.3525	0.2607
20	0.4915	0.0566	0.1004	0.2024	0.8759
21	0.0125	0.0368	0.0431	-	-
22	0.0175	0.3162	0.0565	0.0396	0.2569
23	0.0317	0.0835	0.1139	0.0859	0.0618
24	0.0028	0.0171	0.0166	0.0112	0.0061
25	0.0094	0.0102	0.0094	0.0083	0.0040
26	0.0008	0.0070	0.0057	0.0057	0.0026
27	0.0152	0.0069	0.0084	0.0089	0.0272
28	0.0237	0.0864	0.0122	0.0217	0.0508
29	0.0580	0.0520	0.0650	0.0459	0.0304
30	0.0134	0.0460	0.0108	0.0128	0.0217
31	0.0446	0.0032	0.0034	0.0037	0.0097
Average					
Large-value systems	1.3039	0.9330	1.0597	1.1272	1.4446
ACH systems	0.0129	0.0735	0.0351	0.0266	0.0597
Cheque systems	0.0349	0.0469	0.0228	0.0210	0.0282
Standard Deviation					
Large-value systems	1.1375	1.0491	0.9419	0.7876	0.9558
ACH systems	1.1375	0.1225	0.0430	0.0316	0.0992
Cheque systems	0.0201	0.0342	0.0284	0.0182	0.0173

Notes: Unit costs are reported in USD. Observations 1–21 are large-value systems. Observations 22–27 are ACH systems. Observations 28–31 are cheque systems. Models 3–4 are based on 30 observations, as size of transaction value to number of payment instructions was not available for one observation.

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